Tempus Project 158881-TEMPUS-2009-RS-JPHES National Platform for Knowledge Triangle in Serbia

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ICTT 2013

2013 International Conference on Technology Transfer

under the framework of the TEMPUS project
158881-RS-JPHES

PROCEEDINGS

ISBN 978-86-6125-083-5

University of Niš

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PREFACE

The International Conference on Technology Transfer ICTT 2013 is an international forum devoted to the role of the knowledge triangle in modern society. The conference can be seen as a flagship of the project 158881-TEMPUS-2009-RS-JPHES "National Platform for Knowledge Triangle in Serbia", which links education, research and innovation together, as three crucial drivers for sustainable development. The purpose of the conference is to serve as catalyst for exchange of ideas.

ICTT 2013 is organized by University of Niš in collaboration with University of Belgrade, University of Novi Sad, University of Kragujevac, National Council for Higher Education, Ministry of Education Science and Technology Development - Republic of Serbia, and Chamber of commerce and Industry of Serbia.
The conference gathered 109 authors from 43 institutions and 12 countries.

This proceedings contains 47 peer-reviewed papers, selected out of 54 received papers, which are categorized in the following topics:

Track 1: Research, Education and Innovation
Track 2: University-Industry Cooperation
Track 3: Quality Assurance in Education and Research
Track 4: The Role of Technology Transfer Offices
Track 5: Students in Technology Transfer and Research
Track 6: EU projects as a Chance for Development
Track 7: Technology Transfer

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Track 1: Research, Education and Innovation

2013 International Conference on Technology Transfer

Reasoning, Innovation, and Technology. A Time-space Analysis

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Abstract

Milestones over 1 million of years of the (pre)history of mankind relating Reasoning, Innovation, Technology, and Language are presented. A more specific view appeared in recent centuries as Research, Innovation, Technology, and Communications is analyzed. In this context, Technology Transfer emerges as a specialized Communication of results of technological Research mainly to the middle and small size industry.

Keywords: Reasoning; Research; Innovation; Technology; Language; Technology Transfer;

1. Foreword

Reasoning is understood in this paper, as the main activity of the brain, comprising, among others, thinking, processing of perceptions, processing of knowledge, and feeling. The reasoning capability has been and continues to be a characteristic of the "human race", reaching much higher levels than achieved by any other mammals.

Innovation will be understood, as a significant step forward in the development of "applied knowledge" (which will later be called *Technology*). Innovation represents the process of discovering or figuring out how to make a new useful device; but it may also comprise the improvement of an already existing device (see below: tools), the improvement on the way of using an existing device, or the improvement on the way of producing it. It becomes apparent that innovation requires reasoning.

1.1. Gedanken Experiment 1

Assume that it were possible to travel through time to reach very first specimen of the human race –(a small tribe)– but stay outside of their world (in some "other dimension"), not to disturb their natural environment, and not to be "noticed", however being able to get close to observe their behaviour, and to read (and

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understand) their thoughts. Let a member of the tribe be followed until s/he finds some object that s/he had not seen earlier. Two kinds of questions emerge in her/his brain:

- *What is this ?*
- *What can I do with it? How can we use it?*

The first question represents the beginning of Philosophy: the search for ontological truth; leading later to the development of Science: the search for understanding the nature of things and the rules that govern their existence.

The second question prepares the road for Innovation and Technology.

Remarks on GE-1:

- It is a first example of *reasoning*. Obviously it contains *thinking*. Recognizing that the seen object is different to others earlier seen, represents a form of *processing of perceptions* and *processing of knowledge.* It is reasonable to imagine that the subject of the experiment had seen other members of the tribe using objects to support their daily life. The question "what can I do with it?" is an intend of *processing of knowledge.* (Today we would speak of "case-based reasoning".) There are at least two kinds of *feelings* implicit in the example: on the one hand, a feeling of curiosity (leading to "what is this ?"), and on the other hand, a sense of belonging (to the tribe), expressed in the "we" of the last question.
- Innovation and Technology, even in their very rudimentary embryonic preliminary form, enter the history of mankind, *to serve.*

One important aspect of *reasoning* was not explicitly illustrated in GE-1. A person may think for itself, this being an act of reflection or meditation. The membership in a tribe, however awakes the feeling of a need of *communicating* the results of thinking (that might have lead, e.g. to a new knowledge), which might be beneficial for the tribe. This points-out a strong link between *reasoning* and *language*. Language, in its broadest sense, may have started as a rather consistent set of gestures, possibly facial expressions, and primitive sounds, possibly first to warn of a danger or draw attention on a source of food. Through hundred of centuries these pre-historical highly constrained means of communication slowly evolved to today's "natural languages", where gestures and intonations are (additional) meaning-carriers in any "spoken" natural language. The use of language to express thoughts, including the summarization of events, and the narrative presentation of past events, characterizes exclusively the human race.

Innovation, as suggested above, may be triggered by human reasoning, but it may also be triggered by nature. One of the earliest, and possibly most spectacular natural events must have been a big storm where the lightning set some trees on fire, and the human race had the challenge of understanding fire, learning to access, preserve, and control fire to use it for e.g. heating and illumination of caves, and to keep depredators away from the cave, until the real innovation was possible: humans become able to *produce* fire (500.000 B.C.). Learning to control the energy of volcanoes however, remains even today an open challenge.

1.2. *Tools*

What are tools? A tool is any physical item that can be used to achieve a goal, especially if the item is not consumed in the process [1]. From another point of view it can be said that tools are physical devices that increase the effectiveness and efficiency of their user to accomplish a given task. Effectiveness, meaning that the task would be better done by using the (appropriate) tool, including the extreme case when the task could not be done without the tool. Efficiency, meaning that the task would be finished faster and with less effort than without using the tool. Tool use by humans dates back millions of years. Probably this is one of the earliest signs of technology at the service of mankind.

The western civilization until not too long ago repeatedly insisted in saying that "the use of tools is a sign of *intelligence*, and therefore is a unique feature of the human race". In the last decades, particularly after the advent of internet, it has been documented that the use of tools has also been observed in different kinds of animals. (See [2]). What however seems to be true, is that the human race started to use tools to make other tools –("Innovation")– what has not yet been observed in animals.

Archeological search has documented the early development of hunting-weapons (or defense weapons against depredators), mainly the building of axes and lances, where a synergy-oriented mixture of technologies –("Innovation")– was used, to prepare stones or bones to do the cutting "blade" of an axe or the hurting "stab" of a lance, wood pieces to build the handle of an axe or the body to hold or throw the lance, and binding stripes of vegetal fibers or animal skin to hold together head and body. Later on this was followed by another Innovation to produce possibly skin-made "throwers" for stones and spears, to give them higher speed and reach. Skin-processing was indeed another Innovation step, needed not only to produce stripes to hold together different components of tools, or to give "added value" to the hunting-weapons with the throwers, but even more important, it was needed to protect the human bodies from rain and cold. This represents without doubts, the primitive first steps for the development of clothes.

The much later development of bow and arrow (20.000 B.C.) [3] must have taken lots of thinking, and represents another important technological Innovation: introducing and controlling flexibility, to develop a hunting weapon lighter than lances and allowing successful hunting without needing to be close to the target. Once again, Innovation and Technology are at the service of the human race.

In all this quick overview on the early developments of tools, only "*hunting* weapons" are mentioned. In those early times, the earth population was scarce, tribes were nomads, following the animals that constituted their source of food and accessories. It is very unlikely that tribes would get involve in territorial conflicts. After the domestication of animals (12.000 B.C.) the tribes became nomad stock breeders. It is only after the beginning of agriculture (8.000 B.C.) that the tribes had to settle down, and started defining and *defending* territories, and later on, *conquering* new, possibly better, territories. At this point of time, the concept of "war" enters the history of mankind. Hunting-weapons must have turned into fighting-weapons. Then, technology was no longer used only for the service of the human race, but also misused for its destruction.

1.3. Cave paintings (Paleolithic Art) [4]

Paintings and carvings on the walls of caves have been found in vast regions of Europe-Asia, but also in Africa, Australia, and in the American continent. They have been dated between 7.000 B.C. and 40.000 B.C. The best known caves with paintings are in south France and in north Spain. Paintings on the walls besides documenting an artistic talent, represent historical documents: pictorial summary of events. They also show the first steps towards abstraction and some kind of esthetic.

Why did the tribes start painting in the walls of their caves? No one knows. It may however be conjectured that this might have been motivated by the need of *communicating* hunting experiences, *communicating* which animals would be providers of food, bones, horns and skin, (in some cases also *communicating* which animals were depredators, to keep away of), Occasionally there are paintings representing aspects of some (ritual?) activities of the tribe. It is somehow puzzling that in many of these paintings, animals are represented with much higher fidelity than humans. It is beyond doubt, however, that these paintings represent a form of *language*.

To produce these paintings Innovation and technological developments –supporting language!– were needed, e.g., to produce tinctures of different colors, to develop (or adapt) carving tools, to develop some kind of spraying device –(e.g. pipes from bones)– to produce negative silhouettes (e.g. of hands, see Figure 1), and, of course, some painting talent was also needed. It is however important to remark that besides the paintings of animals and (possibly) members of the tribe, some abstract symbols have also been found. Symbols, which

Fig. 1. Paintings in the "Cueva de las Manos" (Cave of the hands) in Argentina, which belongs to the Unesco World Heritage List [5] Paintings (silhouettes) of hands have also been found in caves in Chile and in Europe.

might well have had meanings like an identification of the tribe (being, in this way, precursors of the "logos" of the present times), or possibly symbols for "danger" or "water". At any rate, these symbols may be considered the first steps towards a possible primitive *written*, not quite pictorial, language.

1.4. The Sumerian writing (3.500 B.C.)

Sumerians lived in ancient Mesopotamia. It was already the beginning of the bronze era, the wheel was already known, humanity had grown considerably, merchant activities –(trade)– were well developed. Sumerians lived in villages comprising small houses. Very early they learned –(*reasoning*)– to make bricks in molds and dry them in the sun or bake them in kilns. (Considerable Innovation and technological development had taken place since the Paleolithic times!) Mud, clay, and reeds were materials the Sumerians had in abundance. This is a good reason why they used clay tablets (and first, an old pictorial language, somehow similar to the hieroglyphs used by the Egyptians) to keep record of e.g. their trade activities to obtain other materials. Whether the Sumerians were the first to develop symbolic writing is uncertain, but theirs is one of the oldest known symbolic writing systems [6]. The clay tablets on which they wrote were very stable when baked. (Archaeologists have recovered many of them; some being dated earlier than 3000 BC.). To "draw" their writings they used a stylus, possibly made of a straight piece of reed with a triangular end.

1.5. Gedanken Experiment 2

Let it be assumed that as in GE-1 it could be possible to return to the Sumerian times to watch them by their writing work without interfering with them. They became aware of the fact that on soft, wet clay it was much simpler to produce triangular forms and straight lines with one or the other end of the stylus rather than to draw pictures. Particularly, curved lines had to be "approximated" by linear piecewise polygons. The results were rather frustrating (from the aesthetic point of view), but the corresponding pictogram could still be recognized. This continued for some time, until one of them had a brilliant idea –(call it unconscious knowledge processing, inspiration, or fantasy)– indeed an innovative idea. Why not replace the difficult figures by a "well defined" pattern of triangles and straight lines? This was the beginning of the symbolic cuneiform written language.

GE-2 is, of course, a conjecture based on archaeological findings, but illustrates how "technological constraints" –(the difficulties to do free drawings with a stylus)- triggered a *reasoning* process, leading to an Innovation ending in the cuneiform written language.

One additional important consequence of the establishment of the cuneiform written language is the appearance of a new profession: the scribe. (This was also known in ancient Egypt, except that the Egyptian scribe would paint on papyrus, and this had less "technological constraints" than drawing on soft wet clay, except for conservation.)

1.6. The ancient Greek thinkers, the Library of Alexandria: Books

Fig. 2: Plato and Aristotle, in Raphael's "The School of Athens"

In the golden age of the Greek culture (VI – V BC), Greek thinkers were concerned with questions about the structure of the universe and its order. From Thales of Miletus, who considered all things had their origin in water, to Leucippus and Democritus of Abdera, who introduced the concept of *atom*, but considered these indivisible particles of matter to be placed in an empty space. Later on, with respect to the structure of the universe, Phytagoras and his disciples considered numbers to support the structure of the universe. Similarly, about a century later, Plato sustained that the order in the universe was based in geometry, although his main concern was the philosophical basis of the scientific method. Plato had a school, the *Academy* where he would teach his ideas to his disciples [7]. The most important disciple of Plato was Aristotle, who disagreed with the philosophical views of his Master, and founded his own school, the *Lyceum* to spread his points of view. It is simple to imagine that the disciples of Pythagoras, Plato, and Aristotle (as well as of other thinkers), would "take notes" of the ideas presented to them by their Masters, and the Masters would produce, (write or dictate), books to *communicate* their *thoughts* to their disciples (see Figure 2).

This is an important testimony of the strong relationship between *thinking* and *language*. In this case, both *spoken* and *written* language.

In one of the wealthy periods of Egypt, the Library of Alexandria was stablished (around 350 BC), and it was initially organized by Demetrius of Phaleron [8], a disciple of Aristotle. The main goal of the Library was to collect "the world's knowledge". A big staff of scribes was dedicated to the task of transferring/translating works onto papyrus paper, meanwhile other staff members travelled mainly to Greece to borrow written documents and books. These papyrus scrolls constituted then the books of the "*bibliothecai*", βιβλιοτηεχαι being the Greek word for "library". It is important to point out here the (indirect, but not to ignore) support given by the Technology to the further spread of the language: The prevailing technology to construct the building that would host (and protect) the books; the ships that sailed back and forth to Greece to borrow, rent or buy written documents and books.

1.7. Middle Ages Scribes, and the Printing Revolution

Scribes also existed in the Middle Ages, but in a totally different context. Handwritten documents and books already existed, but they were mostly, if not always, unique: single exemplars (particularly after the destruction of the Library of Alexandria, possibly in the year 391 AC). Monks started to copy books, particularly books of "sacred" texts, but also philosophical (e.g., Plato, Aristotle) and scientific (e.g. Euclid, Archimedes, Pythagoras) documents. They did however not only copy the texts, but also decorated the pages, if appropriate. The old scribes turned into copyists, and some of them also into artistic painters. Ink and feathers were used to write, calligraphy entered the scope of arts, and many substances were used for the paintwork, to have a large variety of colours that would not (easily) fade. Much technological innovation was behind the working environment of these writing scribes.

Things radically changed in the middle of the XV century, with a tremendous Innovation introduced by Johannes Gutenberg, who "*was a German blacksmith, goldsmith, printer, and publisher, who introduced printing in Europe. His invention of mechanical movable type printing started the Printing Revolution and is widely regarded as the most important event of the modern period. It played a key role in the development of the Renaissance, Reformation, the Age of Enlightenment, and the Scientific Revolution and laid the material basis for the modern knowledge-based economy and the spread of learning to the masses."* (Citation from [9])

Incidentally, with the beginning of the "printing age", the profession of the scribes came to an end, but new ones, e.g. that of the "setter" and that of the "typeface designer" were born.

2. Research, Innovation, Technology, and Language

Research is without any doubt a reasoning-based activity. In the Engineering domain, it is closely related to Innovation and Technology. As a reasoning-based activity, research is linked to language. Results of research are published in specialized journals to *communicate* them to a broad community; products are given appropriate written specification defining their capabilities, requirements, and boundary conditions; user-handbooks support the process of learning how to take advantage of a given product. This link to language is however a two-way channel. All former sections have given information on how Innovation and consequent developments in Technology did support the development of the written language, from paintings to abstract pictograms, to symbols, to the cuneiform language, (alphabets), handwritten documents, and printed documents. More than a "channel" connecting Technology and the written language, possibly a "tree" analogy would be more appropriate. On the way from Gutenberg's press to the Printing Houses of today, mechanical typewriters – "the press of the single man"– were developed, followed much later by more comfortable electric typewriters, however with a limited number of characters (letters) and symbols. And then, a remarkable Innovation step took place: IBM introduced the Selectric, better known as the "golf-ball" electric typewriter [10], with interchangeable balls providing different fonts, different styles (simple, italic, bold), mathematical symbols, and Greek letters. This became the *de facto* "state of the art" until a parallel development in the tree-track of computers: Main frames, mini-computers, workstations, personal computers, at the hardware side; text-processors and graphic user interfaces at the software side, and increasing quality printers at the peripheral side, put an end to practically all typewriters. It becomes apparent that at this stage, Technology, more than supporting the further development of language as such (as in the early times), started to support the "large scale" *use* of the language (writing) and *access* to the language (reading books).

It should be mentioned that starting at the end of the XIX century, Innovation and Technology also began to support developments in the scope of spoken language: from the first phonographs recording on wax-cylinders [11], to the mini-recorders and MP3 players of today. It may be argued that this developments support the spread of music rather than language –(is not music a language that, among other features, allows to express feelings? Is not Sergei Prokofiev's "Peter and the Wolf" a wonderful example of *narrative* music, and Smetana's "The Moldava" a striking form of *descriptive* music?)– however recording and reproducing is also a very effective method to e.g., learn a foreign language or to improve rhetoric for presentations in the own language.

This section on Research, Innovation, Technology, and Language, now that natural languages are well developed, should better be renamed Research, Innovation, Technology and *Communications*. In this context, this section could not be closed without referring first to Internet [12], which gives a very effective support to Research –(see e.g. the list of references of this paper)– by allowing access to an enormous amount of information, and access to communicate with other people working in similar problems, anywhere in the world, communication that ("for the time being") may consist of texts, graphics, paintings, sounds, voice, music, videos, and mixtures of some of them, just to name the most relevant. Technological developments frequently exhibit an unexpected own dynamic. Internet, together with the progress of computers and the production of high capacity memories, paved the way –(Innovation)– to a particular aspect of the "IT Revolution" under the "paperless office" metaphor: documents consisting of text, graphic, paintings or photos are produced in a computer environment and then they are saved in a memory or transmitted through the net to wherever required. If ("and only if") a so called "hard copy" is needed, then the document will be instantiated as a printed version. Even books are beginning to be "challenged" with the introduction of e-books and e-book-readers.

A second important aspect to be addressed in the context of Research and Communications is that of **Technology Transfer**, which represents a goal-oriented kind of communication of Research results specially to the industrial sector of middle or small size. This constitutes an important responsibility of the Engineering Faculties at Universities, and of Technical Research Institutes. To make Technology Transfer *effective* is however a very complex problem, comprising non-trivial engineering efforts to bridge the gap between the "prototypes" that might be developed at a University, and the "product" looked for by an industry; legal aspects (patents, prevailing restricting national or international laws); conformity with norms (e.g., DIN norms, security norms); and social aspects (personal data privacy, ethics). Technology Transfer Offices at Universities should be aware of these aspects, and try to convey support from specialists from different Departments of the corresponding Universities, besides coordinating contacts between researchers and possible industry partners. National networks of Technology Transfer Offices would certainly increase their effectiveness and efficiency, by supporting the share of information, experiences, software tools, and specialized databases.

3. Closing remarks

Over 1 million years of the pre-history and history of mankind were sampled, showing the interaction among Reasoning, Innovation, Technology, and Language. In the last few centuries a similar situation may be observed relating Research, Innovation, Technology, and Communications. Innovation and Technology entered the history of mankind to serve, being much later distorted and misused to destroy. Technology Transfer emerges as a special University task supported by Research and Communications. It will be the responsibility, particularly of the young generation of researchers, to support all efforts for Technology Transfer; but at the same time to care that historical warnings as Chernobyl [13] may never be forgotten, neither disaster be repeated.

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UK Academic Spin –Outs: Beyond Start-up

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Abstract

Most studies on the commercialisation of academic research focus on the spin-off and start-up process of new enterprises. This paper develops this perspective and examines how University based enterprises transition from spin-off and start-up to growth and maturity. The study is qualitative and uses secondary data on two academic enterprises that are quoted on the London AIM market. The important role of scientific novelty, developed in collaborative settings, and the role of complementary assets are identified in a preliminary modelling of the growth process. Whilst the work is exploratory, it aims to develop a model of 'beyond start-up' growth that can serve as the basis for future empirical work in a highly targeted sector of new enterprise development.

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Keywords: Spin-out; Academic, Transition; Growth;

1. Introduction

According to Cooper (2007) there were over 9000 incorporated businesses worldwide that were direct spin-offs from University research. Half of these came out of US Universities and over 15% from UK Universities. Of those UK spin-offs, a third survived the first five years after leaving the incubation of the parent University.

UK government policy, starting with the 1993 White Paper, 'Realising Our Potential' increased the importance of 'application' in the measurement of effective research and the consequent allocation of research funding,. Although underlying policy changes took some time to implement, by the 2014 and 2018 research assessment exercises, impact will be a central feature of metrics measuring 'successful' research. An obvious route to successful application is the spin –off enterprise although licensing, consultancy and taught programs may achieve the same or parallel outcomes.

The phenomena of new technology based companies evolving from University research is not new; much of the high technology growth of the US was attributed to University research linkages and in the UK in1985 the 'Cambridge Phenomenon' was seen as a result the high quality research and effective knowledge transfer

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processes at the University of Cambridge. The UK universities themselves identifying a good news story initiated a report on technology commercialization and the role of science parks. Subsequently hundreds of studies on the processes underpinning academic spin-offs have been published

However, as with SME research in general, much of the interest and subsequent research emphasis is on start-up rather than the survival and growth of these new firms. This paper examines this latter phenomenon. Using the broad SME literature, it posits a general model of growth beyond 'start-up' and through six case studies of successful spin-off enterprises advances a modified framework to explain important barriers and transitions for these firms. The research is exploratory and the sample has a clear survival bias but should be of interest to private and public stakeholders and represents an emerging area of research.

2. Transition of new firms from start-up to survival and growth

Bygrave (1989) argues that SME and entrepreneurship research may be lagging mainstream management and economic research in observing, classifying and theorising about firm growth, organisational behaviours and firm level transition processes. Aldrich, identifying the gap between entrepreneurship and large-firm organisational research, suggests that the two research streams "developed in partial isolation from one another" (2000, p. 6) leading to some replication in the entrepreneurship research of "many of the same disputes that occurred earlier in organisation theory" (ibid.).

Much of the early research on the growth of SMEs focuses attention on identifying and describing the relationships between particular variables and growth of the firm(s) under study. Size or age of the firm (Johnson, Conway, & Kattuman, 1999); strategic choice, (Pasanen, 2006); industry structure (O'Gorman, 2001; and the use of external business advice and collaborative arrangements (Robson & Bennett, 2000) are some research themes identified. Further studies explored the relationships between firm growth and growth intentions (Morrison, Breen, & Ali, 2003), organisational structure (Lau & Snell, 1996), marketing decision making (McLarty, 1998), financial reporting practices (McMahon, 2001a), access to sources of finance (Becchetti & Trovato, 2002; Carpenter & Petersen, 2002), training and development (J. Jones, 2004), business strategies (J. Bell, Crick, & Young, 2004) and dynamic capabilities (Macpherson, Jones, & Zhang, 2004).

Following Porter's (1990) research on the 'geography' of growth the area developed rapidly. Firms located and involved in industry clusters seemed to experience better performance, although only in some sectors (Beaudry & Swann, 2009). Other research identifies a link between strategic planning, environmental awareness and performance (O'Regan, Sims, & Gallear, 2008). While many studies focused on just a few variables, other researchers undertook complex multivariate analyses of the growth phenomenon in small firms Barkam, Hart et al. (2000, p. 412) testing "an extensive list of variables…for their possible influence on firm growth" found that their regression model explained 51% of the variance in growth rates, with unexplained variance possibly linked to entrepreneurial motivation (ibid., p. 422). Another research stream evident in the literature investigates the relationships between knowledge, learning and the growth in SMEs. An example of this perspective includes an exploration of Finnish SMEs (Salojärvi, Furu, & Sveiby, 2005).

An alternative slant on the study of growth in SMEs has been the 'barriers-to- growth' approach that identifies the impediments that may arise as small firms attempt to grow beyond their start-up phase. A comprehensive literature review by Barber, Metcalfe and Porteous (1989) examined limitations to the growth of small, innovative companies in the UK. The review concluded that barriers existed in three areas; resources barriers, market opportunities and structural barriers, and management and motivation barriers. One important barrier, management, includes tangible and intangible aspects. These findings concur with Penrose (1959) who suggests that whilst physical resources can be bought-in to sustain growth, management, embedded as it is in context specific processes, could not, and would therefore be a barrier to firm growth. Barrow (2002) provides support for this and especially the tension between running the business and planning the future of the business.

In assessing data from a range of Canadian, US and European studies an OECD report suggests that regulation, capital market failures, limited access to state-of-the-art technologies, limited international market exposure and difficulties encountered in hiring experienced, skilled staff, all raise barriers to the growth of SMEs (OECD, 1997).

But growth is a complex, multidimensional construct, and often heterogeneous (Delmar, Davidsson, & Gartner, 2003); a view that is consistent with the observation by Coad, and others, that growth patterns of firms are fundamentally stochastic (Coad, 2007; Geroski, 2002). There is consistent recognition that SME growth is not an easy phenomenon to model. Consequently contemporary research needs to address the notion of growth as a complex, multidimensional construct and using integrative approaches to model it (Wiklund, Patzelt, & Shepherd, 2009).

2.1 Contribution of Economics

Economics, whilst failing to explore “inside the black box” (Rosenberg, 1982) of firms, does highlight a number of important issues. These include: Behavioural issues of coordination, managerial motives and irrationality and the Coasean view of ‘why we have firms?’ and the subsequent focus on transaction costs and agency; an evolutionary theory of the firm evolving with path dependencies in a changing external environment and choosing behaviours that are rewarded by the market; a resource and knowledge based view that considers performance to be a function of the resources and capabilities under the control of the firm; and an industrial economics approach synthesised by Porter (1981) which focuses on competitiveness issues.

But there may not be an integrated theory of firm growth. Coad concludes that it is the stochastic element that is predominant and suggests that “firm growth thus appears to be remarkably idiosyncratic” (Coad, 2007, p. 56). Garnsey is also sceptical, suggesting that the “theoretical work at the micro level on the origin and growth of the firm remains sparse” (2000, p. 344).

This confirms the findings of a very early paper by Gibrat (1931) who proposes that the growth of firms is determined by random shocks that are independent of a firm’s size. This view sees the firm as a recipient of changes in environmental conditions that could underpin growth. Gibrat’s law has been tested empirically extensively but there is still no real confirmation or disconfirmation of the law (Coad 2007). Vivarelli et al (2007) identifies significant convergence towards Gibrat-like behavior detected *ex post.* Market selection “cleans” the original population of firms, so that the resulting industrial “core” does not depart from a Gibrat-like pattern of growth.

Other empirical work examines firm specific and industry specific factors. In particular whether industry ‘matters’ (R. M. Grant, 2007). Membership of networks (and in particular centrality in them) also contributes to growth (Powell, Koput, & Smith-Doerr, 1996). Finally Davis, Haltiwanger, Jarmin and Miranda (2006) undertook extensive analysis of the dispersion and volatility of firm growth rates. They find that the volatility and dispersion of growth is decreasing. These decreases are for both public and privately owned businesses but the rate of decrease in dispersion rates is highest for those that have a public listing. Perhaps a model of firm growth exists and is being learnt, but has just not yet been theorised.

2.2 The entrepreneur

An important gap in much of this research is the motivation and the skills of the entreprepreneur and entrepreneurial team. Schumpeter, (1934) and Kirzner (1999) are important figures in this debate although their view of the role of entrepreneurship differs, one emphasizing innovation and the other exploitation of disequilibrium. Baumol (2002) makes the point that effective growth is generated by the "routinisation of innovation" where innovation is constituted as a central part of a firm's activities, removing some of the uncertainty associated with the process (ibid. , p. 4). The focus is on the processes within the firm. Entrepreneurs are also seen as having the three roles of managers, risk-takers, and innovators (Storey, 2000, p. 1243). Storey identified fifteen entrepreneurial characteristics hypothesized to have a relationship to growth. Whilst some characteristics appear to have an effect on growth (most notably motivation, managerial experience, education, multiple founders, and age) the relationships are quite weak. One of the clearest statements to be made on these studies is Storey's summary comment that "the identikit picture of the entrepreneur whose business is likely to grow is extremely fuzzy" However Shane (2005) still contends that "despite decades of effort to identify the special features of successful entrepreneurs, there really are none".

Recognising that no strong relationships between entrepreneurial characteristics and growth emerge from the plethora of studies undertaken, Davidsson (2000) aggregated a range of "low-level explanatory variables" into three groups that he labelled "Ability" (of the entrepreneur; including education and experience), "Need" (for achievement), and "Opportunity" (including factors such as industry structure, rate of growth, and geography). Testing this combination of variables, the "economic–psychological model" was found to account for 25% of the variation in actual growth rates. Commenting on the results, Davidsson noted that they "support the idea that the individual matters" (2000, p. 400).

Whilst a number of positive entrepreneurial characteristics may enhance the chances of a firm growing, it seems clear that others characteristics may in fact work against the successful growth of an expanding company. In what Kets de Vries termed the "dark side of entrepreneurship" specific psychological traits relating to an individual's need for control, their general distrust of others and their desire for recognition may create dysfunctional organisational outcomes that stifle growth (Kets de Vries, 1985). Other personal characteristics such as drive, independence, task orientation, single-mindedness, working in isolation, and loyalty epitomise many successful small firm entrepreneurs, but these same characteristics may undermine their attempts to manage a larger, growing firm and may in effect act as barriers to growth (Hamm, 2002).

The impact of entrepreneurial teams on growth is topical, but much of the evidence is anecdotal (Vyakarnam, Jacobs, & Handelberg, 1999). The field is under-researched, with little empirical work to help explain how teams form, behave, and persist in their efforts to influence growth (Cooper & Daily, 1999). . Birley & Stockley, (2000, p.302) note "One simple truth is obvious. The team is fundamental to the success of the venture. All that we need to do is to discover more about how and why". Finally, Shane(2005) suggests that the starting point of the entrepreneurial process should be a clear understanding of the individual-opportunity nexus; a suggestion that has generated dialogue and debate. Whilst entrepreneurial actions may act positively or negatively on growth in mid term stages of a firm's evolution.

2.3 Transition and Stage Models

Notwithstanding Penrose's butterfly and caterpillar analogy (2000), and Welsh and White's claim that "a small business is not a little big business" (1981, p. 18), transitions, change and firm evolution are critical issues in trying to understand firm growth. Garnsey (2000; , 2002), notes " ..but though there is infinite diversity among instances of firm growth in the longer term, it is argued here that the processes of growth have sequential features" (ibid., 2002, p. 103).. Stages models are popular constructs in contributing fields. Analogous to a biological life cycle, they propose that a product, firm or industry progresses through a set of stages from conception, through birth, development, growth and maturity, to decline.

Garnsey (1998) emphasizes that in the early stages of growth, partly because of high hazard rates, there is a struggle to deploy adequate resources and identify some consistent theme, later with resources at risk SMEs seek to establish routines to assess how to deal with new problems. Later, as they better understand the resolution of uncertainty they develop rules of thumb to solve these problems. An assumption might be that beyond this third stage, particularly in a changing environment, those rules of thumb are no longer sufficient, and some greater specialization in operations and strategy is required.

2.4 People, processes, and structures

Hambrick and Crozier (1985, p. 32) address the transitions issue by emphasizing the "people, processes, and structures that make a difference for rapid growth firms". They identify some overarching themes in firms that have successfully traversed a period of rapid growth:

- The chief executive is able to envision and anticipate the firm as a larger entity.
- The team needed for tomorrow is hired and developed today.
- The original core vision of the firm is constantly and zealously reinforced.
- New "big-company" processes are introduced gradually as supplements to, rather than replacements for, existing approaches.
- Hierarchy is minimised.
- Employees hold a financial stake in the firm." (ibid. , p. 32)

These themes seem to indicate that an interesting juxtaposition of history (the paths), strategy and foresight (the position) and management (the processes), which also underpin dynamic capabilities theory, are important to assist a firm effectively grow through periods of transition.

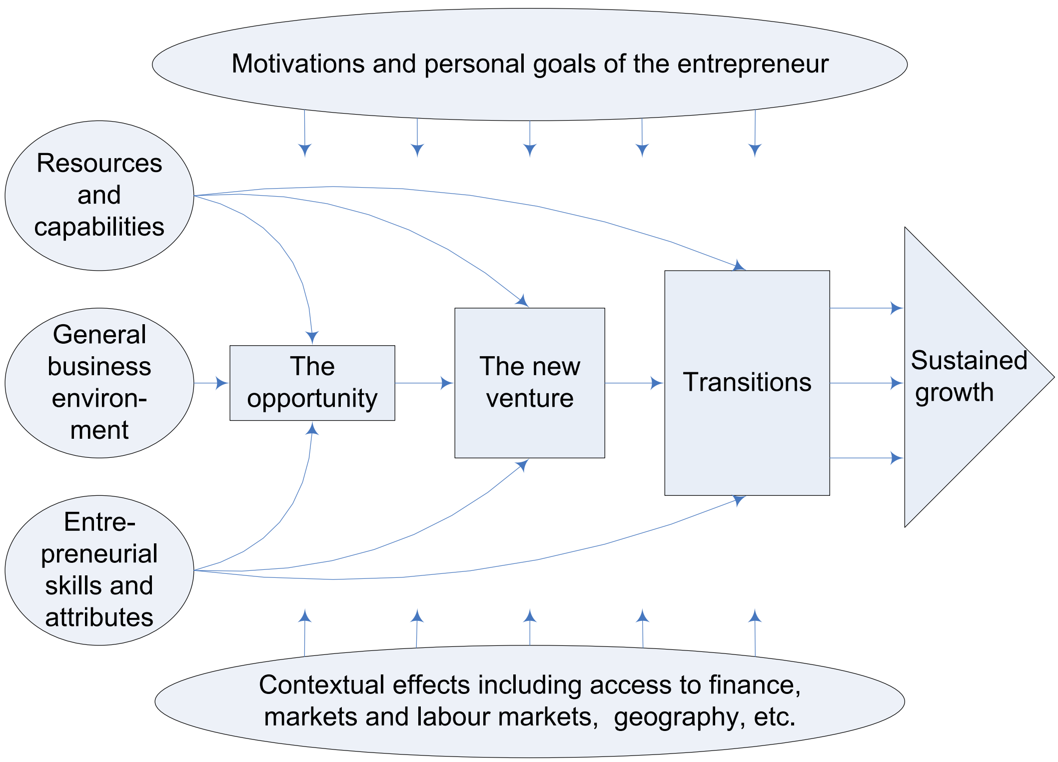
Henson and Lowe (Henson, 2003) advanced the notion of replication and transformation as the framework to understand these choices. This perspective stems from the work of Szulanski in his analysis of the growth and development of Banc One (Szulanski, 2003) and was also a theme taken up more recently by Coad (2007) who poses diversification versus replication as the choices facing the growing firm.

This means that often processes and people have to change. Proponents of these perspectives consider them to be coordinating, rather than controlling, mechanisms within the firm and its environment. These coordination procedures are the things that change as the SME grows, and which define the need for acknowledgement of stages as recognised by Garnsey (2002). Garnsey comments on Penrose's identification of the development of routines, "When a major effort of planning and setting up production for the first time is in order, the firm has experience to learn from. Routines can form, and learning is embedded in procedures" (Garnsey, 2002, p. 106) In continuing, Garnsey further comments "Penrosian analysis suggests a sequential character to early growth because the entrepreneur must (i) search for matching opportunities and resources and select their project, (ii) secure resources to ensure viability. These requirements have a step like quality.

The challenge for the SME as it grows is to identify which routines it continues to invest in and rely upon, and which ones does it need to change in the face of dynamic changes in environments. It is this question of whether to replicate routines and patterns of organizational behaviour (Szulanski, 2003; Winter & Szulanski, 2001) or whether to modify, adapt and change routines and business processes that may be an issue for this study.

2.5 Overview of the process

This broad overview that integrates start-up, growth and the required transitions can be represented in the figure below. Two key points emerge here; (i) the future is significantly influenced by the past, and (ii) the transition to growth requires an efficient replication of past processes but scaled up to larger size, or a transformation of the business so that it can escape its entrepreneurial processes and model. These paths, choices and processes are reflected in the figure below. In the rest of this paper, we take this 'conventional view' and examine what if any changes might be posited if we were to examine the specific spinout enterprise context. This context is examined through the lens of two case studies of UK spin outs – Oxford Catalysts and Oxford BioMedica.



3. Two Case Studies

3.1 Case 1: Oxford Catalysts

The originating intellectual property and technology was born out of concurrent research at the University of Oxford, the Pacific Northwest National Laboratory and the Battelle Memorial Institute. This was initially developed in two parallel paths the former, from the University of Oxford in Oxford Catalysts and the latter in Velocys.

Oxford Catalysts was formed in 2004, a product of the University of Oxford's prestigious Wolfson Catalysis Centre, headed by company co-founder Professor Malcolm Green, one of the world's most respected inorganic chemists with a track record in founding spin-offs. The involvement of Green who brought not only his scientific reputation to the company but also his track record with other spin off companies originating in the Oxford Chemistry department undoubtedly underpinned the listing of Oxford Catalysts Group on the London Stock Exchange’s Alternative Investment Market in April 2006.

Roy Lipski - CEO and also a co-founder brought an undergraduate experience of biochemistry combined with experience of working at Goldman Sachs to the business bringing a commercial outlook to the management team. This was perhaps a critical factor in the subsequent good relationship that that the company has enjoyed with the financial markets.

Velocys was actually formed earlier than OC in 2001, a spin-out of Battelle, the world’s largest independent science and technology organisation . Microchannel process technology was pioneered at the Pacific Northwest National Laboratory in the 1990s and subsequently developed by Battelle.

Oxford Catalysts (OC) major IP was in the development of a process that creates highly stable crystalline catalysts originating from metal carbides. This provided a new mechanism to create super active but stable crystals that maximised surface area and thereby offered the opportunity of reducing the scale of associated equipment. This innovation was then linked to the Fischer-Tropsch reaction first pioneered by Franz Fischer and Hans Tropsch (FT) in the 1920s and used during World War II to produce synthetic fuel from coal and is currently being used for mega-scale (greater than 30000 barrels per day) gas-to-liquids plants in Qatar. This meant that there was no commercial route for the exploitation of orphan or stranded small pockets of gas.

In early 2008 Oxford Catalysts were in a strong position with a market focus on strong hydrocarbon prices and their production of cost saving and performance enhancing catalysts to manufacture high quality hydrocarbons from gas together with an MOU with Novus Energy (up to 50 second generation waste to fuel alcohol plants with royalties each worth 750k flowing to Oxford Catalysts) that would to provide income streams for the next 5 years sufficient to support a market capitalisation of 40 Million and low capital intensity business model. This deal drove the initial leap in share price seen in late October 2007.

The key development at this point was to link the OC catalyst with microchannel process technology from Velocys thus providing the potential to develop highly efficient small scale plants capable of exploiting orphan and stranded gas pockets (down to 1000 barrels per day) not viable using existing conventional technology.

8 July 2008 and Oxford Catalysts announce the MOU with Velocys that effectively provides third party validation for the link between the catalyst produced by Oxford Catalysts and Velocys the developer of the

microchannel process technology further boosting income stream into Oxford Catalysts. September 2008 and sustained high prices in the hydrocarbon market combined with environmental concerns increase the interest in developing hitherto unviable orphan and stranded pockets as well as flared gas from rigs. The market sees the potential value of this technology but current capitalisation only assumes less than 5% penetration of known market capacity.

The two companies recognised and formalised their links with Oxford Catalysts taking advantage of their superior capitalisation and cashflow and acquiring Velocys in November 2008 the market viewing the union as having extremely good fit. This confirms the potential of the catalyst developed by OC being a disruptive technology and the link with the microchannel process proving the platform technology whereby the value of the catalyst can be fully exploited.

Coming out of this was also the acquisition of further management skills in the form of Jeff McDaniel arriving from Velocys as Commercial Director to the newly merged entity. He is credited with forming the key strategic alliances that been fundamental to the development of OC and has a similar dual background to Lipski with a strong personal knowledge and background in science (co-author on several dozen papers in the context of micro channel technology) overlaid by commercial business exposure following his MBA at the University of Michigan.

2010 and OC are in the cash consumptive phase of their technology development but they have three attractive attributes - a clear route to commercialisation, healthy finances due to previous contracts and demonstration sites (eg Gussing) that provide reassurance that the technology is transparently being developed. The regulatory framework is favouring the development of synthetic fuels and government grants are available to help development costs and OC have access to these in addition to their existing commercial income streams.

March 2011 having consumed $250 million of funding and with 15 years of basic scientific input the commercialisation phase appears to be imminent. Oil prices reflecting the increased cost of accessing more marginal sources (eg deep ocean) underpinning the potential value in the production of synthetic fuels via a proven route offered by the OC/Velocys combined technologies an attractive commercial proposition. This provides a the base for a successful 21 million GBP placing in this month.

This is also backed by Oxford Catalysts and Velocys together owning or holding exclusive licences to more than 750 patents and filed applications, and over $250 million having been invested in its technologies, primarily from commercial partners.

September 2011 saw the arrival of Paul Schubert with many years of experience commercialising innovative process technologies, including a stint with FT pioneer Syntroleum. This provided (together with the previous key appointments) the key senior management skill base for the next step of fully commercialising the technology.

The Petrobas Toyo demonstration plant is the next key milestone potentially providing third party validation of the upscaled facility that commences in November 2011.

October 2012 the growth of fracked gas resources provides yet another potential change of gear for the technology inherent in the OC/Vlocys offer with market analysts identifying potential first mover advantage for the group implying that their technology is recognised as being almost fully commercialised. Current valuations suggest that very low market penetration levels (less than 1%) to be justified and that therefore there is significant upside potential.

November 2012 the Ventech placement of 1% of shares at a premium of 44% to the prevailing share price provides tangible evidence for upside revaluation of the company. The £ 8 million order placed by Ventech also provides solid evidence of a market for the commercial small scale plant (1500 bpd) that has been the goal of the development process to date.

3.2 Case Study 2: Oxford BioMedica

Oxford BioMedica (OXB) is a gene-based biopharmaceutical company developing treatments based on a number of platform technologies in gene delivery and immunotherapy. Over 50 patent families protect their intellectual property. As at May 2013 the company was valued at £32million – this is 10% of the peak 2007 valuation and 20% of its issue value. The company now has a pipe-line of in-house development programmes and collaborations with leading industry partners. The pipeline addresses diseases for which there are currently no treatments or that are inadequately treated today; including age-related or inherited neurodegenerative and ocular diseases. Together with collaborators, OXB are also developing targeted therapies and therapeutic vaccines to treat multiple types of cancer. As at mid-2013 there are six pipeline drugs and two are at the final stages of trials. Sanofi has an option on a number of these programs. In May 2013, OXB entered into a manufacturing agreement with Novartis for clinical grade genetic material. Investment research company (Edison) estimates that the company is currently significantly under-valued. Nevetherless it is still at projected valuation only about 50% of its launch value over ten years ago.

Oxford BioMedica is based on research undertaken by Alan and Susan Kingsman who were professors at the University of Oxford, UK. Whilst Kingsman notes in his biography that he was a devout academic, he undertook a number of commercial projects, including a 0.5 position with British Biotech, and acted as an expert witness for pharmaceutical companies in the 1980s. His research Centre at Oxford had commercial and research income in excess of £1million p.a. The aim of the new company (OXB) was to commercialise gene therapy discoveries. Alan Kingsman became the new CEO whilst Susan Kingsman became Director of R&D. Andrew Wood – one of Alan's students, who later trained as an accountant, became finance director.
Between 1996 and 2006 they raised £86 million in public offers. Subsequently there were a number of new fund raisings as the 'Cash Burn' for the company's business model required new financing or improved revenues. Until 2007, revenues were consistently less than £1 million per year. The share price was highly volatile over the period; at float it was 88p, reached a high of 130p and by 2013 fell to less than 2p. Over this period the company narrowed its focus from a broad range of applications of gene therapies mainly for licensing in the company's early years, to the main emphasis being given to ocular products, development of a proprietary platform and a manufacturing facility.

There were a number of turning points for the company. In the early years Kingsman in a biographical note identifies as important:

- An early link with Rod Hall, a City financier, to access AIM funding
- Influence of the first Chair of the new company – Sir Brian Richards –founder of British Biotech and inaugural Chair of ISIS (the Oxford organisation facilitating technology transfer and industry linkages) who facilitated linkages into the venture capital and 'City' communities
- Moving 'market' sentiment about biotech companies in general led to early optimism and later pessimism about these organisations
- Strong science training amongst most OXB employees - who also remained loyal in hard times
- Knowledge of the emerging field of neurobiology as well as the core work in cancer therapies
- 'Earning their spurs' through strong research work on cancer that is easier to get to 'clinic' fast

- Contracting out trials
- Collaboration with pharmaceutical companies who provide cash and commercial credibility (e.g. Wyeth who were a co-developer of cancer research therapies).

Stages of OXB's development are captured in the table below:

Year	Strategic and technical developments	Direction and Management	Revenue (£mn)	Share price (p)
1995	Oxford BioMedica was founded in 1995 by Professors Alan and Sue Kingsman from the University of Oxford's Department of Biochemistry.	Science push through knowledge and patents in gene therapy		
1996	Initial public offering (IPO) on the alternative investment market (AIM) of the London Stock Exchange	CEO –Alan Kingsman (Founder) R&D Director – Susan Kingsman Finance Director – Andrew Wood		88
1999		Establish technology across a broad range of product opportunities through in house R&D and collaboration	0.44	
2001	New collaboration with Wyeth (acquired by Pfizer in 2009) for development of a 5T4-targeted antibody therapy. First patient treated with TroVax® in a Phase I study in colorectal cancer. Oxford BioMedica moved to the main market	Management of risk through creation of as many commercial opportunities as possible. Balance an early deal and future internal investment Entry into US Non – Execs from large pharmaceutical companies (Elan). New Chairman	0.40	130
2003		Rights issue. Volatile share price	0.37	12
2004			0.50	15
2005		New share offering and alliance with Sigma Aldrich	0.84	25
2006			0.76	30
2007	Acquisition of Oxxon therapeutics Limited. Global licensing agreement with Sanofi for TroVax®; upfront payment of US$39 million with potential for a total of US$690 million subject to certain project objectives. Oxford BioMedica secures rights to endostatin and angiostatin genes from Children's Hospital Boston.	Sue Kingsman leaves Alan Kingsman become Chairman John Dawson takes over as CEO	7.02	40

	Initiation of Phase I/II study for ProSavin® in Parkinson's disease.			
2009	Oxford BioMedica regains rights to TroVax®. New collaboration with Sanofi to develop four novel, gene-based therapies for ocular disease; US$26 million upfront payment with US$24 million committed funding for Phase I/II development. StarGen™ received orphan designation from the Committee for Orphan Medicinal Products of the EMA.	Increased focus on conserving cash and reducing costs	19.0	11
2010	UshStat® received orphan designation from the Committee for Orphan Medicinal Products of the EMA. Oxford BioMedica and VIB-K.U.Leuven enter new collaboration funded by the Motor Neurone Disease Association to develop MoNuDin® for Amyotrophic Lateral Sclerosis. Licensing agreement with Emergent BioSolutions Inc. RetinoStat® IND application approved by the FDA for a Phase I/II clinical trial in neovascular "wet" age-related macular degeneration (AMD).		11.2	6
2011	Acquisition of a manufacturing facility in Cowley, Oxford. StarGen™ IND application approved by the FDA for a Phase I/II clinical trial in Stargardt disease. New 5T4 antibody research collaboration with ImaginAb. UshStat® IND application approved by the FDA for a Phase I/II clinical trial in Usher syndrome type 1B.New R&D collaboration with Mayo Clinic to develop a novel gene therapy for the treatment of chronic glaucoma.	Changes to Chairman, CEO and CFO	7.7	3

2012	ProSavin® Phase I/II study met primary endpoints. MHRA approval received to enable GMP manufacturing for clinical supply. Sanofi acquires exclusive worldwide rights to develop and commercialise StarGen™ and UshStat® for a total option exercise payment of US$3 million. New collaboration with Immune Design Corp.	Consolidation and narrowing Business scope: Focus on ocular products including a collaboration with Sanofi. Develop the LentiVector platform Build Manufacturing capability	7.7	2

4. Adaptation of the standard model

Consideration of the two cases (based on chemical engineering and bioscience technologies respectively) suggests a number of issues for transition and growth that need integrating into the standard model:

In the early stages of development, access to networks that can reach potential funders and business advice may be critical

The early academic innovator and entrepreneur are important at the early stage to differentiate and authenticate the science but might not be appropriate for the new business environment, irrespective of their past experience in applied research and consulting. However a balance needs to be struck that continues to link the business to parent leading edge research

An academic spin-out may need significant changes in personnel and direction to grow and achieve profits. Given initial share allocations this may take time.

The achievement of significant revenues may take many years and in the interim 'cash burn' for some technologies will be high. This will require regular access to potential funding sources or some 'soft' elements in the business model that can provide some sort of revenue base

Financial markets might underestimate the time it takes to become cash positive

Changes in the 'climate' for technology based ventures may significantly affect new firm development and access to funding

Complementary assets that might not be understood at the IPO stage are nevertheless critical to progress

Sometimes these complementary assets require alliances, acquisitions or licence agreements to be effective

Control of costs even potentially high margin industries is critical

The assembly of an effective team that can take the enterprise forward and the development of replicable dynamic capabilities is complex and affected by the previous paths, current position and management processes

Some technologies, either because of regulatory regimes or competition might take many years to implement into a profitable business.

We suggest a revision of the conventional model but one that builds on it by recognizing the importance of previous paths and transforming processes to build new capabilities that need both research and business inputs. Any new spin out that has a combination of both soft and hard aspects of a business model should have a higher probability of success.

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Orchestration of Complexity – Instruments for Economic Transition and the Dortmund Experience

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Abstract

Dortmund and the Ruhr-Area is a prominent example for a local economy where dominant industries – notably mining and steel – quickly vanished. Dortmund's decision-maker initiated the structural transition at an early stage. The foundation of the TU Dortmund University in the 60th was a far-sighted decision whose relevance for the change process and the economic transition in Dortmund turned out almost 20 years later. TU Dortmund's technological focus has not only been the driving engine for the establishment and growth of new research institutes but a precious asset utilized by a Technology Centre, and a Technology Park. Numerous institutes add significantly to the scientific character of Dortmund. Today, Dortmund has a visible knowledge based economy and the financial impact of the technology transfer activities is considerable. In this presentation we outline that the multi-dimensional orchestration of economic change requires more than courage from the stakeholders to experiment with innovative policy. Essential is a sound systematic and sustainable tool box on all levels of planning - similar to the set of instruments used by companies to navigate through troubled times.

Keywords: Technology Transfer, Local Economy, Planning, Instruments für Business

1. Introduction

Since the 60th, the City of Dortmund has been coping with a painful economic transition. For a long time, Dortmund's wealth and the economic dynamic in the Ruhr area were based on coal and steel. However, the first problems occurred in the late 1958 in the mining industry, marking the beginning of a continuous downward trend. 1987 saw the closure of Dortmund's last coalmine. Its prominent symbols, the winding towers, disappeared from the townscape and were consigned to industrial museums. The steel crisis, which began in 1975, was another shock to the region and Dortmund's position as Europe's no. 1 beer-producing city, which dates back to the decade between 1950 and 1960, was mesmerized as well. 90,000 jobs were lost between 1960 and 1994, i.e. the number of industrial employees decreasing from 127,000 to 37,000.

Today, Dortmund is working to position itself as a service and science city. The region is home of a considerable number of medium-sized companies which operate on an international, many on a global level and are considered to be among the top of their business (hidden champions). Nevertheless, the situation is more fragile than many imagine, also because of a fast-growing competition from BRIC and MIST-countries (Mexico, Indonesia, South-Korea and Turkey) [1].

2. The Complexity of Transition – The Dortmund Case

2.1. Dortmund's First Move: Higher Education and Science Investment

Dortmund and the state government reacted to the structural change at an early stage. Presumably the most forward-looking decision (propagated by numerous stakeholders) was the foundation of Dortmund University

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at the end of 1968 (29,672 students winter-term 2012). The University of Applied Science (11,145 students winter-term 2012), opened in 1971, and a few smaller institutions for higher-education contribute to Dortmund's stance as a knowledge-driven city. With reference to the industrial history of the region, the core focus was from the beginning on technology like IT, chemical technology, mechanical engineering, and automation. Scientific Institutes like Fraunhofer Institute for Materials Flow and Logistics (IML), Fraunhofer Institute for Software and Systems Engineering (ISST), Institute for Analytical Sciences (ISAS) and Max Planck Institute of Molecular Physiology – some already in Dortmund for many years – expanded and contribute to the image of Dortmund as a city considerably driven by science and technology (Fig. 1).

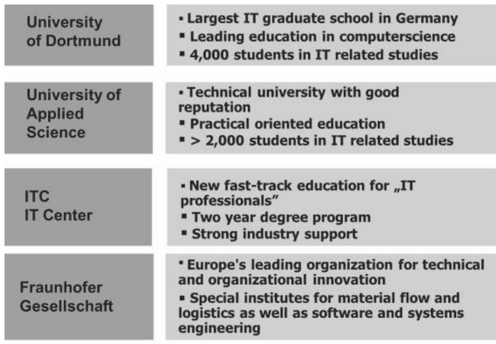

Fig. 1. Some of Dortmund's scientific forces [2]

2.2. Dortmund's Second Move: TechnologyCentre and TechnologyParc

TechnologyParkDortmund (TPD) [3] [4] was founded in 1984 and soon became visible as a showcase concentrating on selected, promising technologies. International studies list TPD among the leading and most successful technology parks, alongside Sophia Antipolis, the Research Triangle Park, MIT University Park and Cambridge Science Park. TCD was built around the TechnologyCentreDortmund (TCD). TCD is an excellerator for start-ups which is now one of the largest and most successful centres of this kind in Germany and beyond. The center supports new businesses and small- and medium-sized companies in transforming innovative ideas into practice, offering individual consulting services during the foundation and set-up phase. With an excellent infrastructure for product development, companies are supported to position themselves on the market. One precondition for the admission in TCD is a competitive product concept with a well-founded business plan. TCD is designed to operate as an incubator and laboratory where prototypes and pre-production batches are tested in selected technological fields, based on technologies pooled from Dortmund's scientific and economic potential in Microsystems technology, Software Engineering, Logistics, Automation and Biomedicine / proteomics.

Today, 267 companies have settled in TPD and work hard with more than 8,200 employees to earn 450 Mio. Euro/year, approx. 103 companies with 1,300 employees settles today in the TCD buildings with an overall floor space of 81,500 m². The efficiency of TCD and TCD is based to a large extent on its vicinity to the Technical University and the research institutes, intensifying the continuous technology transfer between science and industry.

2.3. Dortmund's Third Move: The Dortmund-project

Soon it was obvious that the technology park can only be part of a larger approach to face Dortmund's economic troubles. Encouraged by ThyssenKrupp AG, the City of Dortmund initiated at the end of the 90^{th} the

Dortmund-project as an outstandingly ambitious approach to create 70.000 workplaces within 10 year [5]. The consulting company McKinsey, in close collaboration with the City of Dortmund, outlined a sophisticated roadmap for mobilizing Dortmund's economic potentials – with the academic and scientific institution in the center. This project tackles three equally challenging dimensions: ignite new industries, enhance the competence and potentials of people (and existing businesses) and boost infrastructure to offer attractive space for expansion (Fig.2). The set of activities was based on a comprehensive strategic analysis, which was derived from a comprehensive set of data, facts and global technology trends.

New industries	People and competences	Locations
▪ start2grow (formation and growth) ▪ Locate IT (establishment) ▪ MST.factory (micro-system and nanotechnology) ▪ e-port-dortmund (logistics) ▪ TZDO und ECC (information technology and communication)	▪ Dortmund as location for university/ colleges ▪ IT-Center ▪ JOY – IT training campaign ▪ Education network microsystem technologies ▪ Agency for personnel services	▪ Phoenix ▪ Harbour ▪ Technology park ▪ Stadtkrone Ost ▪ Westfalenhütte ▪ Old airport Dortmund-Brackel ▪ City

Fig. 2. Three pillars for economic growth

What makes the Dortmund project so special is the comprehensive and interrelated approach of the activities, the focus on transparent goals and well-defined criteria to monitor the success. Managing and controlling this project poses considerable challenges. One example: Fig. 3 indicate the network of experts for the start-up-competition start2grow (see "New industries" in Fig. 2). More than 600 coaches are involved in supporting and encouraging people to start a business with – from unleashing entrepreneurial spirit, to the first innovative idea, to the legal foundation, and beyond. Obviously, start2grow alone needs clockwork-like precision and considerable financial resources to guarantee a certain success. [6]

In this paper we spotlight a few instruments which can help to cope with the complexity of projects similar to the Dortmund-project.

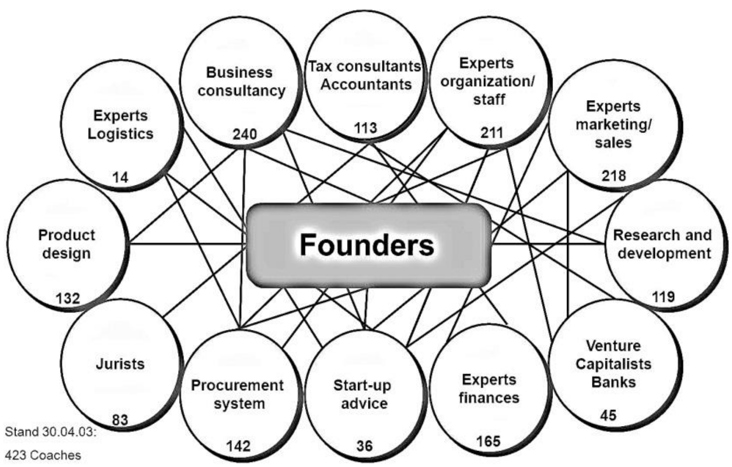

Fig. 3. Network of expert: Hundreds of coaches support start-up ideas

3. Orchestrating Complexity: Instruments for Economic Policy

3.1. From a Simple Cause-Effect-Approach to an Understanding of Complexity

Regional planning in Germany goes back into the 60th when the notion of social engineering became political mainstream thinking. The basic approach was: set clearly specified objectives for regional development and subsidizes those industries/services/companies that reveal potentials [7]. This concept turned out to be much so simple. Reimut Jochimsen, later Minister for Economic Affairs in North-Rhine Westphalia, demanded a more systematic approach by working out three relevant dimensions for state investments: tangible, human and legal/institutional infrastructure [8]. Later it was Frederic Vester [9], who introduced cybernetic or system theory into regional planning and paved the way for a deeper understanding of the many variables, interdependencies, feedback-loops, reinforcing and weakening correlations. Finally, the concept of cluster building was introduced and became a driving concept behind economic transition [10]. With 29 clusters in Baden-Wurttemberg, 19 in Bavaria and 15 in North Rhine-Westphalia, this policy has gained almost inflationary character [11]. All these concepts require clearly specified objectives, instruments and activities.

3.2. Learning from Business Development

Herman Simon, one of the leading strategic business consultants in Germany, defines *strategy* as an art and science to use all sources and instruments aiming at a long-term survival of an institution [12]. Constitutive for a strategy are the innovative character (something new), the relevance for exploiting external opportunities as well as the internal competencies. Furthermore, strategy requires sustainability (hang-in-factor). At the end of the day it is about to know what to want, what not to want and to consequently work for what to want.

Simon regards instruments (Fig. 4) as tools to develop and implement strategies and he propagates to drain their potentials to:

- develop vision and strategy
- derive clear goals
- identify cause-and-effect relations
- define operative actions
- decide on figures to evaluate / measure expectations
- develop an action plan for implementation and a feedback process.

When it comes to implementation, instruments shall help to define responsibilities, milestones, achievements, target deviation and consequences.

	Analytical Instruments	Instruments for Implementation
Instruments for the Strategy of an Institution	• Vision • Portfolio Analysis • Scenario Analysis • Competitior Aufklärung • Goal Strat • ….	• Quality Managment • Knowledge Management • Balanced Scorecard • Investor Marketing • Options Selection • ….
Instruments for a Business Unit of an Institution	• Benchmarking • SWOT Analysis • Lifecycle Analysis • Strategic Business Unit A. • Brand-Equity Analysis • Comstrat Analysis • ….	• Value-to-Customer • Market Segmentation • Pricing Instruments • Decision Support Systems • ….

Fig. 4. Hermann Simon's tool kid

With respect to economic transition the question is if and how these instruments contribute to

- set clear short, medium- and long-term objectives
- identify branches, cluster, technologies which promise expansion
- identify a harmonic set of activities
- calculate vital resources
- continuously evaluate the success of all actions
- gain commitment of all stakeholders (city, business, science).

4. Strategic Tools

4.1. Vision building

According to Peter Drucker [13], a company needs a simple, clear and easy to grasp vision, grounded in its history, culture or identity. A vision has numerous dimensions and

- gives direction by pointing beyond the present
- helps to understand the path between reality and utopia
- challenges the question about the abilities
- is based on hard facts, global trends, assumptions of abilities
- is an instrument of consensus building
- requires convincing communication and personification of leadership.

The vision of Dortmund was simple and unmistakably clear: to create 70,000 Jobs within 10 years in high-technology sectors (Fig. 5). From the beginning, this vision was propagated by the mayor, the President of the chamber of commerce and the rector of TU Dortmund (the "Dortmund consensus").

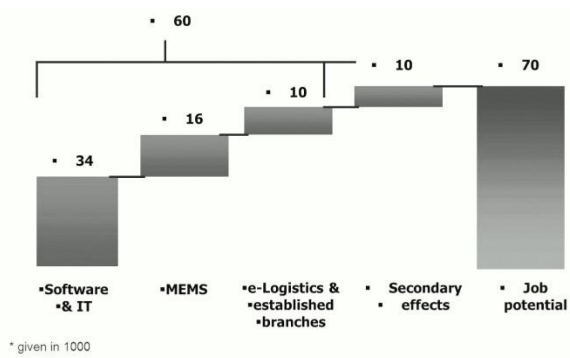

Fig. 5. One clear vision: 70.000 new jobs within 10 years

4.2. SWOT-Analysis

SWOT analysis is a method to specify and evaluate strengths, weaknesses, opportunities, and threats [14], all with reference to the competition. This analysis can be carried out for a product, an industry – or a regional entity. Strength and weaknesses result from an assessment of the own potentials and the information about the competition. Essential result is the identification of feasible options for actions and their priority. Opportunities and threads refer to the identification and anticipation of the environmental issues, i.e. external facts and trends. The main focus in this second dimension is to fathom strategically relevant disconinuities (Fig. 6).

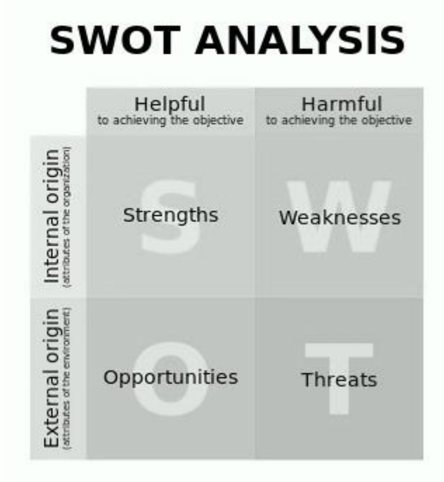

Fig. 6. SWOT analysis is based on hard facts, not speculation

SWOT Analysis in the context of economic transition aims at

- providing a description and audit of economic facts and potentials
- assessing current and future growth conditions
- evaluating the activities of the public sector
- agreeing and summarizing the key features of the region.

SWOT is based on facts, not speculation. Although not explicitly stated, the Dortmund-project was based on on the scientific strengths of Dortmund and the opportunities of the New Economy (SWOT-like analysis). These results were carefully complemented by an analysis of the competition by German and European regions and an evaluation of technological disruptions (threads and opportunities).

4.3. Portfolio Analysis

Portfolio Analysis was introduced in the 70th by the Boston Consulting Group as an instrument for analyzing a company's or product's position in the market and to prioritize future investments. Originally, the Portfolio Analysis was based on "market growth rate" and "relative market share" and resulted in a classification into stars, cash cows, questions marks and dogs [15].

Portfolio Analysis is a tool to structure options in a comprehensive context, i.e. it offers a framework for discussing strategic decisions concerning

- the distribution of resources on activities and
- the combination of activities with a long-term promising perspective.

Fig. 7 shows a portfolio for industries in the Ruhr-Area [16] based on the degree of specialization (vertical axis, indication of the competitive advantage compared to Germany in total) and the employment growth in 2000 – 2005 in % (horizontal axis). *Recycling* for instance exhibits an outstanding growth in employees but is a small industrial sector (size of the circle) with no significant quantitative impact. Coal industry (upper left corner) shows a very negative development in employees, but is very specific compared to the rest of Germany.

Portfolio Analysis has proved to be a comprehensive, useful instrument to visualize market-, marketing-, innovation- or regional potentials. Besides the high level of abstraction and a certain degree of subjectivity, this kind of analysis supports a comprehensive discussion of scenarios with a variety of "business units".

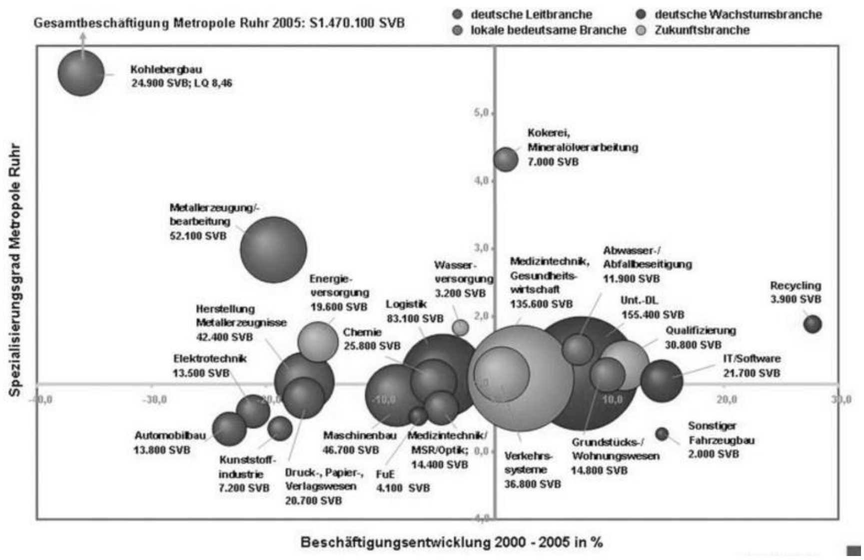

Fig. 7. Specialization, employment growth and relevance of industries in the Ruhr-Area

4.4. Balanced Scorecard (BSC)

Developed by Kaplan and Norton in 1990, BSC is a strategic instrument to deal with four essential performance dimensions of institutions: customers, financial aspects, internal processes and learning & growth (Fig. 8). BSC is a powerful instrument to support the implementation of projects. The characteristic of the BSC and its derivatives is a blend of financial and non-financial measures each related to target value within a single concise report. With certain adjustments, BSC can assist non-profit organizations accomplishing strategic planning and control functions by

- clarifying and gaining consensus about strategy
- communicating strategy within the organization
- linking strategic objectives to long-term targets and annual budgets
- identifying and aligning strategic initiatives
- structuring periodic and systematic strategic reviews
- obtaining feedback to learn and improve strategy.

Steering and controlling the complexity of economic transition is getting more and more complex. BSC helps to understand how vision and strategy can be translated into tangible targets. Financial figures are related to a Performance Measurement approach where figures and key indicators are selected from a global perspective. BSC helps to find a balance between quantitative and qualitative control variable. The case of the “IT Cluster” [17], and further studies like [18] indicates the benefit of BSC for cluster management and the development of regions in general.

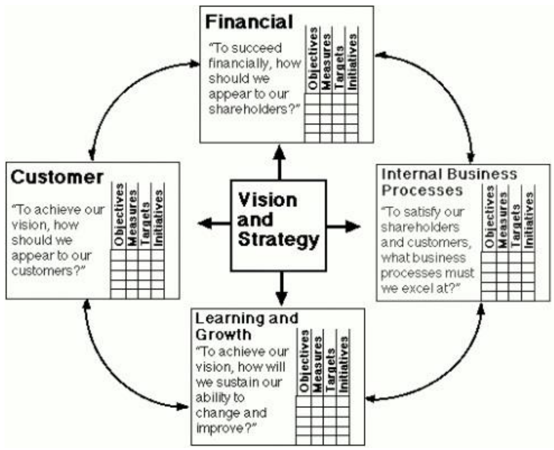

Fig. 8. Four target dimensions driven by vision and strategy [19]

5. Summary

Sparking economic growth and prosperity is a complex challenge. In its core, it is a political process based on socio-economic expertise, consistent decisions, and the courage to take risks. The process to identify objectives and to work out a promising set of activities must be transparent for the many stakeholders. Essential is an appropriate mix of instruments that gives structure to the complete planning and implementation process. These instruments must be carefully selected and we recommend to make excessive use of trusted tools that help companies to prepare, implement and follow-up critical decisions.

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2013 International Conference on Technology Transfer

A ‘road map’ for Serbian Research to Join the ERA

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Abstract

Serbia has some excellent scientists doing competitive research, but the majority of Serbian research is uncompetitive on the European scene. Although around €45 million has come to Serbian researchers so far for FP7 projects, the number of scientists writing FP7 proposals is only about 260-265, and the number of Serbian researchers benefiting from FP7 projects only around 900. So far only about 37 Serbian private companies have taken part in funded FP7 projects. To increase the contribution of Serbia’s scientists and companies to Horizon 2020, four measures are proposed: targeted networking, support for developing project proposals, improved research training and a new Ministry European Science Fund scheme.

Selection and/or peer-review under responsibility of the organizers of the 2013 International Conference on Technology Transfer

Keywords: Serbian researchers; FP7; Horizon 2020; SME; ERA

1. Introduction

Serbia has some excellent scientists doing excellent, world class research. However, these are, typically, pockets of excellence within a generally gloomy picture. The majority of Serbian research is uncompetitive on the European scene. This picture is gloomy for several reasons, not just lack of money for research from the Serbian government. Generalising, it has its origins in the socialist era following the Second World War, when the concepts of research quality and relevance were largely ignored and competition unnecessary. The Balkan wars of the 1990s then turned an already mediocre scientific cadre into an apathetic, unmotivated (not to mention unprincipled) as well as mediocre scientific cadre. For many areas of science this largely remains the picture today, with the only visible difference in many laboratories between the desperate years of the 1990s and today being the presence of occasional expensive, state-of-the-art items of equipment on lab benches or locked away in offices, often covered with dust sheets because no-one has the money for consumables or maintenance contracts essential to keep the equipment running.

Inevitably lack of money for science and research is a major contributor to the current low state of Serbian research, but the solution to the problem of mediocrity, apathy and lack of motivation amongst Serbia’s scientific community is not just money. Indeed, lack of money is probably the least important of the factors determining the ability of Serbia’s research to enter the European Research Area (ERA) - to contribute on an

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equal footing to European research for the benefit of Europe's economy and society - the pillars supporting the three key objectives of Horizon 2020, which starts on 1st January, 2014.

With Horizon 2020 literally on the horizon, the handful of researchers that succeeded in taking part in FP7 projects will be looking forward to similar opportunities in Horizon 2020. The much smaller number of researchers who tried to take part by writing their own FP7 proposals, mainly unsuccessfully, will be weighing up whether to continue the struggle in Horizon 2020 or whether not to bother (a concern not unique to Serbia).

Although the details of Horizon 2020 projects are still being determined behind closed doors in Brussels, it looks as though average consortium size is expected to be somewhat greater than in FP7, and project impact will be more important than in FP7. The commercial sector (particularly SMEs) will be expected to take an even greater role in project consortia than in FP7. Horizon 2020 will very much be focusing on solving Europe's problems and challenges, creating more jobs and improving industrial competitiveness. So, scientists in academia and research institutions will be expected to target their research even more for the benefit of society through the commercial sector, which will need to be an integral component of project consortia.

2. Analysis of Serbia's contribution to FP7

FP7 proposals with people in Serbia ***have succeeded***! The following analysis is based on various sources of information from the Commission, including information from the FP7 support action WBC-INCO.net [1]. None of these sources is error-free. Because of the way applicants have provided the information to the Commission, it is sometimes impossible to avoid double-counting with the same proposal occasionally being submitted to two calls, and projects written by Serbs could be missed, particularly for the Marie-Curie PEOPLE programme, because they were recorded by the Commission as being submitted from another European country. However, taking FP7 as a whole, the analysis is probably as good as anything available to the Commission on Serbian scientists taking part in FP7.

At least the success rate for those scientists who took up the challenge of getting funding from FP7 by writing their own project proposals, at 13.3% after about six years of FP7, compares favourably with the success rate for proposals in which Serbian scientists were only partners (12.3%).

Until 2 May, 2013 (over six years of FP7), the main FP7 website (CORDIS) had recorded 190 projects with at least one Serbian partner, and another *ca.* 20 are known to be present on Commission MAINLISTs to enter grant agreement negotiations. In total, a little over 1000 scientists were recorded as taking part in FP7 project proposals, and by the end of FP7, the number of Serbian scientists named as either coordinators or partners in project proposals will be around 1100 (about 1600 proposals representing around 520 Serbian organisations, counting university faculties/departments as separate entities). About 170 Serbian private companies (PRCs), 78 public institutions (PUB) and 73 other non-research organizations (societies and NGOs) have taken part in proposals for FP7 project consortia, giving over 300 non-research partner institutions from Serbia. Of those, 37 private companies, 20 public organizations and 15 other organisations got funding to take part in FP7 projects (nearly all Cooperative Research). At least nine Serbian organizations have got funding so far for the Competitiveness and Innovation Programme (CIP), though only four participants could be classed as PRCs.

Analysis of who was writing proposals for successfully-funded projects showed that the large majority of Serbian scientists were ***partners*** (153) in ***other people's*** project consortia - few Serbs wrote successful proposals! Only around 37 Serbian researchers were successful in getting their proposals funded, of whom five succeeded in getting at least two FP7 proposals funded. The interest in writing FP7 project proposals started off relatively high in 2007 (Fig 1), with 101 scientists writing proposals, but rapidly faded over the subsequent six years, so that only 25 new scientists wrote their first FP7 project proposal in 2012, and only 53 proposals in total were estimated to be submitted by Serbian scientists that year. By the end of 2013 the number of Serbian scientists writing project proposals for FP7 will probably be only 260-265.

Using an estimate of 2.5 researchers being funded per FP7 cooperative research project and 25 researchers being funded per REGPOT (institution capacity-building) project (including PhD students), the total number of Serbian researchers taking part in FP7 so far is around 900 (the remainder being non-researchers).

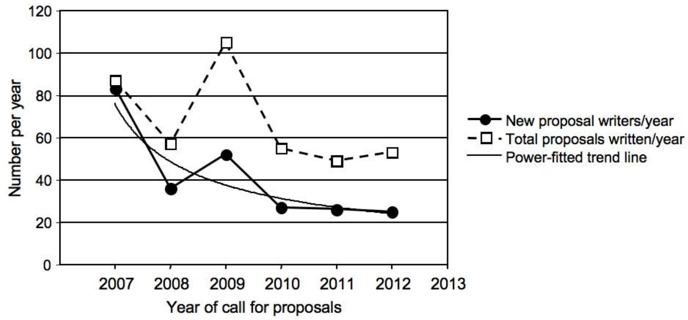

Fig. 1. FP7 proposals written each year by Serbian scientists. A power-fitted curve is fitted to data for new proposal-writers per year to illustrate the negative trend with time for new scientists writing proposals.

FP7 projects have given so far is around €45 million to Serbian scientists, though only about a third of this will have funded actual research, the rest going on coordination and support activities. Although the money brought into Serbian science from FP7 looks encouraging, the small number of scientists interested in writing project proposals for FP7 is not. Only around 2.2% of the country's 12,000 or so researchers [2] have written project proposals, and maybe *ca*. 7.5% of Serbia's researchers have taken part in FP7 projects. This hardly bodes well for Horizon 2020.

3. The current state of Serbian proposal writing

All the emphasis so far in Serbia has been on persuading scientists to write project proposals for FP7, as evidenced by the regular FP7 Information Days held by Serbia's NCPs, funding by the former Ministry of Science and Technological Development for the Consultative Bureau for International Projects (CBIP) (2008-2011), and IPA institutional capacity-building projects such as ICIP (2011-2012) [3]. The net result of all the encouragement and support from the CBIP and ICIP is probably only another one or two project proposals successfully funded. In particular, the ICIP project provided support and advice to Serbia's SMEs to encourage them to take part in FP7 and the EU Competitiveness and Innovation Project (CIP) scheme and ICIP struggled to identify a handful of high-potential SMEs, a small minority of which were persuaded to write and submit project proposals. Despite all the help from EU and local experts to develop project concepts and give advice in proposal writing, it seems that no proposal was funded.

So, if we want Serbian scientists to contribute to the ERA, we should ask ourselves the question "Do we want Serbian scientists to write EU project proposals or do we want Serbian scientists to take part in EU projects?" The eventual answer will be both, but all the emphasis so far has been on persuading scientists to write proposals for projects financed from probably the most difficult and competitive research funding scheme in the world (e.g. 5.2% success rate for REGPOT projects in 2009). Previous experience of writing research project proposals for most of these scientists will be (the former) Ministry of Science and Technological Development project proposals, where 878 scientists wrote proposals with success rates varying from 84.4% for TR projects to an impressive 94.0% for III projects; not a good starting point for expecting scientists to know how to write highly-competitive project proposals for European funds. Another major challenge faced by Serbian scientists is that Ministry projects currently come only once every four years, so any scientists wanting to improve their proposal-writing skills in preparation for the rigors of FP7 or Horizon 2020 have only one chance in four years to practice!

Having taken part in the current Ministry funding round as both a project partner and an international reviewer for TR proposals, it is clear that not only is the application process for Ministry projects seriously flawed, but also the review process, at least as far as international proposal reviewers are concerned. The current application procedure and criteria required essentially no elements of competition. Thus, none of the proposals reviewed as an international reviewer gave any project objectives, either explicitly or implicitly (one project did mention the word objective in the section under “Expected key results”!). No proposal gave any precise information on the research currently in progress by either the leading partner laboratory or any other researcher contributing to the project; no proposal included any references in the text to justify any statements made, either as evidence of the progress they had achieved so far or evidence of what other research groups around the world were doing on the subject. No proposal gave sufficient detail of any planned experimental work to know whether they knew what they were doing or could achieve any assumed objectives. No proposal gave any timetable of the work planned to know whether it could be achieved in four years.

In consequence, assuming those proposals were representative of the rest, it would not be possible for any international proposal assessor to judge whether a proposal would achieve any objectives: none was defined and no details of any activities were given to achieve objectives - presumably because proposers were not specifically asked to give this information in English versions of their proposals! Because of this lack of information in proposals, it would not be possible to make any assessment of the impact a project would have on the contribution to competitiveness of products and technologies produced in the Republic of Serbia.

Presumably, the same lack of information and inconsistencies in proposal assessment would also have been true for OI and III proposals. Perhaps this is the way proposals have always been written in previous project rounds, but the limited space available to provide information makes it difficult to give the evidence that an external reviewer would need to make a judgement on whether to recommend the proposal for funding or not. In consequence, decisions on funding these proposals would inevitably have been made by the Ministry on the basis of subjective rather than objective assessments.

The current Ministry criteria do not seem to require any evidence a) that the research is necessary, and b) that it will have any genuine impact! This is very different from what would be expected for international research proposals, and international expert reviewers of the science would find it very difficult to judge the quality or value of the science proposed. Thus, the format required by the Ministry for the current projects does not help Serbian scientists to develop skills in putting together internationally-competitive research project proposals.

4. Industry and international research

How do we get SMEs to take part in FP7 and Horizon 2020? As explained above, internally-funded projects giving support specifically to SMEs (such as ICIP) have failed to make much, if any, impression on the contribution of SMEs and the commercial sector in general to FP7 projects. The reasons for this are complex. SMEs in Serbia do exist and they do their best to contribute to the country’s economy and provide employment. However, many spend their time concentrating on remaining solvent, with all available manpower being focused on this task. Although FP7 is a grant-awarding scheme for projects to meet Europe’s research challenges, funding for research is never 100% (75% for SMEs in FP7). Thus, SMEs are expected to make, often significant, financial contributions to any research projects they take part in. When even the good companies are struggling to survive in Serbia, the extra financial burden to contribute to an FP7 project, which is a long-term, strategic project, is usually just not worth the extra problems and inconvenience. Nevertheless, despite the obstacles and financial commitment, 37 Serbian private companies (organization type PRC) have taken part so far in funded FP7 projects, with the majority probably classified as SMEs.

Although it may be unrealistic to expect Serbia’s SMEs to be enthusiastic about writing their own FP7 or Horizon 2020 project proposals, SMEs make ideal project partners, assuming that they achieve sufficient visibility on the national or international research scene. Indeed, the importance of SMEs as consortium partners and share of the project budget will be even greater in Horizon 2020. So, how do SMEs achieve sufficient visibility to be invited to become a member of a project consortium? The following information may help. A questionnaire was sent to several scientists in the UK and Republic of Ireland in December 2012 who wrote proposals for FP7 SME projects, with the following results:

How did you identify the SMEs to include in your consortium?

A) Using the NCP network - 1
B) Using the Cordis partner search facility - 2
C) Using the Chambers of Commerce - 1
D) Using the European Enterprise Network - 1
E) Using personal contacts - 6
F) Using an internet search - 8
G) Using another source, please specify ... 3

Answers for “G” included trade fairs, scientific conferences, and other forms of personal contact. It is clear that personal contacts and internet searches were the most popular way to identify potential consortium SME partners. So, developing a network of international contacts is important, as well as having a good quality company website in English, giving appropriate information on the company’s suitability as a consortium partner for particular research subject areas.

For SMEs wanting to be proactive in targeting inclusion in project consortia, the UK provided the most coordinators for FP7 SME project proposals with WBC partners (Fig 2), and they also had a much higher success rate (MAINLISTED) than other EU country coordinators. The coordinating institutions leading those funded projects and coordinators’ names would be on the FP7 CORDIS website.

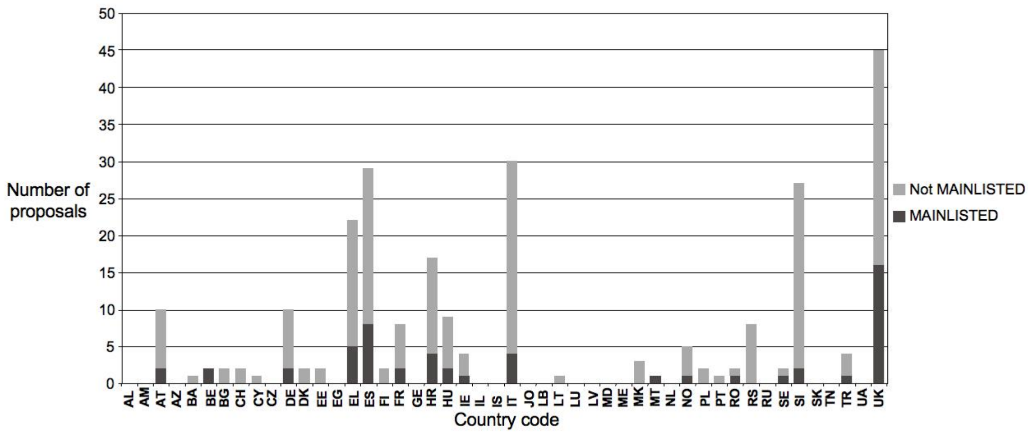

Fig. 3. Number of FP7-SME proposals that include WBC SME partners according to proposal coordinator (proposal writer) country, divided according to MAINLISTED (assumed to be funded) and non-MAINLISTED proposals (assumed to be rejected).

5. The way forward

Preparing their own project proposals for Horizon 2020 will take researchers up to a year to put together and write, with an average success rate of perhaps 10-15%. On the evidence of FP7, that will provide research funding for only around 400 Serbian researchers. On the other hand, taking part in ***other people’s*** FP7 project consortia would provide research funds for another 400 researchers (other non-research staff would also get funding). Becoming a partner in someone else’s consortium requires only a few days’ work and about two pages of text to write at the proposal preparation phase. However, if Serbian researchers do not have an active network of international scientific contacts, they will remain largely invisible to the Horizon 2020 proposal-writing community. Targeted support and long-term planning would be needed for more Serbian scientists to become partners in other people’s project consortia in Horizon 2020 than was the case in FP7.

Therefore Serbia’s researchers should aim to master the philosophy needed for success at writing EU-funded research project proposals, while developing their network of contacts. Here is a typical ‘road map’ for Serbian PhD students just starting out on a research career. They should:

- start developing their network of potential consortium partners - year 0
  (send emails to other international scientists, present research at international conferences, ask international scientists for short visits, etc.)
- write a short proposal for local funds for a small project - year 1
- write a proposal for a small bilateral international project - year 2
- write a proposal for an IPA or other international project - year 2
- join a suitable COST Action to increase networking opportunities - year 4
- be invited to be a partner in someone else's H2020 project - year 5
- become a Work Package leader in a Horizon 2020 project - year 7
- eventually write their own EU "Horizon 2020" project proposal - year 10

As indicated above, this will not happen overnight, though it will happen more quickly with appropriate support from the Ministry. Four measures could be put in place to help Serbian scientists increase their contribution to the ERA, through Horizon 2020 and other EU funding schemes:
1. Support for targeted networking.
2. Support for developing project ideas and writing project proposals.
3. Support to improve research and PhD student supervision skills, and
4. A new Ministry funding scheme to give researchers practical experience of competitive proposal writing.

5.1. Targeted networking

Serbia's NCPs have access to all the FP7 proposals submitted in their area of responsibility together with the results of proposal submissions and Commission Evaluation Summary Reports (ESRs). However, at present, no-one is responsible for any monitoring and analysis of this wealth of useful information. While the CBIP existed, this was one of its functions.

How do researchers develop their network of suitable international contacts? Networking should be an integral part of any researcher's training. Serbian scientists need to be proactive in ensuring that other research groups, especially around Europe, are aware of their research, and their motivation/enthusiasm to collaborate with other research groups. If nobody knows they exist then they will never be invited to join a project consortium. Even if a young researcher is able to present a poster at an international conference, he/she will remain invisible if the poster attracts no attention!

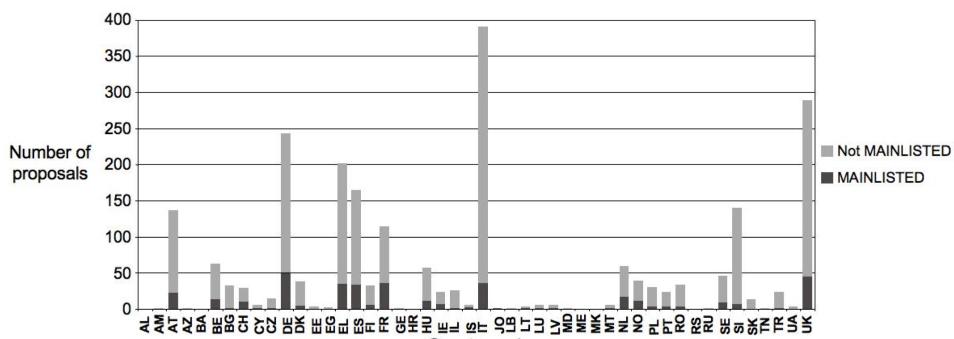

Fig. 3. Number of FP7 proposals that include WBC partners according to proposal coordinator (proposal writer) country, divided according to MAINLISTED (assumed to be funded) and non-MAINLISTED proposals (assumed to be rejected).

Analysis and monitoring of EU projects could provide Serbia's researchers with valuable intelligence on how to target networking to EU institutions and scientists that write project proposals and succeed in getting the money. For example, Fig 3 shows the frequency and success rate (MAINLISTED) for the countries that write FP7 proposals with WBC partners. Although, Italian scientists include the most WBCs as partners in their project consortia, their success rate with FP7 proposals is below average. Similarly, Slovenian coordinators, traditional partners for Serbian scientists, have a particularly low success rate for FP7.

In the same way, NCPs with access to ESRs for each programme and subject area have the means to identify the European institutions with the best success rate at writing project proposals, so that Serbian researchers could target these institutions for networking. For example, analyzing the complete ESR list for FP7-KBBE (agriculture and food)-2012 showed that one institution in The Netherlands wrote 18 proposals for 17 KBBE topics, of which 14 proposals scored at least 11/15, with 8 getting onto the MAINLIST for grant negotiations. Abstracts provided with ESRs could also be collated to search key words to help scientists identify research groups writing project proposals in their subject areas. Thus 14 proposal abstracts in FP7-KBBE-2012 contained the key word “irrigation”.

A similar analysis of every FP7 theme and call is perfectly possible with information available to all the country’s NCPs (most of whom are in the Ministry of Education, Science and Technological Development), and would provide Serbian scientists with an extremely valuable resource for targeted networking.

5.2. Proposal development support

There is very clearly a need to provide support and advice to scientists trying to put together project proposals. While the Ministry CBIP, when in operation, could not claim many success stories, this was largely for two reasons. Firstly, uncompetitive science was being presented for funding, and even the most competent of proposal writers would be unable to create “silk purses out of sows’ ears”. Secondly, the majority of applicants for FP7 projects using the services of the CBIP were completely unaware of the rigors of FP7 proposal writing and evaluation and had difficulty in understanding why their project proposals had received critical comments by evaluators in their ESRs. In general, the few Serbian scientists who put together successful FP7 proposals were doing research that is genuinely competitive at the European level. Poor quality, uncompetitive research was not funded in FP7, and will not be funded in Horizon 2020. So, similar good quality support should be provided in the future to Serbia’s scientists doing the best quality, internationally-competitive research to help them develop their project ideas into project proposals. This will eventually have a significant impact on the quality of project proposals and funding success.

5.3. Improved research training

Serbian academia is finally coming round to the view that the quality of research and student supervision has room for improvement. Thus, the final round of Tempus proposals, submitted in March 2013 included the TRAIN project proposal which, if funded, will provide training to PhD students and young researchers in research skills, similar to those previously provided by the CBIP. It will also target “training the trainers” by giving improved skills in PhD supervision to young professors who will be training the future generations of PhD students.

Although, if the project gets funding, it will face many challenges to achieve productive impact (in terms of implementing newly-learned skills) and sustainability (in terms of identifying sufficient competent and motivated trainers to train), it is final recognition of the need for formal training in research and supervision skills - an integral component of any good quality European university PhD degree. This will also contribute to a long-term strategy to improve the contribution of Serbian research to the ERA. Training in such essential skills should be recognised and encouraged by the Ministry through an appropriate reward scheme. Ministry stipends for PhD students, for example, could be made conditional on the candidate attending an accredited training course in research skills.

5.4. A Ministry European Science Fund scheme

A scheme of short projects for individual research groups would have the following aims:

- to allow the best scientists to have their own research projects
- to stimulate scientists to do good quality, relevant science
- to give them an opportunity to set up EU collaborations
- to give them practice at writing proposals
- to get Serbian scientists rapidly involved with the ERA

The Ministry of Education, Science and Technological Development does not have any scheme to fund individual research groups to do short projects. The present Ministry science projects last four years, with applications only once in four years. This is completely unrealistic, and even large collaborative EU FP7 projects are normally only three years. Long projects tie up valuable resources, with no flexibility, especially if quality control of progress shows limited achievements.

Introducing a scheme for short projects on science relevant for both Serbia and the EU could revolutionise the effectiveness and relevance of research in Serbia and achieve the Ministry's objectives of integrating Serbian scientists with those of the rest of Europe. The scheme could work as follows:

- Everything to be in English (proposals, evaluations and reports - just as for an FP7 project).
- Budget maximum equivalent to €20 000 per project and duration up to 2 years.
- A fund equivalent to €1,000,000 would allow at least 50 projects to be funded each year.
- Project application forms to be based on a simplified version of an FP7 research project proposal. This would get scientists writing proposals in the format needed for an FP7 proposal and give them an opportunity to practice what they learn on FP7 (Horizon 2020) training courses (suggestion 2 above).
- Visits during the project to at least two EU institutions would be obligatory to set up future collaborations and facilitate inclusion in future FP7 collaborative research projects.
- Presentation of the science at at least one European conference outside Serbia per year would also be obligatory.
- Research topics for proposals to be within one of the FP7 (Horizon 2020) Themes and existing topics (i.e. in FP7 calls already published).
- Project proposals would include a SWOT analysis of the research group and have three Work Packages: Research (including SWOT analysis and State-of-the-art), Visits and networking, and Dissemination and impact.
- Budget headings to be personnel, material resources, visit costs, 20% overheads.
- Submission deadline once per year.
- Proposal criteria and Guide for Applicants to be strictly followed, to get scientists used to rules rigidly enforced in FP7 (Horizon 2020).
- Proposal evaluators to be selected from a pool of experts from Serbian FP7 evaluators already with evaluation experience, scientists successful with their own FP projects and Work Programme country representatives, together with willing international assessors. This will ensure only the best proposals get funded.
- The proportion of projects funded in a particular Theme could be based either on an established Serbian research priority list or the proportion of FP7 funding available for each FP7 Theme.

Basing research on FP7 topics will ensure it will be useful, and in some cases will force scientists to refocus their research to ensure it is relevant to an FP7 (future Horizon 2020) topic. Including Dissemination and impact will force scientists to interact better with their stakeholders and encourage them to set up links with industry. Thus, not only does the scheme ensure good research science but it also ensures EU networking. This will guarantee rapid inclusion of the best scientists in the ERA, doing research of benefit for Serbia.

Because this will be a Serbian funding scheme, every scientist will have access to it and every scientist can apply with their own research ideas. It is likely that the scheme would be heavily over-subscribed - maybe at least 500 proposals per year. That will give a success rate of around 10%, similar to success rates for FP7. Thus, scientists will get used to the concept of competition, eligibility criteria and quality - getting them used to the philosophy of mind needed to compete effectively for FP7 (Horizon 2020) proposals.

A common complaint of scientists has been lack of EU partners for collaborative research projects, and therefore the difficulty/unlikelihood of being invited to join someone else's FP7 research consortium. Making visits to at least two European laboratories (i.e. the minimum partner number for FP7 research projects) obligatory as part of each project would give every scientist with a European Science Fund project the opportunity to get to know future potential FP7 (Horizon 2020) project partners.

A benefit of the scheme is that it will encourage scientists to write proposals that would be mini-FP7 proposals - hundreds each year, in addition to all the *genuine* FP7 proposals written. Also, the science to be done would be relevant for Serbia, successful projects would have significant *impact*, helping to stimulate interactions with industry, as well as having a European dimension. This scheme ought to put Serbian scientists in a more competitive position within Horizon 2020, compared with our neighbours, as Serbian scientists would become more familiar with the strict requirements and difficulties of FP7 proposals and many more scientists would have the necessary skills and be able to take part in FP7 collaborative research projects. The proposal SWOT analysis would force scientists to self-evaluate the quality and relevance of their existing research. Many will perhaps realise that their science is not relevant for either FP7 (or Horizon 2020) Theme topics or Serbia's science priorities, thereby stimulating them to evolve from their current area of research to a more relevant area.

6. Conclusions

The small percentage of Serbian researchers actively taking part in FP7 projects and even smaller percentage actively writing project proposals must be major concerns for Horizon 2020, as the largest opportunity for Serbian scientists to contribute effectively to the ERA. More of its good quality researchers need to be encouraged/facilitated to contribute to Horizon 2020 compared with FP7. However, the number of scientists operating effectively at a competitive European level is currently an unacceptably small percentage of its total science base, in comparison with the overall quality of researchers in the European Union. Future actions should target support both for the existing good quality scientists and for improvements in the quality of research being carried out by the rest. A long-term action plan to achieve this needs to be developed and implemented by the Ministry - another challenge for Serbia's researchers to overcome!

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2013 International Conference on Technology Transfer

Know How Transfer in Austria

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Abstract

The Austrian government has recognized approximately 40 years ago the necessity of cooperative research between universities and research centres as well as the industry, preferably small and medium-sized enterprises (SME´s). Especially in the field of High Technologies there was a big gap between these two worlds. Since that time the Austrian government started several initiatives to close this gap. In the following a short overview about this actions as well as some results are given and shortly discussed.

Keywords: Industry, SME, Research centers, Cooperative research

1. Introduction

In the sixties the Austrian government the former Ministry for Science and Technology has recognized a deficit of the Austrian industry, especially SME´s by the introduction of new technologies. According to several studies the reasons were:

1. Limited knowledge on future technological developments.
2. Less capacity for own developments.
3. Nearly no educated people in high technologies.
4. Less experiences for future market developments.
5. Employees are not in favour for new technologies.
6. Limited financial resources.

In the past 40 years the Austrian government started several initiatives to minimize these deficits. Therefore in the following some initiatives will be described according to these six points.

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2. Initiatives and realisations

2.1 Limited knowledge on future technological developments. Example Automation

Austria as a founding member of the “International Federation of automatic Control – IFAC” was present with 5 contributions at the first IFAC World Congress in Moscow 1960. At this first world congress Austria had recognized that some of the new results in automation presented and discussed at this congress could be of interest for the Austrian industry as well as universities and research centres. Therefore the Austrian government was in favour to support the Austrian presence in IFAC. Since the foundation of IFAC in 1957 the Austrian NMO was the Austrian Centre for Productivity and Efficiency – ÖPWZ; an organization for technology transfer in the Austrian industry.

Until now time more than 60 IFAC events were organized in Austria – third place in IFAC statistics – to offer Austrian researchers and industrialists a easy possibility to present their research results an international forum of specialists.

Austria was and will be also involved in the organization of IFAC events together with other countries.

In 1969 during the IFAC World Congress in Warsaw the IFAC Technical Committee on “Social Aspects of Automation” was initiated by the Austrian Fred Margulies. Meanwhile this Technical Committee is one of the largest in IFAC. Furthermore in 1991 – as a follow up of the first workshop on “Supplemental Ways for Improving International Stability – SWIIS” an IFAC TC with the same name was installed by Hal Chestnut (USA) and Peter Kopacek.

The Austrian government was also responsible to the transfer of the IFAC Secretariat to Laxenburg in Austria in 1984. The IFAC secretariat has until this time a permanent secretariat as an annual financial contribution from Austria.

As a national platform for the transfer of knowledge of IFAC in the Austrian industry the “IFAC Beirat” Austria was installed in 1983. The main tasks of this “IFAC Beirat” are:

a) to advise the Austrian government in subjects on automation or related to automation.
b) make the Austrian industry especially SME´s familiar with selected newest developments on an international level in the whole field on automation – process as well as manufacturing automation.

The IFAC Beirat Austria consists now of 30 members from industry as well as from academia. In the meeting of this body twice a year industrial developments and research guidelines were discussed.

For these tasks the IFAC Beirat Austria has two major tools. He is responsible for the publication of the International Journal Automation Austria (IJAA) which is published two times a year and is distributed free of charge to approximately 800 interested people in Austria and abroad. Furthermore the IFAC Beirat Austria is responsible for the organization of the annual Austrian automation day; usually in October. In 2010 the 25th Automation Day will be organised. In short presentations from industry, universities and research centres the state of the art and further developments are outlined. In this annual automation day the Fred Margulies award is given for outstanding contributions in application of modern automation concepts.

Because of the success international, bilateral Automation Days were organised e.g. with Argentina, Brazil, Bulgaria, Cuba, Czech Republic, Ecuador, Slovakia, Slovenia, Romania,...

The “IFAC Beirat” Austria is also responsible for relations to other international organizations like International Federation on Robotics – IFR, International Advanced Robotics Programme – IARP and Robotics in Alpe-Adria-Danube-Region – RAAD. Some of the members are involved in other international organizations, like the “International Federation of Information Processing – IFIP” and the “International Measurement Confederation – IMEKO”.

Because of reasons of the Austrian law the “ Austrian Society for Automation and Robotics – ÖGART” was founded as a legal umbrella of the IFAC Beirat Austria.

This is only one example for Know How transfer from the international via a national level to the industry.

2.2 Limited knowledge on future technological developments. Example Automation

As pointed out earlier Austrian small and medium-sized enterprises have usually too less capacity for own developments. As a logical consequence research topics should be outsourced from these companies to university and research centres. One of the reasons is the situation on Austrian universities.

- Universities have man-years on research capacity available in form of project works, MSc theses, PhD theses.
- If a student works in a company – its a good possibility to a test for a future employment.
- Universities are used to be confronted with “unsolvable” problems.
- SME`s should contact University institutes as early as possible – because of their “Dead time”.
- Most of the University institutes are not in favour to implement a solution.
- Usually institutes have more experience in funding.

Actions for the improvement the cooperative research between the industry especially SME`s and Universities.

Support of consulting:

First consulting of a company by a University institute, between 4 or 8 hours is free of charge for the company – financed by the Austrian chamber of commerce.

Extended consulting, 40hours is free of charge or the company has to contribute with 50% of the costs (depends on the sub-country) for the company – financed by the Austrian Chamber of Commerce.

Innovation cheque

For an innovative project idea there is the possibility to get an innovation cheque (€ 5000.-- to 15000.--) from the Austrian Chamber of Commerce. This cheque must be used for a feasibility study by an independent expert. According to the evaluation the innovator can apply for start up support from different sources – maximum € 200.000.-- - for the founding of a company.

Support for a co-operative project:

There are several sources available. A project could be financed

a) by the Austrian Research and Promotion Agency –FFG
b) by the local government
c) by the government
d) by the European Union (Austrian Research and Promotion Agency –FFG)

Examples for b)

The City of Vienna:

ZIT Zentrum für Innovation und Technologie (The ZIT Center for Innovation and Technology), a subsidiary of the Vienna Business Agency, was founded in the year 2000. ZIT serves as the technology promotion agency of the City of Vienna.

The activities of ZIT encompass providing direct financial assistance (i.e. grants) to companies or making a technology-specific infrastructure available, as well as the implementation of a broad range of accompanying measures in all phases of the innovation process. ZIT employees evaluate the technology sector with respect to trends, developments and functionality. On this basis, they design measures to support technology-oriented companies.

INiTS is an organisation that helps to achieve a constant increase in the number of company start-ups with an academic background in Austria. Our objective is to continuously increase and secure the quality and likelihood of success in these start-ups through early and well targeted support. Thanks to close cooperation with the industry and links to existing programmes that support start-ups, we see ourselves as the central contact point for innovative entrepreneurs in and around Vienna.

The greatest potential for know-how and knowledge-based company start-ups in the whole of Austria can be found in the Vienna region. Our objective is to harness and activate this potential. "Innovation into Business" - we come in with our services when academics want to put their innovative research findings into practice by starting up a company. Our aim is to promote entrepreneurship and anchor it in natural-scientific, technical and other research facilities.

The Region Upper Austria.

Within the last years, Upper Austria has positioned itself as a competent region for clusters and networks. The policy for economic development and technology is cluster and network oriented and is consequently realized – as a strategy for companies to sustain innovation and competition. This idea will be continued systematically in the future on base of the strategic program “Innovative Upper Austria 2010plus”.

Since 1998, clusters were gradually developed in important economic branches in Upper Austria: automotive, plastics, eco-energy, furniture & timber construction, food, health technology, mechatronics and environmental technology. In addition, inter-branch networks have been set-up in the fields of human resources, design & media, logistics and energy efficiency. Small & medium sized enterprises (SMEs) are particularly supported in our policy.

Research grants from several ministries (BMVIT, BMwA, BMSA) for application oriented research directly given to the University or an Institute. Duration: 6 – 36 month

Special research emphases: Including several partners (12 in average) from industry as well as from Universities. The duration is in the average 3 years, there is a possibility to get financing for an extension.

Examples are: Microelectronics, CIM, IMS, Biotechnology, Renewable Energies, Electronic scrap recycling, Nano- and Femtotechnology…

Centres of excellence: Universities/research institutes and companies (min. 12) are working together on a specific subject for at least 3 years. (Financed by BMVIT and BMWA).

Action “Scientists for Industry”: A scientist from the University works for 6 to 12 month in a company on a distinct project. Half of the costs of company for the scientist will be covered by the government.

Technology Centres: In Austria we have currently 70 Impulse centres and 20 Technology parks.

Example: Biocenter Campus Vienna

Biocenter came into being in 1992, offspring of the close relation-ships between private industry and the life science research facilities at the University of Vienna. The nucleus was made up of eight university departments doing world-class research in molecular biology and the Research Institute of Molecular Pathology, a life science think tank set up by the Boehringer Ingelheim Group. The year 1998 marked the foundation of Austria’s largest young biotechnology start-up at the Campus. The Campus has not stopped expanding since. A broad range of individual organisations creates an environment in which cooperative research and development thrives. The Campus continues the Viennese tradition of diversity and contrasts.

Research Centres

Example: AIT

The AIT Austrian Institute of Technology, Austria's largest non-university research institute, is among the European research institutes a specialist in the key infrastructure issues of the future. As an Ingenious Partner to industry and public institutions, AIT is already researching and developing the technologies, methods and tools of tomorrow paving the way for the innovaertions of the day after tomorrow.

The Republic of Austria (through the Federal Ministry for Transport, Innovation and Technology) has a share of 50.46%, while the Federation of Austrian Industries owns 49.54% of the AIT Austrian Institute of Technology.

In Austria, there are over 900 employees - largely based at the main facilities Vienna Tech Gate, Vienna TECHbase, Seibersdorf, Wr. Neustadt, Ranshofen and Leoben – working on the development of those tools, technologies and solutions for Austrian industry considered to be of future relevance and which comply with the institute's motto "Tomorrow Today".

Seibersdorf is also where the two wholly-owned subsidiaries "Seibersdorf Labor GmbH", which offers laboratory and other services, and "Nuclear Engineering Seibersdorf GmbH", are located.

Attract Austrian SME`s to join projects from the EC:

Austrian SME´s have problems to be involved in EC projects. Therefore there is a

e) support for making a first proposal, financed by BMVIT

f) The Office for international technology co-operation BIT was founded and financed by the Austrian government BIT is responsible for: First decisions: national or international project partner search, first project draft. “Fine tuning” of an EU project proposal, contacts with responsible officials in Brussels, support in project management, nomination of project evaluators in Brussels. This is now the task of FFG.

2.3. Education in new technologies.

30 years ago Austria had nearly no educated people in automation. First initiatives were the development of postgraduate courses on several subjects of automation on different levels. On the lowest education level for example the Austrian College for Automation (ÖCAT) was installed in Styria. In one year unemployed people got a special education in fundamentals of High Technologies from a practical point of view. Furthermore fundamentals of High Technologies were also introduced as a obligatory subject in Engineering Schools (HTL). A little bit later in the same schools special postgraduate courses were also offered. Examples are automation and information technologies, both with a duration of one year.

On a higher level postgraduates university courses were installed mostly together with the Extension Institutes of Austrian Universities. There were two types of courses: long courses like automation I, II and III in the duration one year each were collected in the Austrian postgraduate education programme in automation. The participants received an official certificate from Vienna University of Technology. Beside this fundamental education short courses of special new topics of automation, like time discrete systems, application of artificial intelligence, fuzzy and neuro controls, robotics… were offered with a duration from 8 – 40 hrs.

On the management level some postgraduate international study programs were also developed mostly together with universities as well as education institutes from abroad. A very good example is the Engineering Management Program of Vienna University of Technology. After three semesters the participants will receive the degree Master of Science in Engineering Management granted by Vienna University of Technology.

In future technicians, lawyers and managers will be specialists not only in their field of expertise but also the respective complementary fields such as marketing, business management, law and engineering. In areas where economists, lawyers and engineers work together on the same level, either at the top of small and medium sized companies or in units of big companies, a well qualified engineering manager provides expertise and solutions to bridge existing interfacial gaps.

This MSc Program offers graduates from engineering schools the chance to extend and deepen their knowledge of economic and legal issues as well as it provides education in technical sciences for business managers and legal experts.

The highlights of this program are:

- “Master of Science – MSc.” Degree from Vienna University of Technology.
- Executive program: 10 (12) 40 hrs. Modules (Friday morning to Tuesday evening) every 3-6 weeks in Austria.
- Combined American – European faculty (50 : 50).
- Company visits. Program unique in Europe.
- Language: English.
- More than 60% of the approximately 140 graduates reached high management positions.

2.4. Less experiences for future market developments.

A company can cooperate with an institute on several Universities e.g. University of Economics, VUT (Institute of Economic Sciences), ...or with a marketing company. They are ready to make a marketing analysis and a short, mid and long term forecast for a distinct product or a group of products. Partially supported by the government. See “Innovation cheque”.

2.5. Employees are not in favour to introduce new technologies.

One of the main tasks of the IFAC Beirat. The founder – Fred Margulies – installed 1969 during the IFAC World Congress in Warsaw the IFAC TC on “Social Aspects of Automation”. Meanwhile this TC is one of the largest in IFAC.

2.6 Limited financial resources.

This item is closely connected to “Less capacity for own developments”. The actions of the Austrian Government are nearly the same than in this item.

3. Conclusion

The Austrian government has recognized 40 years ago a deficit in co-operation between universities and the Austrian industry, mainly SME`s in the field of High Technologies. Therefore some actions in different fields were initialised. As a result of these actions, mentioned above, we have now in Austria a good “climate” for cooperations between industry and universities as well as research centres. We have now some companies which are very efficient in the field of new technologies worldwide. Austrian scientists and engineers are recognized in the international community.

But nothing is perfect – we have to look for further improvements.

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2013 International Conference on Technology Transfer

Technology Transfer in Modern Russia: Problems and Prospects

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Abstract

Competitiveness of a modern economy is even more often characterized by the capabilities of innovation, as the most complex and advanced form. In order to gain a competitive advantage in a particular market segment, one needs to correctly implement an innovative project. Developments of small innovative companies in the national economy appear fundamental to development.
The role of innovative companies is increasing each year not only in Russia, but also worldwide, and primary importance of that companies is the technology transfer, which sometimes starts immediately after the initiation of business ideas.
To enhance the competitiveness of Russian companies, it is required to increase the rates of growth of the transfer of unique and high technologies, attract funding to develop their innovation activities. At the same time, implementation of innovations in enterprises should become the foundation of effective business. This article describes the problems of technology transfer in Russia, the main conditions for improving the competitiveness of innovation infrastructure, to which, undoubtedly, the transfer of high-tech innovations applies.

Keywords: competitiveness; economy; globalization; innovation; innovation company; innovation system; intellectual property; investment; technological innovation; SME; technology transfer; Russia

1. From Soviet Union to presence

Processes of globalization of national economies are increasingly going on specialization of these economies through the provision of development and only a certain number of sectors. For example, the ratio of the concentration of the G7 countries has grown over the past 30 years, the four leading sectors are on average 55% of total value added.
However, despite the highly specialized economies, new companies are showing the benefits of a broad industrial base for the development of key technologies. As an example, the chemical industry, including developing areas of biotechnology and pharmaceuticals, and in particular nanotechnology. Innovative companies are beginning to play an equally important role in high-tech sectors, such as universities. New information and communication technologies are concentrated in a number of areas: computer and communications industries, and environmental technology takes shape in the patent activity of the specialized equipment manufacturers and certain types of technical and engineering services.

The presence of young firms among patent applicants highlights the intense dynamics of firms in the stage of their development and their desire to develop new activities and products - that is crucial for their survival and relative growth. During 2007-2009, the firms that have been established less than five years ago and that have filed at least one patent application, represented on average 25% of the firm's patents, and about 10% of all patent applications [1].

Also, there are new experimental parameters such as, for example, the quantification of tax incentives for R&D and indicators of forms of government funding. Their use can certainly give a boost to the development of new knowledge, but the evaluation of these parameters can lead to science policy.

Russia since the time of the Soviet Union has deep foundations for the development of science and

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industry, which are still valued in the international market. Some of the key areas of technology development to date is a priority, and clarify as major supplier. Such examples are: nuclear energy, biotechnology, aerospace technology, engineering industry, and specialized software (Fig. 1. a).

Thus, it can be stated in a number of Russian saved sophisticated hi-tech sectors of the industry, creating globally competitive products and services that keep the core of the scientific and educational potential, created and developed the key elements of the innovation infrastructure that provides the susceptibility of the economy to new technologies.

Additional difficulties with the response to the new challenges of modern globalization processes in Russia stem from the fact that the forward-looking in terms of innovative development and increasing the share of high-tech manufacturing sector in GDP was among the hardest hit by the crisis in 2008. Aviation, shipbuilding and space industry, and the electronics industry are still experiencing problems with debt. Prospects for improvement in these areas are mainly associated with the modernization, with the support of the government. In 2009-2010, managed to keep the budget support to these sectors at an acceptable level, but that support was only enough to ensure the survival of key enterprises, and was not enough to shortly increase global competitiveness and promotion in foreign markets.

2. Current situation with innovations

The bulk of Russian R&D is still performed in government-owned branch research institutes, which are mostly separate from industrial firms and HEIs.

GERD was 1.16% of GDP in 2010, a level significantly below the OECD median. The business enterprise sector funded just 26% of GERD in 2010, and government funded 70%, following a steady rise from 55% in 2000. R&D expenditure funded by government grew at an annual rate of 7.9% in the five years to 2010.

Business R&D is concentrated in larger companies, especially in resource-based industries. Besides traditional areas of excellence (*e.g.* nuclear energy, aerospace), these activities mainly support modernization and technological renewal for productivity growth. Apart from a few high-technology firms (especially in the ICT sector), SMEs pursue non-R&D innovation strategies including technology adoption.

Limited cooperation between science, education and industry hampers innovation. The legal framework has been recently amended to promote co-operation. A series of federal laws (2009-11) encourages the creation of spin-offs from universities and research institutes, provides co-funding of research co-operation between companies and universities, and offers assistance in developing university innovation infrastructure. The Technology Platforms Initiative (2011) aims at fostering knowledge exchange and pre-competitive co-operation by enterprises, research institutes, universities and design bureaus along competitively selected thematic areas [2].

However, the initiatives undertaken by both the government and the business community cannot yet show brand new indicators of development of science and innovation, like activation of number of patent applications.

The World Intellectual Property Organization (WIPO) said 6.6% increase in the number of international patent applications by the end of 2012.

There was a total of 194.400 patent applications on the procedure for PCT (Patent Cooperation Treaty). The largest number of requests for registration of intellectual property rights is directed from the United Governments – 51.207, an increase over the 2011 - 4.4%. In second place is Japan with a score of 43.660 (+12.3%) and Germany closes the top three with 18.855 applications.

Russia's top ten was not included. It is noted that the number of international patent applications filed from our country declined in 2012 by 4% [3].

According to other research organizations OECD, the number of PCT patent applications (among countries that are not members of OECD) in Russia had changed little over the last ten years, and currently only able to catch up with pre-crisis levels. Although, for example, Singapore over the last few years, almost caught up with Russia (Fig. 1. b).

3. World market of technology transfer

The current situation in the world market of technology transfer is such that the main role in the total market play a licensing agreement. Russia's share in this market is now less than 3%, which means that Russia is about on par with Estonia, Thailand and Senegal, and in recent years, and more and more pessimistic predictions about the decline of the indicator [4].

Technology transfer as a source of new technologies apparently plays a more significant role in India, South Africa and Brazil than in China and in particular Russia. It appears plausible that this form of technology appropriation is less characteristic for Germany, as high national competence in technology development already exists here. Also in the area of in-company R&D, all the rapidly growing economies lie far behind the German level, not only as far as the experts' assessment of the innovative capacity and R&D expenditures of the firms are concerned, but also in the question of legal promotion of development and application of new technologies. India leads the BRICS countries in this area, while Russia brings up the rear [5].

At present, Russia is considered as a net importer of licenses: according to the balance of payments in 2010, payments for foreign license is eight times higher than export earnings from licenses. Unfavorable industry structure and trade licenses: there is the predominance of technology intensive industries in importing and traditional - in exports, as the cost of import licenses to several times the value of exported technology.

According to statistics, in recent years, the format of the export-import in the technology transfer area was primarily export of new technologies and import of old technologies. According to the latest balance of exports and imports of technology, it fell from -798 million USD in 2010 to -1277 million USD in 2011 [6].

4. Technology commercialization: Specifics of Russia

Based on the analysis of the time and the territory of the license agreements, can be concluded that only a small part of the companies uses constraints to optimize the structure of the license agreement and to control the management of IP in the long-term strategy. The study showed that in Russia about 55% of the licenses are for the entire term of the patent, while in developed countries an unlimited duration of the license is only 20%, and only 12% of those examined licenses have restrictions on territory [7].

At the moment, stream of new technologies from west to Russia has not yet appeared, although the need to use new technologies to increase profits is growing in all companies. The main reason for this situation is the lack of interest on the part of Russian big business in the application of innovation.

However, after the accession of Russia to the WTO in August 2012 there are preconditions for more active exchange of technologies. Naturally, the new conditions of competition in the international market of innovations should increase the level of Russian innovations.

The Russian market of intermediaries in the commercialization of innovative technologies is mainly represented by two types: consulting companies and investment foundations. Consulting company providing services in the field of intellectual property and marketing activities, and investment foundations focused on finding the investor. Also, the investment foundations generally do not have access to financial resources.

A characteristic feature of Russian intermediary companies that specialize in commercialization and technology transfer is to provide mostly the consulting services. The issues of financial responsibility or the protection of intellectual property, including payments of examination and patenting often assigns the company-developer. The Russian reality is that the intermediary companies do not have enough confidence of the owners of intellectual property.

In the process of commercialization of innovative projects, the developers generally get consulting and legal services, but the strategy of intellectual property often decides the developer itself. In the case of the sale of licenses, the developer requests the consulting company to negotiate and sign a license agreement (mainly for transactions with foreign companies) that gets to consulting company about 10-15% of the royalties.

Today, such services in the implementation of patents and other intellectual property have a

sufficiently large number of Russian intermediary companies.
However, these companies have differences, which consist mainly of the volume of services provided, up to promote innovation product, and increase sales.
It is worth mentioning one more characteristic feature of the provision of consulting services, the work of experts during the business evaluation, examination, marketing analysis, most such services are provided in the loan borrowed from future investments.

The bulk of intermediary companies are concentrated in the capital and largest cities, and the geography of services generally do not go beyond the home region. Thus, it leads the lack of opportunities for the development and commercialization of technologies in the regions, and as a result, continues to influence the quality and competitiveness of the Russian innovations in the international market.

Opportunities for the commercialization of research results can be a lot, and all of them depends on a variety of factors, but the bulk of technology transfer is in the form of:

- sale of the license on the patent and / or know-how;
- creating a new company, mainly in the form of a joint venture.

Thus, the analysis of the Russian market of technology transfer shows that the main players are the intermediary companies that provide opportunities for communication between developers and investors. The main types of services they provide: legal, organizational and investment services.
The main problem of the major players in the Russian market transfer of innovation is still the inability to overcome a number of financial, managerial and organizational barriers.
The main causes of low efficiency of technology transfer in Russia can divide into several types:

- researchers and developers typically do not know the market and can hardly realize their new scientific results, and convert into a marketable product;
- economic agents of the technology transfer market (managers of consulting companies) are practically not familiar with the nature of modern science, the structure and the main directions of its activity, breakthrough achievements. They cannot judge the validity of research results proposed for implementation, and technical efficiency;
- government (represented by politicians and technical experts) that establish rules for technology transfer, weak conception of the real-life science laboratories, the conditions for research and development of technology, the possible implications of the implementation of the legislative provisions for the production of scientific knowledge and its commercialization [8].

In addition, there is a problem with the effects of accelerated privatization for the innovation sphere. After the change of ownership of most enterprises, were cut off many connections “fundamental research - research and applied R&D - OCD - innovation in production”, that were supported previously centrally. However, the formation of a new innovation infrastructure, based on a well-functioning market economy is still in process.

5. Western practices of innovation infrastructure

The peculiarity of Western innovation infrastructures is to conduct a full innovation cycle. The implementation of the innovative project from concept to creation of small innovative enterprises is realized with the abilities to further develop and grow.
The first preliminary assessment of the demand for innovative technology in the market, is based on checking the patentability of intellectual property. The result of that analysis is a detailed marketing report, including a list of possible buyers of technology. In the case of determining the prospects of an important point is drafting a patent application and patent. The following issues are considered at the next stage of possible technology transfer: the delivery of a certain type of license, the establishment of a subsidiary or a joint venture, the sale of a patent.
Also, in the case of developer solutions continue to research and develop technology based on: an undertaking, help making a business plan, incorporate a company, the necessary calculations, obtain intellectual property

portfolio, and even assist in finding suppliers and buyers.

Should be noted, that in some foreign countries (USA, Finland), technology transfer is one of the three missions of universities - along with teaching and research work.
Its failure is punishable by deprivation of rights of the university that created intellectual property [9].

In international practice, the bulk of the university rather clearly defines the potential of intellectual property and the distribution of future license revenue between the university, department, inventor and technology transfer centers. So, usually, the mediator receives about 30% of the net license revenue, a portion of which compensates the costs of patenting, and other legal costs for the management of intellectual property. However, the main economic effect of the intermediary activities is not only to make a profit. Also an important factor is that in the process of commercialization of innovative technologies created: new small and medium-sized businesses, jobs for highly skilled workers, and there is growth in tax revenue budget.

Also, in a foreign practice there are integration processes, that are formed as a network of technology transfer to support innovative businesses, private and public technology transfer centers.

For example, Enterprise Europe Network (Enterprise Europe Network - EEN) currently has about 250 consortia, 600 organizations from 50 countries.
Besides the main activity in 2007 started a new framework program - Competitiveness and Innovation Programme - CIP aimed at promoting the growth of small and medium-sized enterprises (SMEs) and the creation of new jobs through increased competitiveness and innovation. The program is created for 2007 - 2013 years, with a budget of 3.621 billion euros.

CIP - this is one of the European development institutions, similar to the Framework Programme to support research (FP7), but with a focus on the development of SMEs, in particular, through the use of innovation (new knowledge, technologies) and internationalization (international cooperation, access to new markets) [10].

That activity allows companies to provide innovative services in the field of business development and innovation, including information services, to promote the capacity of business contacts, internationalization of enterprises, the transfer of knowledge and technology, as well as the participation of small and medium enterprises in the framework programs of the European Union.

6. Conclusion

Thus, it is clear the need for the original control schemes of the innovation process according to the realities of the Russian economy, which would be able to ensure the full and effective cooperation between private industry and public research institutions. It is possible that for effective organization and for control the system of the transfer of technology will be able to use the experience of other countries in Russia.

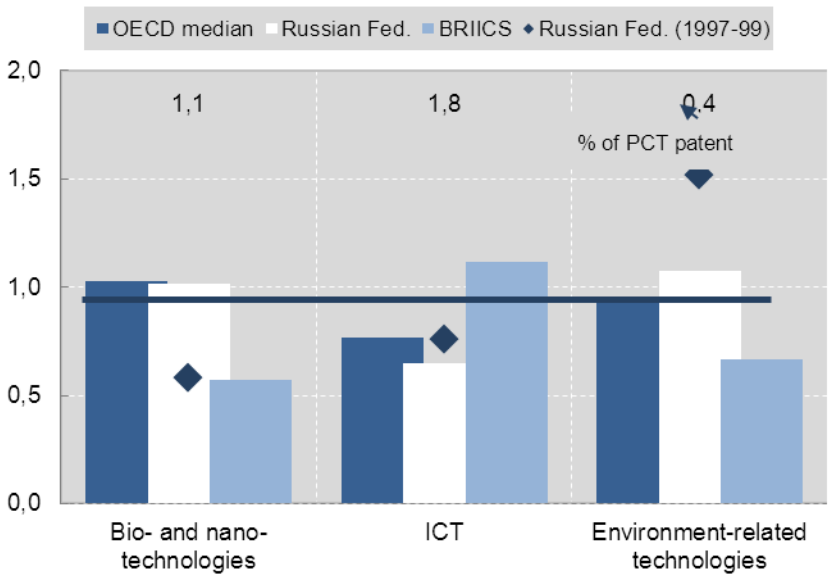
A prerequisite for successful application and implementation of this experience should be not only the creation of an appropriate infrastructure of innovation, but also the appropriate control of the development of certain areas.
These areas are the following:

- creation and organization of specialized research centers and innovative companies, to ensure the transformation of promising new research ideas into product and process innovation;
- reforming the legal framework for the promotion of innovation and entrepreneurship guarantees adequate protection of intellectual property rights;
- establishment of standards in the field of technology transfer processes for the protection of participants of the transaction from abuse;
- formation of an infrastructure of technology parks and business incubators throughout Russia;
- full functionality developed network of venture capital foundations;
- the emergence of the market shares of small innovative companies;

and other areas of innovation infrastructure development, has not yet been sufficiently developed in Russia, but working effectively in Western industrialized countries.

According to the author's personal experience, there is still a problem of trust in Russian technologies, as well as to intermediaries that turn to large Western companies. The process of checking the data, re-analysis of the prospects, performance evaluation, and the negotiations, themselves can take up to one and a half or even years. Such a long period is adversely affects the opportunities for the commercialization of innovative technologies and the value of intellectual property. Russia's accession to the WTO may be able to speed up the process and the decision of this problem.

7. Figures



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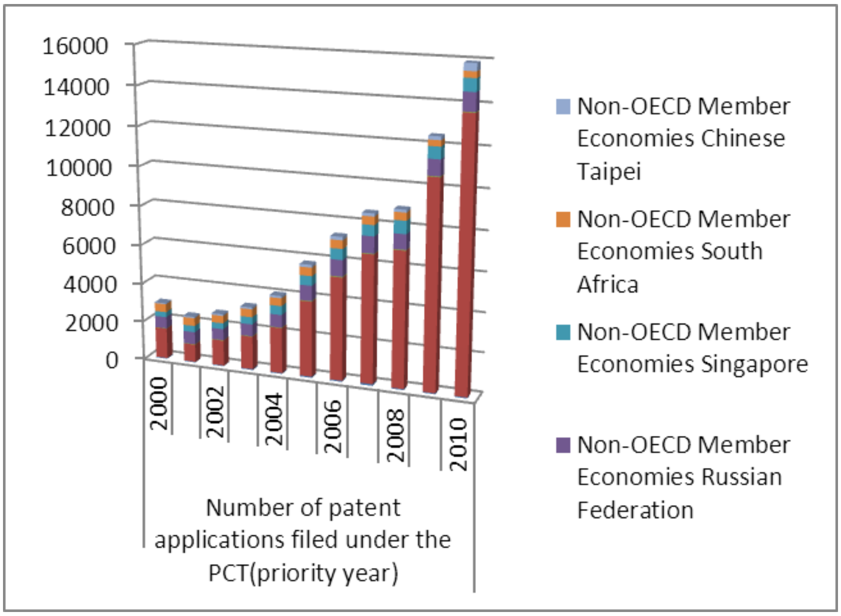

[12]

Fig. 1. (a) first picture; (b) second picture

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2013 International Conference on Technology Transfer

Challenges for European Higher Education in the Framework of Knowledge Transfer

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Abstract

The aim of this paper is to present in brief the steps taken in the framework of Bologna Process through the years, the policy decisions that have been taken by ministers responsible for higher education in their different meetings the last 14 years in order to establish a European Higher Education, the big challenge for changes that higher education institutions face, and finally how the "Europe of knowledge", as envisioned by the European Commission in the framework of Knowledge Transfer, is taking shape through the years and how is the current situation in education today.

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Keywords: Knowledge Triangle; Bologna Process; EHEA

1. Introduction

The knowledge triangle (KT) can be considered as the interaction between research, education and innovation, which are key drivers of a knowledge-based society. The KT aims at fostering innovation and is emerging as the central concept on the European innovation policy landscape, at the core of the next generation of higher education policies and programs.

KT's key concept is knowledge transfer. Regardless of the setting, knowledge transfer's objective is to transfer source knowledge successfully to a specific recipient but in the framework of KT, knowledge transfer can be considered within a broad definition of technology transfer which is the diffusion of the complex bundle of knowledge surrounding a level and type of technology including transfer of information and knowledge at micro- and macro-level between individuals, organizations, and economies [1]. Innovation policies promoting knowledge transfer tend to reinforce the concept of innovation as a linear progression from research to technology development and from there to innovative products.

Enhancing the relations and synergies between innovation, research and education is crucial to boost competitiveness of the EU industry and services and create jobs and sustainable growth in the European Union. According to [2], there are 3 misconceptions or myths about the innovation process: 1) innovation is driven by scientific research although studies have shown that innovating companies use the public research base as a source of inputs to innovation considerably less frequently than they use other sources such as in-house expertise, customers and suppliers, 2) knowledge transfer is about the exploitation of university-generated intellectual property (IP), patents in particular. In practice, innovation policy needs to focus on increasing opportunities for businesses to interact with the research base by whatever means possible, and not focus solely on IP, 3) exploitation of intellectual property is a new source of income for universities, although studies in Europe and the US consistently demonstrate that the top 10-20% of universities earn around 80% of all license income and

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most of the remaining universities and research institutes are not able to derive significant levels of income from IP.

Whatever the interaction of research with innovation is, European Research Area needs Education Area and vice-versa [3]. Higher Education remains the main source of providing research and to be successful in that requires that the offered studies to be of high standards. It is important for Europe to have modern, excellent Higher Education Institutions (HEI) with a unique and crucial role in the knowledge society. This imposes that universities have to develop their own strategies, to position themselves at European and international levels and to better link their activities with the needs of society, market and industry. The last decades, the Bologna Follow-up Group has proposed a number of measures to facilitate the proper and full implementation of the agreed Bologna principles and action lines across the European Higher Education Area (EHEA). As the ministers responsible for higher education in the countries participating in the Bologna Process declare at 2010 meeting in Vienna “Only by continuously developing, enhancing and strengthening the European Higher Education Area and taking further the synergies with the European Research Area, Europe will be able to successfully face the challenges of the next decade” [4]. This declaration is obviously in line with Lisbon strategy for 2020.

This study tries to brief the steps taken in the framework of Bologna Process and the results of the put challenges. More specifically, the paper is structured as follows: next section provides an overview of Bologna process from its first declaration in 1999 through the last Ministerial meeting in Bucharest in 2012. Section 3 discusses the current situation in EHEA. Finally, Section 4 presents the concluding results of the study.

2. Overview of the Bologna process

The Bologna Process is the product of a series of meetings of Ministers responsible for higher education at which policy decisions have been taken in order to establish a European Higher Education Area by 2010. The basic precepts of the Bologna Process date back to the Sorbonne Joint Declaration on Harmonization of the Architecture of the European Higher Education System, signed in May 1998.

The Sorbonne Declaration focuses on: a) Improving the international transparency of courses and the recognition of qualifications by means of gradual convergence towards a common framework of qualifications and cycles of study, b) Facilitating the mobility of students and teachers in the European area and their integration into the European labor market, c) Designing a common degree level system for undergraduates (bachelor’s degree) and graduates (master’s and doctoral degrees).

The Bologna Declaration on the European Higher Education Area was signed in June 1999 by 29 European countries. The Bologna Declaration became the primary document used by the signatory countries to establish the general framework for the modernization and reform of European higher education; the process of reform came to be called the Bologna Process. In the Bologna Declaration, ministers affirmed their intention to adopt a system of easily readable and comparable degrees, implement a system based essentially on two main cycles, establish a system of credits (such as ECTS), support the mobility of students, teachers and researchers, promote European cooperation in quality assurance and promote the European dimension in higher education (in terms of curricular development and inter-institutional cooperation).

In May 2001, the meeting in Prague was convened to assess the progress accomplished to date and identify the main priorities that should drive the Bologna Process in the years ahead. The Prague Communiqué emphasized three elements of the Bologna Process: a) Promotion of lifelong learning, b) Involvement of higher education institutions and students, and c) Enhancement of the attractiveness of the European Higher Education Area [5].

Held in September 2003, the Berlin Conference was an important stage in the follow up to the Bologna Process. With the Berlin Communiqué, the Bologna Process gained additional momentum by setting certain priorities for the next two years such as the development of quality assurance at institutional, national and European levels, starting the implementation of the two-cycle system, recognition of degrees and periods of studies, including the provision of the Diploma Supplement automatically and free of charge for all graduates, elaboration of an overarching framework of qualifications for the European Higher Education Area, inclusion of the doctoral level as the third cycle in the Process, and promotion of closer links between the European Higher Education Area and the European Research Area [6].

In the Bergen Communiqué (May, 2005) , ministers enlarged their priorities for 2007, which additionally include the reinforcement of the social dimension and removing obstacles to mobility, the implementation of the standards and guidelines for quality assurance as proposed in the European Association for Quality Assurance (ENQA) report, the developing national frameworks of qualifications in compatibility with the adopted Framework of Qualifications for the European Higher Education Area, awards and recognition of joint degrees and creation of opportunities for flexible learning paths in higher education, including procedures for recognition of prior learning [7].

The London Ministerial meeting, held on May 2007, provided a landmark in establishing the first legal body to be created through the Bologna process – the European Quality Assurance Register (EQAR). This is to become a register of quality assurance agencies that comply with the European Standards [8].

In next two years, a seminar was organized in Ghent (Belgium) on 19-20 May 2008 titled "Bologna 2020: Unlocking Europe's potential - Contributing to a better world". An extra meeting held in Sarajevo (Bosnia and Herzegovina) in June 2008 was devoted to the topic. This formed the basis for a report on "Bologna Beyond 2010", which was gradually drafted, involving all countries and organizations participating in the Bologna Process, and submitted to the Leuven/Louvain-la-Neuve Ministerial Conference which was held on April 2009 [9]. Participants emphasized the key role that higher education plays in the development of EU societies based on lifelong learning for all and equitable access at all levels of society to learning opportunities. They underlined the importance of public investment in higher education, and urge that this should remain a priority despite the economic crisis, in order to support sustainable economic recovery and development. They declared their support to the strategic role of higher education in the pursuit and advancement of knowledge and therefore advocated global sharing of knowledge through multi-national research and education projects and exchange programs for students and staff, in order to stimulate innovation and creativity. They declared convinced that fair recognition of studies and qualifications is a key element for promoting mobility and expressed their support on transnational exchanges for a better understanding and long-term collaboration.

In 2010, the Budapest-Vienna Declaration on the European Higher Education Area welcomes the interest in other parts of the world and look forward to intensifying the policy dialogue and cooperation with partners across the world and notes that adjustments and further work, involving staff and students, are necessary at European, national, and especially institutional levels to achieve the EHEA. Participating ministers promise to step up their efforts to accomplish the reforms already underway to enable students and staff to be mobile, to improve teaching and learning in higher education institutions, to enhance graduate employability, and to provide quality higher education for all. At national level, they recommit to academic freedom as well as autonomy and accountability of higher education institutions as principles of the EHEA and underline the role the higher education institutions play in fostering peaceful democratic societies and strengthening social cohesion. They acknowledge the key role of the academic community in making the European Higher Education Area a reality. They reaffirm that higher education is a public responsibility and they point out that they have to increase their efforts on the social dimension in order to provide equal opportunities to quality education, paying particular attention to underrepresented groups [10].

Last ministerial meeting was held in Bucharest on April 2012. Having outlined the main EHEA goals which were to provide quality higher education for all, to enhance graduates' employability and to strengthen mobility as a means for better learning, the Ministers set out the following main priorities for action by 2015: a) strengthening of policies of widening overall access, including that of underrepresented groups, and raising completion rates, b) establish conditions that foster student-centered learning, innovative teaching methods and a supportive and inspiring working and learning environment, while continuing to involve students and staff in governance structures at all levels, c) allow EQAR-registered quality assurance agencies to perform their activities across the EHEA, while complying with national requirements, d) work to enhance employability, lifelong learning, problem-solving and entrepreneurial skills through improved cooperation with employers, especially in the development of educational programmes, e) ensure that qualifications frameworks, ECTS and Diploma Supplement implementation is based on learning outcomes, f) implement the recommendations of the strategy "Mobility for better learning" and work towards full portability of national grants and loans across the EHEA, and finally g) encourage knowledge-based alliances in the EHEA, focusing on research and technology [11].

The next EHEA Ministerial Conference will take place in Yerevan, Armenia, in 2015.

3. Where is European Higher Education currently?

A noticeable number of changes have occurred in higher education the recent years though it is often remarked that Universities are resistant to change. Universities are no more obligatorily embedded to a specific geographical location, a lot of globally interconnected institutions exist as a result of technology advances. Mobility of international students, supported by joint partnership curricula and international branch campuses, brings economic benefits to both sending and receiving countries.

Although more and more countries aspire to economic benefits from their educational system, the cultural expectations of the role and function of education in society are distinctive across countries. National priorities and old established traditions determine the activities of universities and frame their ability to respond to changes [12]. As a consequence, higher education systems in most countries are still far from having reached the stated goal of European policy declarations, permitting to students from the upper income quartiles to be still much more likely to graduate from higher education than those from the lowest income social groups [13], despite the 2007 Council Resolution request to member states to establish incentives so that higher education institutions accept more non-traditional learners and improve the learning environment [14]. At the same time, studies show that the participation rates of different social strata have changed as the expansion of higher education participation increases the likelihood for participation of all social groups even when differences between social strata persist.

According to Vassiliou [15], Commissioner responsible for Education, Culture, Multilingualism and Youth, the social dimension of higher education demands commission's urgent attention and this implies widening access to higher education to as many European citizens as possible. The social dimension had been mentioned in all ministerial communiqués since 2001, yet it was only in London 2007 that the concept was comprehensively defined, as the goal that: "the student body entering, participating in and completing higher education at all levels should reflect the diversity of our populations" [and emphasizes the] "importance of students being able to complete their studies without obstacles related to their social and economic background" [8]. Continuing her analysis, Vassiliou [15] argues that flexibility to move from one higher education institution to another, admission and selection criteria and completion rate are indispensable aspects for achieving the goals of social dimension policy and these measures must be underpinned with adequate funding.

Availability of adequate funding and graduates' job prospects are crucial aspects nowadays as Europe is undergoing an economic and financial crisis with damaging societal effects. Public funding of higher education institutions is the main financial source for most HEI in Europe. Because of economic crisis, the funding gap between what is required and what is actually provided increases continuously while the prevailing attitude is to get reduced state funds while increasing the required tuition and private contributions.

In Europe, universities have historically played an important role in building the notions of nation and state. As a result, research and education has turned out to be politically sensitive, making it difficult even today to achieve institutionalized European-level cooperation and integration in these policy areas [16]. However, although recently all Bologna process key players emphasize the need for a common European perspective on universities and a considerable number of decisions on university governance has been decided in last ministerial meetings, still the debate on "what kind of University for what kind of society" is always timely. Simultaneously, the accountability of the University to society requires an external system of quality assurance and accreditation, and a transition from state control to external controls through increased competition, externally defined standards and goals, demands for results that can be documented in numbers, and external monitoring units [16]. Quality assurance in higher education is nowadays a big concern all over the world. For Europe, to achieve its aspiration to be among the most dynamic and knowledge-based economy in the world (Lisbon Strategy), the EHEA needs to prove that the quality of its educational programs and innovation achievements seriously assure and demonstrate a high quality. The fulfillment of a truly European dimension to quality assurance will reinforce the attractiveness of the EHEA's higher education offering and the achievement of this challenge has been assigned to the European Association for Quality Assurance Agencies in Higher Education (ENQA).

Today's situation is promising but there are still many things to be done to accomplish the challenges put at Bucharest Communiqué in 2012 focusing mainly on social dimension of higher education. Empirical studies of access to and participation in higher education illustrate that higher education systems in most countries are still far from having reached the stated goal of European policy declarations. The extensive report included in [15] provides a reliable empirical basis for the comparative analysis of data on the social dimension of higher

education today. Overall, the report suggests that countries have struggled to keep pace with the scale of change experienced over recent years in their higher education systems. The social dimension has not generally become a significant driver for higher education policy, but numerous special measures are in place in most countries to address the under-representation of particular groups. Political declarations do not always seem to be met with coherent measures and funds to realize them or monitoring mechanisms to evaluate their impact. Lifelong learning is becoming a necessity to enable the workforce to be competitive in a global market but still maintaining traditional approaches to admission, recognition and completion appears to be a high risk strategy. In the same study, it is pointed out that while to some extent the relative prosperity prior to 2008 can be seen as a time of missed opportunity to invest in a higher education sector that will be key to future social and economic development, failure now to invest sufficiently and effectively in higher education could prove to be a major hindrance to societal recovery and success. As a consequence, there is an urgent need to address social dimension issues more forcefully and coherently both at EU and national level.
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4. Concluding Discussion

Until recently, the benefits of education were considered to be mainly offered to the students and the society. Now, education is valued as a driver for economic growth: for producing an educated workforce, attracting new businesses to a region, and generating innovations in science and technology that resonate throughout society. The Bologna Process took an approach based on addressing the practical problems inherent in coordinating multiple systems of higher education: developing common tools and education structures to increase cross-border understanding, facilitating cross-border mobility of students and faculty, improving the quality and attractiveness of a coherent European higher education area, and improving Europe’s ability to strategically compete and cooperate with other countries and regions.

The tendency in EHEA is towards a “massification” of studies, pressing HE institutions to accommodate more students which in turn brings with it a cultural shift as underrepresented groups are now encouraged to participate to tertiary education. This shift dictates upon institution to help their students to be more successful, identifying in parallel procedures and restrictions which put obstacles in the smooth carrying-out of studies and work to eliminate them. New ways of learning must be offered to the students, based on information technology for distant learning.

In this changing situation, institutions have to improve their existing organizational capacity without additional funds as governments’ support for them declines due to the economical crisis. Key challenges to be met in order to get there are: Autonomy and accountability, focus on attainment, internationalization, changing faculties’ role, use of alternate academic roles, involvement of all the major actors in the region (from policy makers to the private sector) in higher educations’ agendas and finally enhancing capacity for change and innovation. Challenge for changes is experienced differently in different countries and different institutions. Other are almost there and few additional funds and efforts are needed and other have a long path in front of them to cover. It is important to recognize that for both categories the pressure will be high and the outcome will be a dramatic change in their current state.

“Europe of knowledge”, as envisioned by the European Commission in the framework of Knowledge Triangle, is taking shape through the years but more time is still needed for completely changing university practices and structures developed over long historical periods, as well as conceptions of their proper role in the economy and society.

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Tailor – made Education for Entrepreneurs – Can Serbia be Like Silicon Valley?

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Abstract

Entrepreneurs are often regarded as a driving force behind the current world economy, and quite a lot of attention is given to the education of future and current entrepreneurs. However, the education in entrepreneurship is not always "hitting the spot". The changes in the business world are happening fast and educational institutions tend to stay unaware of changes, not adjusting their courses to the current needs of the market. This can be seen on the education of current entrepreneurs, or entrepreneurs that already have some experience. While leading the company most of them encountered some specific problems, or have specific needs that university entrepreneurship programs tend to overlook since they don't appear so often. That is when tailor – made education for entrepreneurs start to make sense. In this paper, the authors will present development and functioning of tailor – made education for entrepreneurs provided by University of California at Berkeley and Stanford University, and the possibility of application of this model in the Republic of Serbia.

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Keywords: Entrepreneurship ; Education ; High – Tech companies

1. Introduction

Change is the only certain thing in today's business world. The driving force behind the changes in the business filed are people with the entrepreneurship skills, but also entrepreneurs and small and medium companies (SMEs) are the ones that are affected the most by the changes. According to Onetti, new technology-based firms are likely to be impacted by globalization, in terms of both pace of innovation and pressure of competition. [1] Most of the hi-tech conglomerates existing nowadays were started by entrepreneurs with an idea and not a lot more. The thing that those companies had in common at the start was the fact that they were started and managed by people with no formal entrepreneur education, they tried to provide a non-existing product on the market and that most of them were based in Palo Alto county, also known as the Silicon Valley.

Currently, most of the universities in the world are providing entrepreneurship programs at undergraduate or graduate level. Those programs should not just educate students in processes that make up the

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entrepreneurship, but also to direct them into being entrepreneurs. However, currently most of entrepreneurs and owners of SMEs (small and medium enterprises) are people with academical background quite different from business or entrepreneurship as an academic discipline, and most of them are coming from engineering field. One of the problems of the entrepreneurial education is that it actually has an opposite effect that it is supposed to have. According to Oosterbeek et al, the effect on students' self-assessed entrepreneurial skills is insignificant and the effect on the intention to become an entrepreneur is even negative. [2] One of the reasons behind those effects could be lack of adjustment of curriculum of entrepreneurship studies to certain circumstances that entrepreneurs could encounter and taking more generic approach

Taking into account that current approach to entrepreneurship as an academical discipline has an opposite effect and that most of the entrepreneurs are from the different academic fields, with little entrepreneurial skills, and operating in the ever-changing business world, a lot of entrepreneurs are facing the problems of different nature, some with greater and some with lesser success. The common thing for all good entrepreneurs is that they recognize the areas of business in which they have little formal knowledge, and they want to upgrade their knowledge needed to successfully run the SME. Universities, along with the business incubators, should be the right places for entrepreneurs to address in those situations. In co-ordinance with the concept of life-long learning, the universities could provide tailor-made education to existing entrepreneurs, focusing on specific needs of single entrepreneur. The authors will show, on the examples of universities of Stanford and California, Berkeley, how tailor-made education is functioning in the Silicon Valley. Furthermore, the authors will outline the possibilities of tailor-made education in the Republic of Serbia.

2. The case of Stanford University

Stanford University was founded by the former United States Governor of the State of California and the United Senator at the time, Leland Stanford, a wealthy railroad tycoon, in 1891. Only in the 1950's, with Frederic Terman as a provost, Stanford University gained the fame as a leading institution in entrepreneurship, especially in the field of electrical engineering and, later, computer sciences. One of the first high-tech companies established in what today is known as a Silicon Valley was Hewlett-Packard in 1939, with both founders being the students of Frederic Terman and alumni of Stanford.

After Second World War, during Terman era, Stanford University took hi-tech SMEs as a main stakeholder in the creation of its study programs. According to Eesley and Miller, Stanford has for many years provided education specifically designed to encourage and develop entrepreneurs. The university began offering classes in small business and entrepreneurship as enrollment mushroomed after the Second World War. [3] In the 1950's, Hewlett-Packard, together with the Stanford University, made tailor-made program for their employees focusing on innovation management and business, making it the first tailor-made program on Stanford University.

According to Eesley and Miller, around 39,900 companies can trace its origins to Stanford. Jointly, they could make 10th world's largest economy that generates 2,7 trillion dollars annually. Among those companies are Google, Yahoo!, Cisco, Netflix, Tesla, Nike and Gap. [3]

Number of factors put Stanford University on top of hi-tech entrepreneurship programs. Firstly, entrepreneurship is a part of not just School of Business, but also of School of Engineering, since most of entrepreneurs are coming from this field. Kenney and Goe [4] research concluded that Stanford University graduates form School of Electrical Engineering and Computer Sciences are more likely to become hi-tech entrepreneurs. Lecturers on entrepreneurship are usually coming from an alumni network and are entrepreneurs themselves, which provides insight of the current trends and gives the opportunity to influence the curriculum of the program. Enrolled students have the opportunity to choose their own mix of subjects, since most of classes on one school is available to students from the whole university. The courses themselves are often done together with certain company, such as Apple's iPhone Application Development course or Creating a Startup course which is done with the Stanford staff, Silicon Valley entrepreneurs and local venture capital companies. The success of the start-ups was also tracked trough the Stanford Project on Emerging Companies ("SPEC") – which has tracked a large sample of high-technology start-ups in California's Silicon Valley. The project has examined how the founders of those enterprises approached key organizational and HR challenges in the early days of building their companies, and with what effects on the evolution and performance of their ventures [5]. These researches were beneficiary to both sides. Companies had an expert overview of their current problems and thus could find a solution, while University had a starting point for a reformation of their curriculum.

Stanford University works closely with several business incubators. The only incubator that is a part of Stanford University is StartX. StartX is a community of the best startup founders out of Stanford designed, built and run by other founders. StartX provides structured access to the information, resources and networks that propel a startup founder forward. [6] StartX was founded by Stanford alumni-turned-entrepreneurs, professors and students of the University. It is a non-profit organization with aim of helping current Stanford students and freshly graduated students set up their small business, develop their idea and entrepreneurship skills and help them find adequate funding. Each founding company is given a mentor, which is usually entrepreneur or head of venture capital company, whose task is to provide consulting for founders around the clock for the duration of the program, which is three months. The founders who are chosen to be part of StartX do not pay services nor StartX takes equity in new business.

3. The case of University of California at Berkeley

The roots of the University of California go back to the mid-19th century, when hundreds of thousands of fortune seekers came west in the gold rush, California became a state, and farsighted drafters of the 1849. State Constitution dreamed of creating a university that would contribute even more than California's gold to the glory and happiness of advancing generations.

The seat of learning they envisioned was born nearly two decades later, in 1868, through a merger of two fledgling institutions — the private College of California, in Oakland, and a new state land-grant institution, the Agricultural, Mining, and Mechanical Arts College. [7]

The history of Haas Business School of University of California can be traced back to 19th century and the College of Commerce which was one of the first schools in United States of America to offer in its curriculum such subjects as accounting and marketing. However, it was only after 1980. that University of California at Berkeley started providing some form of innovation management program, jointly with School of Engineering. With opening of Lester Center for Entrepreneurship as a part Institute for Business Innovation, entrepreneurship gained more support on University of California. Most of the affiliates of the Lester Center have previously been entrepreneurs. There are classes such as the Lean LaunchPad, aimed at those students who already have a business plan and developed product, but are in search of customers.

Beside classical education, Haas Business School offers a year-long entrepreneurship course aimed at high-school students called The Center for Young Entrepreneurs at Haas (YEAH), aimed at students of final years in high-school who want to learn basic skills needed to work as an entrepreneur.

UC Berkeley works closely with a number of business incubators in the Bay Area, as well as having founded companies as a part of different institutes. However, only SkyDeck is a part of Haas Business School. Contrary to Stanford's StartX, SkyDeck is managed by professionals. Its aim is to accelerate growth of start-ups, provide mentorship and expand network of connected start-ups, all for free. SkyDeck is a visionary business accelerator, created as a joint venture between UC Berkeley's College of Engineering, Haas School of Business, and the Vice Chancellor of Research Office. Together, the leadership of these three UC Berkeley organizations has launched a unique startup accelerator model, which provides startups with the tools necessary for growing their businesses. Amongst the first of its kind, SkyDeck combines the consulting know-how of traditional accelerators with the vast resources of the research university. This unique partnership, coupled with the five stage SkyDeck program, gives startups the opportunity to not only grow their businesses, but also to launch and compete with industry leaders. [8] Most of mentors at SkyDeck are venture capitalists, business angels and entrepreneurs, with help from professors. Similar to StartX, start-ups are being part of SkyDeck for three months, and at that time it is not required to pay nor SkyDeck takes equity in start-ups. One of main differences between SkyDeck and StartX is that at StartX each founder has a dedicated mentor, while at SkyDeck it is allowed to use all metors available for consultations.

4. How to catch up with the best?

In two presented cases of top-education institutions, one can see that both Stanford University and University of California have some similarities when it comes to entrepreneurship education and hi-tech start-ups development. We could divide key factors in two fields, academical and start-up incubator support. Acadmical key factors are: interdisciplinary courses, freedom for students to choose subjects and create own course (especially in further education), professors with strong practical background and considering industry as a main stakeholder when discussing curriculum. Key factors for successful incubator support for start-ups are: mentoring program for each start-up (either through dedicated mentor or through mentorship network), mentors from different background (entrepreneurs, venture capitalists, professors), access to venture capital, and wide network of different stat-ups founders.

The Republic of Serbia had put emphasis on IT industry through different incentives. IT business incubator has been opened in Novi Sad, city that can be considered as a Serbian Silicon Valley. Currently, from academical perspective, the biggest obstacles that need to be passed are freedom to choose subjects freely and for academic institutions to take further employers of their graduates as a serious stakeholder. Both of obstacles could be removed with the right legislation.

Bigger problem is that Stanford and University of California at Berkeley have their own incubators and, more important, through them have a connection to a large number of venture capitalists, which in Serbia are almost non-existent, with government being the only institution ready to support start-ups. When that is changed, Serbia has the potential to become second Silicon Valley.

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Knowledge Triangle as an Important Ingredient of EU Modernisation Agenda and Regional Strategy for Smart Growth

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Abstract

The Europe 2020 strategy highlights the key role of innovation in contributing to smart, sustainable and inclusive growth. Regions are important sites for innovation because of the opportunities they provide for interaction between businesses, public authorities and civil societies. We take here some important excerpts from the EU Modernisation Agenda and SEE2020 Strategy. Most of the selected parts can be immediately applied to the Serbian case while some were rewritten to correspond better to the Serbian environment.

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Keywords: knowledge triangle, EU modernisation agenda, SEE 2020 strategy

1. Introduction: Key elements of the knowledge triangle (extracts form [1])

The knowledge triangle refers to the interaction between research, education and innovation, which are key drivers of a knowledge-based society. In the European Union, it also refers to an attempt to better link together these key concepts, with research and innovation already highlighted by the development of the Lisbon Strategy and, more recently, lies behind the creation of the European Institute of Technology (EIT) (Wikipedia).

Research and experimental development (R&D) are formally defined as "... creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications." (OECD, 2002, [6]) The general feeling, however, is that this definition is very narrow and of little relevance to the inventive activities of most small firms or many parts of the service sector, as well as failing to capture all the creative investments of large organisations.

The United States Patent Office states that an invention includes "... any art or process (way of doing or making things), machine, manufacture, design, or composition of matter, or any new and useful improvement thereof". European patents are granted for "... inventions that are new, involve an inventive step, and are susceptible of industrial application." The EC (2005, [7]) define innovation as "Technological product and process innovations comprise implemented technologically new products and processes and significant technological improvements in products and processes." CRIC (2005, [8]) defines innovation as "…the successful exploitation of new ideas. That is, the development and commercial exploitation of a new idea for a product or process that contributes to wealth creation and profitability."

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2. Delivering on the modernisation agenda for universities: Education, research and innovation, (excerpts from [2])

2.1. Challenges ahead

Research, education and innovation are three central and strongly interdependent drivers of the knowledge-based society. Together they are referred to as the “knowledge triangle”. To realise ERA, research needs to develop strong links with education and innovation. The close interaction between research and training activities in universities is what gives them their unique and crucial role in the knowledge society. This is why it is so important to have modern, excellent universities.

In Serbia, there is still a need to improve management and organisation of universities and to give them more autonomy and accountability. This will allow universities to develop their own strategies, to themselves at European and international levels and to better link their activities with the needs of society and industry. In some cases, some concentration and specialisation will be necessary to create centres of excellence competitive on the global scale. The mobility of graduate students and researchers is of course the necessary complement of such evolution.

Serbian universities have potential, but this potential is not fully harnessed and put to work effectively to underpin drive for more growth and more jobs. As a result, they are behind in the increased international competition for talented academics and students, and miss out on fast changing research agendas and on generating the critical mass, excellence and flexibility necessary to succeed. These failures are compounded by an insufficient funding.

2.2. Incentives for structured university partnerships with the business community

Structured partnerships with the business community (including SMEs) bring opportunities for universities to improve the sharing of research results, intellectual property rights, patents and licences (for example through on-campus start-ups or the creation of science parks). They can also increase the relevance of education and training programmes through placements of students and researchers in business, and can improve the career prospects of researchers at all stages of their career by adding entrepreneurial skills to scientific expertise. Links with business can bring additional funding, for example to expand research capacity or to provide retraining courses, and will enhance the impact of university-based research on SMEs and regional innovation.

To secure these benefits, most universities will need external support to make the necessary organisational changes and build up entrepreneurial attitudes and management skills. This can be achieved by creating local technology transfer offices serving as an interface with local/regional economic operators. This also implies that development of entrepreneurial, management and innovation skills should become an integral part of graduate education, research training and lifelong learning strategies for university staff.

While the public mission and overall social and cultural remit of Serbian universities must be preserved, they should increasingly become significant players in the economy, able to respond better and faster to the demands of the market and to develop partnerships which harness scientific and technological knowledge. This implies recognising that their relationship with the business community is of strategic importance and forms part of their commitment to serving the public interest.

2.3. Provide the right mix of skills and competencies for the labour market

In order to overcome persistent mismatches between graduate qualifications and the needs of the labour market, university programmes should be structured to enhance directly the employability of graduates and to offer broad support to the workforce more generally.

Universities should offer innovative curricula, teaching methods and training/retraining programmes which include broader employment-related skills along with the more discipline specific skills. Credit-bearing internships in industry should be integrated into curricula. This applies to all levels of education, i.e. short cycle, Bachelor, Master and Doctorate programmes. It also entails offering non-degree courses for adults, e.g. retraining and bridging courses for students not coming through the traditional routes. This should extend beyond the needs of the labour market to the stimulation of an entrepreneurial mindset amongst students and researchers.

In summary, while the integration of graduates in the labour market is a responsibility shared with employers, professional bodies and governments, labour market success should be used as one indicator (among others) of the quality of university performance, and acknowledged and rewarded in regulatory, funding and evaluation systems.

3. Smart Specialisation Platform and South East Europe 2020 Vision (excerpts from [3,4])

The Europe 2020 strategy highlights the key role of innovation in contributing to smart, sustainable and inclusive growth. Regions are important sites for innovation because of the opportunities they provide for interaction between businesses, public authorities and civil societies.

3.1. The mechanisms by which universities contribute to regional development

There are a range of ways in which universities can and do contribute to regional development and smart specialisation. However within each of these roles there are a range of mechanisms which can be employed, either as individual projects or collectively as part of a wider programme or strategy to support a regional development agenda.

In reviewing these mechanisms it is important to make a distinction between the regional impact of‘normal’ university activity financed as part of the core business of teaching and research and purposive regional interventions initially funded from a source outside higher education and then hopefully ‘mainstreamed’. Individual mechanisms can vary in their complexity. At one end of the spectrum are fairly straightforward ‘transactional’ services in response to a stated need or demand; at the other end of the spectrum are more developmental or ‘transformational’ activities which recognise latent or unstated needs.

3.2. South East Europe 2020 Vision (excerpts from [3,4])

Following the adoption of the SEE 2020 and the endorsement of high-level regional headline targets for growth by the SEE region’s Ministers of Economy, the Regional Cooperation Council (RCC) and its partners initiate the development of a regional SEE 2020 strategy, as the main regional framework for growth. The strategy is based on five pillars:

(i) Integrated growth - through deeper regional trade and investment linkages and policies that are non-discriminatory, transparent and predictable and enhance the flow of goods, investment, services and persons within the region.,

(ii) Smart growth - through a commitment to innovate and compete on value-added rather than labour costs in the long run

(iii) Sustainable growth - through raising the level of private sector competitiveness, entrepreneurship and a commitment to greener and more energy-efficient development.

(v) Inclusive growth - through skills development, employment creation and labor market participation by all, including vulnerable groups and minorities., and

(vi) Governance for growth - through improving the capacity of public administrations to strengthen the rule of law and reduce corruption so as to create a business-friendly environment for growth.

Although the development of a regional SEE 2020 strategy was largely inspired by Europe 2020, it was evident that the regional strategy is going to differ considerably from the EU framework in two main aspects:

1. Focus: from the regional point of view, the three pillars of Europe 2020 strategy (smart, sustainable and inclusive growth) although relevant, required considerable customization to fit with the regional context. The main alterations were envisioned along two main axes: a different emphasis within the three pillars (along with realistic and credible targets), and the need for a fourth and fifth pillar - integrated growth and governance for growth - relating to the deepening of the regional common market within a good governance framework.

2. Governance: To be able to successfully engage with SEE 2020, the region would need to develop its own version of the governance mechanisms and processes that exist in similar EU-level initiatives. Employing such mechanisms (e.g. open method of coordination), implies determining common policy goals and reform targets that are both regionally relevant and consistent with Europe 2020 priority areas. Non-binding guidelines were to be developed to help shape the transposition in national policies, and specific benchmarks and indicators were to be agreed upon to help measure progress. Finally, RCC would embark on regular monitoring and evaluation of the results achieved. Similar to other areas of regional cooperation, no enforcement mechanisms could exist or be needed, given that the entire process would serve to continuously support policy makers in comparing developments in the region and exchanging best practice.

The process of associating various stakeholders with the pillars of SEE 2020 and the strategy implementation requires a de-centralized approach in strategy development. Bringing together the relevant contributors within each of the pillars is the first step envisioned in the strategy development process.

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Appendix A. SEE 2020 Strategy - Matrix Overview

Overall targets:
i. Increase regional GDP PPP per capita from 38% to 46% of the EU-27 average
ii. Grow the region's total value of trade in goods and services by more than 130%
iii. Reduce the region's trade deficit from 14.1 to 11.6 per cent of regional GDP

Coordination Mechanism for the Implementation of SEE 2020:

Pillars	Integrated growth			Smart growth			
Pillar targets	iv. Increase intra-regional trade in goods by more than 230% v. Increase overall FDI inflows to the region by at least 120%			vi. Increase GDP per person employed by 33%; vii. Add 300,000 highly educated people to the region's workforce			
Pillar Dimensions	**Free Trade Area**	**Competitive Economic Environment**	**Integration into Global Economy**	**Education/ Competences**	**R&D and Innovation**	**Digital Society**	**Culture & Creative Sectors**
Dimension co-ordinator	CEFTA/SEEIC	CEFTA	CEFTA/SEEIC	ERI SEE	Regional Research Platform	e-SEE	RCC TFCS
Other regional platforms involved in the dimension	SEEIC	SEEIC SEETO	CEFTA	Novi Sad Initiative SEECEL	Steering Platform on Research for the WB WBIF/EDIF SEEIC SEETO	CeGD	CoMoCoSEE
External partners	OECD, EC	OECD, IFC, EC	OECD, IFC, EC	ETF, EC (DG EAC)	World Bank, EC (DG R&I)	UNDP, ITU, EC (DG Connect)	CoE, ICOM, EC
Monitoring system	RCC/OECD			RCC/OECD			
National administration participants	Ministry in charge of trade; other related institutions	Ministry in charge of trade; other related institutions	Ministry of economy; IPAs	Ministry of education; Employment bureaus and other related	Ministry of Science; Ministry of Economy	Ministry of Information Society	Ministry of Culture; Ministry of Economy;

Pillars	**Sustainable growth**		**Inclusive growth**			**Governance for growth**	
Pillar targets	viii. Increase the rate of enterprise creation by 20% ix. Increase exports of goods&services per capita from the region by 130%		x. Increase the overall employment from 40.2% to 45.2%			xi. Increase government effectiveness by 20% by 2020	
Pillar Dimensions	**Competitive-ness**	**Resource Efficiency**	**Employment**	**Skills and Inclusive Education**	**Health**	**Effective public services**	**Anti-Corruption**
Dimension co-ordinator	SEEIC	REC	WG on Social Agenda 2020	SEECEL	SEEHN	RESPA, NALAS	RAI
Other regional platforms involved in the dimension	ECS SEETO CEFTA SEECEL	ECS SEETO RENA/ECRAN NALAS ISIS ISRB Comm. RRD SWG	CPESSC SEETUF AREC	ERI SEE CDRSEE		CeGD	
External partners	OECD; EC (DG Enterprise)	IFIs (EIB, EBRD, WB, KfW); WBIF; EC (DG Environment, DG Clima), GIZ	World Bank; LSEE; EC (DG Employment)	ETF, EC	WHO, EC	WBI, SIGMA, GIZ, SIDA, EC	OECD, GIZ, SIDA, EC
Monitoring system	RCC/OECD	RCC/ECS	RCC/OECD			RCC/OECD	RCC/OECD
National administration participants	Ministry of Economy	Ministry of Energy; Ministry of Environment	Ministry/ies in charge of Employment and Social Affairs	Ministry of Education; Ministry of Employment and Social Affairs	Ministry of Health	Ministries and agencies in charge of PAR, Judicial Authorities	Ministries of justice, interior, police

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Applying Marketing in Serbian Institutions of Higher Education

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Abstract

Due to the unique characteristics of services, higher education institutions face special challenges. To overcome them, and to be more market-oriented institutions must better know their environment and market in which they operate. Reduced government's investment (public sector) in education and increasing number of private institutions of higher education however, increase number of students and competitors. The negative demographic and economic trends in Serbia emphasized the necessity of marketing applications, the choice of adequate marketing philosophy and systematic approach to problem solving. Higher education institutions, if they want to achieve competitiveness, must work within the marketing concept, which consists of: establishing a market position, identify the competition, research and learning needs and motives of different market segments and developing marketing strategies.

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Keywords: marketing, higher education institutions, service, consumer, Serbia.

Introduction

All the characteristics of services and their differences relative to the product, also apply to educational services considering that education has its additional specifics relative to other kinds of services. Due to unique characteristics of services, institutions of high education are facing special challenges. To overcome them and be more market oriented, institutions must know better the environment and market on which they operate. Lessened investments of the state (in public sector) in education or independent financing (in private sector), emphasize the inevitability of application of marketing, choice of adequate marketing philosophy and of systematic approach to solving problems. The most important marketing issue for educational institutions is to become truly marketing oriented. This involves fostering a greater degree of collaboration between internal departments, monitoring competitors and developing a focus on a wide range of institutional publics [1]. As higher education institutions have a wide range of publics, institutions must understand how and when decisions are taken by students, parents and other public works, if they want to market effectively. This study is therefore undertaken to assist higher education institutions in understanding their market better as well as to employ marketing action more effectively.

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Education is an activity of common social interest and is, as such, subject to public opinion. Goals of processes like education are multiple and to create and shape the strategy that would satisfy all these goals is extremely hard. Financial indicators do not determine the process of exchange between the providers and consumers of educational services, and especially in public institutions, most often. In their name, such decisions are being delivered on other levels of decision-making. Exchange between higher school institutions as providers of services and their consumers usually occur through marketing communication. Such exchange is often performed without awareness of the role that marketing has in this transaction. Educational services are just like other services, intangible. Therefore, students and their parents often draw conclusions on the quality of a high education institution or on the quality of a teaching process, based on physical evidence: tidiness of the building, how well equipped are the institution and its rooms, libraries, workshops and similar.

Services performers have to offer their “abstract” service with physical evidence and to convert intangible into tangible service [2]. Service cannot be stored. Lectures, drill sessions, library, student service, are not something that can be stored for future and then taken and used according to need. Service cannot be anybody's property. Because of human factor involvement, services are subject to heterogeneity. Namely, school class and its quality depend on the lecturer that holds it, on the intensity of established interaction with students and other human factors in the given surrounding. Therefore, the same lecturer can very hardly hold two identical classes.

Considering all the challenges that high education institutions are facing, it is evident that they will have to become market oriented in a higher degree. According to Rindfleisch, this forces higher education institutions to increasingly focus on marketing techniques used by profit organizations [3]. According to Paulsen [4], higher education institutions, in order to remain competitive, will have to use a marketing framework consisting of the following: (1) establish its image or market position; (2) identify competition; (3) determine the needs of the various market segments; and (4) develop a marketing plan for promoting their educational services. One of the key issues to the successful development of a marketing strategy is to determine which factor students consider when they have to make a decision on which institution to attend.

1. Importance of applying marketing in higher education

The business-philosophical component of marketing refers us on special way of creation, entrepreneurship and realization of business activities, so then on specificity of mental and operational access to whole organization of life [5]. Active approach signifies such a form of mental and operative approach, which needs to provide efficient adaptation to the surrounding. The essential characteristic of the active approach is to provide that the process of adaptation is performed not subsequently but beforehand. Business philosophy of marketing directs us also to an integral approach of all participants in the process, and not only of individuals and certain groups. It also directs to the general social importance of marketing, which is not used only in material production but we might say, in the whole system of life. Therefore, we consider statements of many authors who point that marketing is more than a business technique, more than economic and social function to be correct, because the way of thinking about marketing reflects on the way of thinking of life.

Only some of the reasons for the need of involvement of marketing in high education are:

- survival in the conditions of very apparent competition on the market of educational services,
- influence of globalization where internationalization of services becomes more and more its key element,
- fast changes in the surrounding that demand responsibility for the needs and wishes of consumers, and
- the whole society, greater and greater demands for the quality of educational services.

When we speak about high education in Serbia, we can add to these reasons transitional and reform trends and efforts to include high education into contemporary European flows, economic-social situation, as well as many projects, which are given by government and non-government organizations as help to the development of high education etc.

Miller, Erickson and Redman quote main reasons for introduction and application of marketing in institutions of higher education [6]:

- demographic trends,
- higher responsibility of educational institution in society, and
- increase number of institutions.

Barnes quotes some other reasons [7]:

- better communication between providers and consumers of educational service,
- creating positive institutional image,
- improvement of educational possibilities with aim to derive additional funds, and
- better organizational efficiency and success of integration key issues of management.

Researches of consumer’s needs of educational services are meager. Higher education institutions offer what they can produce. They approach the market from their position as the centre of ideas and the starting point for the definition of consumers' needs, considering that the „producer knows best”. According to this, Foskett aims that if even marketing exists, it mostly appears through sales activities like secondary function that is designed to ensure delivery to consumers [8]. The changes that have been taking place, have effects on increased competition among higher education institutions, so some institutions are able to survive while some of them disappear from educational market or have big problems [9].

Number and kind of institutions of higher education have significantly increased in Serbia. In the past, there was almost no competition. There were only state institutions, which were evenly distributed regionally. In the recent past and today, besides state institutions, also private faculties have been and still are opened without any special concern for the condition and number of other institutions in the near and more remote surrounding. In such conditions, for many institutions the question of students' choice has become the key condition of survival. Marketing represents the way of fighting the competition and positioning institution of higher education with the purpose of becoming the students' first choice. Decreased number of students may mean also the decrease in financing sources and the amount of finances, and thus reduction in programs and number of employees.

In the last few decades, significant demographic and economic changes happened in Serbia's population. Demographic changes are reflected in decreased number of inhabitants, increased age of the population, decreased number of marriages, increased number of divorces, decreased number of children etc. Economic changes reflected in the change of the structure of economy in regard of kinds of works, increased unemployment, lowered standard of living etc. Marketing puts these two kinds of changes in mutual relation and draws certain conclusions on the question of choice of the target group which also represents one of its key tasks.

The task of high education is to satisfy expected future needs in the function of the development of the society, so it is often a mistake to think that high education aims to satisfy existing needs of consumers of educational services. Especially these needs emphasize the importance of the function of marketing in education, because marketing can play out a significant role in connecting long-term needs of the whole society and the satisfaction of consumers’ needs. First of all, it applies to quality research and presentation of the things that consumers do not want in short term, but will in long term influence their development and the development of the society guiding the needs of consumers in a socially acceptable way. In the end, this will fulfill the mission and goals of a institution.

2. Marketing Philosophy in Higher Education

As part of marketing activities, it is necessary to shape the marketing mix, in time, in good quality and competitively and constantly keep track of the market. The question of marketing in higher education is even more complex, because it is closely tied to the education system as a whole, on one side, and institution of higher education as a separate whole on the other side. Rindfleisch quotes that that the following is important for marketing in higher education [10]:

- Marketing is the process, not only the single action or event that is paid attention by several enthusiastic people. This process is not happening by itself and it is needful for higher education institutions, not only for increasing the number of students but also for accomplishing better quality. Successful educational marketing is about meeting the needs, wants, and expectations of an organization's various customers or stakeholders is an essential part of any marketing strategy. For higher education institutions, the need already exists. There is a need to provide consumers with the means to receive an education;
- Marketing in higher education institution means good knowing the environment of higher education institution in which it exists and good anticipation of changes that influence on the ambient of the. Marketing should be an ongoing undertaking that is incorporated into the daily actions and thinking of all institution's personnel. To do otherwise wastes resources, weakens future marketing efforts, and conveys the idea that the institutions responds to its stakeholders only when compelled to do so;
- Marketing in higher education is not only sales. To many people, marketing and selling are the same. They are, however, significantly different. Marketing activities are strategic, comprehensive, and indirect. Marketing includes multiple phases of activities such as forecasting, product development, position assessment, market research, branding, creation of communication materials, and public relations that enhance the institution's long-term relationship with its "customers" or audience. Sale is short-term, operational activity that is part of the marketing process;

According to these citations, Fosket adds that marketing should be present in whole higher education institution, not only in small group of enthusiastic people [11].

Marketing in institutions of higher education represents all those activities and means that are aimed at satisfying educational needs of their consumers. It is focused on students, their parents, and employees, economic organizations and state administration. Activities include development, implementation and maintenance of the concept of marketing and of the strategy of communication. Means include brochures, flyers, newspapers, internet site and the rest that is in the function of marketing activity. Nevertheless, marketing of high education is more than that; it is a way of thinking. Exactly that way of thinking, especially in the early stages of marketing, is the critical element of success. Way of thinking is critical, because in many institutions of higher education marketing efforts and marketing are underestimated. Many employees consider it unnecessary and just one heavier task. Marketing demands both money and effort, but benefits from successful marketing efforts are worth every kind of investment. One successful marketing program can successfully shorten the time that administration of the institution needs in its work with students, to make a selection of lecturers and other staff, to find alternative sources of financing and strengthen ties with local self-government where institution of higher education does its business.

To claim that marketing is unnecessary means that it is not suitable for high education. But, every time when there is work going on for the bettering of the teaching process and activities, advancement of physical attraction of the building and its surrounding or advancement of relations of employees between themselves or with students, it relates specifically to marketing, but maybe those things are not called the right name.

Successful marketing in high education relates to satisfying the needs, wishes and expectations of internal and external public, and in return, in the end, loyalty of existing students and employees is received as well as increased number of enlisted students. Determination of needs, wishes and expectations of consumers or targeted groups, represents one of the more important tasks of any marketing strategy. For higher education, need already exists. That is education. Institutions must find a way of efficient education of their students. The law also provides for that. Marketing strategy of an institution of higher education focuses on wishes and expectations of students, their parents, and employees of the institution, economic organizations and state institutions. In connection with this, marketing efforts of institutions of higher education should be focused on creation of educational organization in which students want to enlist, in which qualified personnel wants to work and for which, such as it is, there is support of the wider community.

3. Marketing Concept and its Role in Higher Education

Marketing has very important role in any organization, and it starts with the identification of target groups, then with research and establishment of needs and demands of these groups, with establishing what organization can do to satisfy these needs and demands, with the establishment of communication with consumers, existing and potential, and in the end, there is selling. Although basic marketing goal is to satisfy needs and demands of consumers, it encompasses a group of activities like innovation of product/service, design, development, distribution, advertising, sale and collecting information on how the products/services were received by the consumers, i.e., in what way were their needs satisfied. McCarthy and Perreault consider that marketing is process of planning, determining prices, promotion and distribution of ideas, goods and services in order to exchange that satisfies individual and corporative aims [12].

Successful marketing in higher education understands that institution identifies its target group, defines its needs and demands and communicates with them directly or interactively if it is possible. Marketing of higher education represents proactive management of relationships among institution and its different markets by using marketing instruments: product/service, price, place, promotion, process, people and physical evidence [13]. Most important task of marketing is to enable exchange between institution and its target groups for whom it is intended. Marketing should know in detail needs and demands of those groups and create ways that efficiently satisfy their needs and demands. Good and substantial knowledge of target group's needs can contribute to creation and keeping the competitive advantage. The higher education institution’s sustainable competitive advantages are usually based on superior knowledge, reputation, innovation and architectural related advantages [14].

Marketing today and some time ago is not the same. It changes with the changes in society. Kotler and Armstrong [15] identify four stages that strongly influence the evolution of organizations’ marketing activities. These stages are referred to as production, sales, marketing and societal marketing. Production orientation is aimed at internal capacities or possibilities of production or service process, and not at market. It relates to situations when basic goal of higher education institutions is to provide space, to develop study programs, to employ necessary number of professors and thus provide working conditions. As it has been already said, then, market is not in the focus, i.e., demands of potential consumers of educational services. In this way, institutions offer what they can consider its capabilities. Until 80-s of the last century in Serbia, such approach provided “positive business result” because overall situation in former Yugoslavia was such that highly educated personnel of almost all professions were needed, and there was also a high degree of financial security when survival of higher education institutions was in question.

Orientation towards sales comes from belief that people would buy more or use more services if aggressive forms and sales techniques were applied. About this kind of orientation, when we speak of high education in Serbia, we must speak in present time. Namely, basic goal of this orientation is to enlist the highest possible number of students or to organize courses for as many employed in economy as possible. It is essential to use existing capacities as much as possible in order to realize higher profits. Most institutions of higher education in Serbia today, apply the same kind of orientation. In that sense, question is whether we can speak at all of marketing concept and of one of its phases of development. Institutions apply certain promotional activities in order to attract bigger number of students and mainly, that is where everything stops. After enlisting, there is very little work on satisfying the needs of students.

However, if organizations put the products market in their focus, i.e., strive to build long term and stable relationships with consumers, then we can speak of marketing orientation. This kind of orientation of marketing concept is the newest. Marketing orientation puts the consumer of educational services in focus of its activities. Everything starts with him and with research of his expectations, needs and demands and ends with satisfying those same expectations, needs and wishes and all that should be done better than the competition does. Social marketing is also based on marketing, but certain social benefit is created by satisfying needs according to that principle.

According to Kotler and Fox, there are also definite stages in the evolution of marketing in higher education. The focus has moved from “marketing is unnecessary” to “marketing is promotion” to “marketing is positioning” to the stage where in some cases marketing is seen as part of strategic planning for higher education institutions [16].

Some organizations have tried to be successful by buying land, building, equipping it with people and machines, and then making a product that they believe consumers need. However, these organizations frequently fail to attract buyers with what they have to offer because they defined their business as “making a product” rather than as “helping potential customers satisfy their needs and wants”. Such organizations have failed to implement the marketing concept [17].

According to marketing concept, higher education institutions should, through coordination and implementation of a whole range of activities provide those services that will, in the best possible way satisfy expectations, needs and demands of consumer of education services, with simultaneous realization of positive results for the institution. Consumers' satisfaction is the basic and main goal of the marketing concept. To achieve consumers' satisfaction, institutions must first what is it that will make them satisfied. After they reach the information through thorough research, institutions try to create adequate product, i.e., service. Nevertheless, this process does not end here. Institutions still must change, adapt and develop existing services in order to adapt most quickly to changes in the surrounding and in the behavior of consumers. In addition, satisfying consumers must not be understood as one short-term job that is to be done quickly, but as a continuous and complex process, which is preceded, by market research, planning and organization of marketing. Based on information from the surroundings, setting goals, choice of target market, development and application of adequate marketing strategy and adequate organization of marketing in a higher education institution, it is possible to develop and do business according to marketing concept. Besides that, marketing concept cannot be carried out by just a part of the employees in institution of higher education that deals with marketing. It has to encompass the whole institution, including all its offices and all employees.

Assael underlines the importance of the marketing concept by stating that the marketing concept embodies the view than an industry is a consumer satisfying process, not a goods producing process [18]. Production or servicing are start with consumers and their needs, but not with patents, raw materials or selling skills. Assael [18] and Trustrum [19], agree that the basic idea of the marketing concept is to give the consumers what they want. However, consumers are not always sure of their wants or what they are being offered, and are much more opened to persuasion than is commonly acknowledged by the marketing concept. According to Kotler [20], the marketing concept is based on four based principles: consumers’ orientation or the target market, long-term maximization of profitability or another measure of long-term success, total organization effort, and social responsibility.

CONCLUSIONS

Higher education institutions are organizations that provide services in which educational service is given to consumers. One of the basic specifics of high education, even in comparison with other servicing activities, is that this service is provided for many years and that its value after successful ending of usage is for lifetime. Satisfaction of consumers of educational service is influenced by many factors, but in the majority of them, the role of humans is dominant – those who provide service. Institutions have a unique opportunity to, by creation of good relations with existing consumers, directly influence increase in number of consumers in future time. Advantages of such approach are multiple: satisfaction of existing consumers increases and at relatively low cost promotion of institution of higher education; institution is carried out and, which is most important, that is done through sources of information of utmost credibility.

According to the above-mentioned, future development and application of marketing in institutions of higher education in Serbia should be aimed at:

- satisfying increased needs and demands of consumers of educational services;
- more efficient connecting of education and labor market;
- paying more attention to the bettering of quality of total service of higher education institution;
- development and application of new forms of lecturing;
- development of more efficient communication with relevant factors from the surrounding;
- involvement of consumers in evaluation of results of educational process for the purpose of increasing their satisfaction and diminishing the rate of abandoning studies and creation of partnership relations between higher education institution and its consumers.

Considering length of time of usage of educational services (three years and more), creation of satisfied consumers represents continuous process. Its primary task is to make students enroll each consecutive year of study on a regular basis, graduate and eventually continue with their education through master and doctoral studies and that after finished studying continue their cooperation with institution in which they have studied (Alumni). Besides that, satisfied consumers will orally spread positive picture of institution in which they study, among potential consumers of educational services. In the opposite case, if dissatisfaction of consumer occurs, there usually comes to abandoning further studies and spreading negative picture of the institution. Therefore, in the purpose of its survival on the market, it is necessary that institutions of higher education accept and apply marketing concept.

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Technology Transfer, Generic Skills and Back up Support

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Abstract

Perhaps, the earliest quantitative TT model is ascribed to Sharif and Haq (1980) proposing the concept of potential technological distance (PTD) between a transferor and transferee, arguing that when the PTD is either too great or too small between the transferor and transferee, the effectiveness of the transfer is low. Thus when a transferee first looks for a potential transferor it is important to look for one with an "optimal" PTD. This is important because a potential transferor at the firm level may not be willing to easily divulge information enabling an assessment of the PTD. The greatest value of the model is that it draws attention to the need for incorporating the concept of a PTD in deciding the transferor. It may be said that the main contribution of the quantitative models is their emphasis on the need for partners in technology transfer projects to develop skills to be able to use formal, analytical approaches that can generate needed information for better technology transfer planning. An examination of the models of technology transfer shows that there are several valuable lessons that they convey.

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Keywords: quantitative model; transferor; transferee; generic skills; support

1. Introduction

Raz et al. (1983) introduced a model of technological "catch-up" showing how a technology leader, through technology transfer, can assist the rate of technological development of a technology follower. The model examines three phases of growth of a technology follower, namely, the slow initial phase with high technological capability gap, the faster learning phase with the decreasing gap, and catch-up phase when the technological gap is very small or closed. It is argued that this type of analysis would enable technology leaders to develop clear policies, based on considerations of competitiveness, security, and other related issues, when entering into technology transfer agreements.

Using an econometric model, Klein and Lim (1997) have studied the technology gap between the general machinery and electrical and electronic industries of Korea and Japan. Their findings suggest that technology transfer from leaders can play a critical role in upgrading the technological levels of follower firms. Their study

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also shows that the followers should supplement the transfer by independently putting in place measures to assimilate, modify, and localize the technology transferred from the leader. This model thus emphasizes, based on empirical evidence, the need for post-implementation activities that facilitate assimilation and modification of the transferred technology. It also clearly delineates the need for a firm, as it grows technologically, to link its technology transfer activities with internal R&D.

• It is important to expend comprehensive analytical effort in establishing the need for a technology transfer project prior to the commencement of a TT project.

• A TT project should not be commenced without a careful feasibility study since such projects often require heavy resource commitments.

• A process approach must be adopted in planning and implementing TT projects and to ensure effective technology transfer there is a need to comprehensively examine the entire process from “technology search” right through to “post-implementation” activities.

• The many changes that have taken place and are taking place in the global business setting today have made it imperative for managers of technology to gain good insights into the transferee environment, transferor environment, and the greater environment when planning and implementing a TT project.

• Multiple sources of technology must be identified to enable a good choice of transferor.

• The transferee must be involved right from the beginning in the planning and implementation of a TT project.

• It is important for transferees to develop sound engineering and project management skills without which the technology transfer process cannot be managed effectively.

• Partners in TT projects need to develop skills to be able to use formal, analytical approaches that can generate needed information for better technology transfer planning.

• It is important to have milestones and decision points so that activities can be strengthened, mistakes corrected, or even the project terminated at any point in time.

• The mechanisms chosen by a transferor to transfer technology will depend on the transferor and transferee setting, the technological capability of the transferee, the relative newness of the technology, its strategic importance to the transferor firm, and the level of intellectual property protection needed.

• As a transferee firm advances technologically, it needs to choose appropriate mechanisms of transfer, depending on the stage of the life cycle of the technology and its own technological capability profile.

• A technology transfer project does not end with commencement of production. Unless explicit measures are in place to ensure assimilation of the transferred technology the technology transfer cannot be said to have been successful.

• The success of a technology transfer project would be determined by the extent to which the transferor and transferee manage the barriers that impede transfer and strengthen initiatives that facilitate it.

However, what may also be noted is that there is no model that tries to capture all of these important considerations. An eclectic model that presents all this wisdom in a process-oriented approach would be very useful to managers of technology transfer project. Such a model must also have the capacity to address many of the problems faced by firms, especially small and medium enterprises (SMEs), when planning and implementing technology transfer. The next part will first present a summary of common problems faced by SMEs in planning and implementing technology transfer and then propose an eclectic, process model called, “the Life-cycle Approach for Planning and Implementing Technology Transfer” that tries to incorporate the wisdom of the models discussed. It is envisaged that the adoption of this process model will enable SMEs to manage the common problems they face in planning and implementing TT projects.

1.1.Key Competency Definitions

Collecting, analyzing and organizing information
Implies the capacity to locate information, sift and sort information in order to select what is required and present it in a useful way; and to evaluate both the information itself and the sources and methods used to obtain it
Communicating ideas and information
Implies the capacity to communicate effectively with others using the range of spoken, written, graphic and other non-verbal means of expression.

Planning and organ sing activities
Implies the capacity to plan and organize one’s own work activities, including making good use of time and resources, sorting out priorities and monitoring one’s own performance.
Working with others and in teams
Implies the capacity to interact effectively with other people both on a one - to - one basis and in groups, including understanding and responding to the needs of a client and working as member of a team to achieve a shared goal.
Using mathematical ideas and techniques
Implies the capacity to use mathematical ideas, such as numbers and space, and techniques such as estimation and approximation, for practical purposes
Solving problems
Implies the capacity to apply problem - solving strategies in purposeful ways, both in situations where the problem and the desired solution are clearly evident and in situations requiring critical thinking and a creative approach to achieve an outcome.
Using technology
Implies the capacity to apply technology, combining the physical and sensory skills needed to operate equipment with an understanding of scientific and technological principles needed to explore and adapt systems
(Source: Moy, P. The Impact of Generic Competencies on Workplace Performance, 1999)

1.2. Competencies for Next Generation Employability

<u>Generic Competences</u>

Capacity for analysis and synthesis
Capacity for applying knowledge in practice
Planning and time management
Basic general knowledge in the field of study
Grounding in basic knowledge of the profession in practice
Oral and written communication in your native language
Knowledge of a second language
Elementary computing skills

Research skills
Capacity to learn
Information management skills (ability to retrieve and analyse information from different sources)
Critical and self-critical abilities
Capacity to adapt to new situations
Capacity for generating new ideas (creativity)
Problem solving
Decision-making
Teamwork
Interpersonal skills
Leadership
Ability to work in an interdisciplinary team
Ability to communicate with non-experts (in the field)
Appreciation of diversity and multiculturality
Ability to work in an international context
Understanding of cultures and customs of other countries
Ability to work autonomously
Project design and management
Initiative and entrepreneurial spirit
Ethical commitment
Concern for quality

Organisation of Generic competences

Table of generic competences		
Instrumental	Cognitive	Analytical, systemic, critical, reflective, logical, analogical, practical, team, creative and deliberative thinking
	Methodological	Time management, problem-solving, decision-making
		Learning orientation (in pedagogical framework, learning strategies); planning
	Technological	PC as working tool; Use of databases
	Language	Oral communication skills; written communication skills; foreign language proficiency
Interpersonal	Individual	Self-motivation; diversity and interculturality; resistance and adaptation to environment; ethical sense
	Social	Interpersonal communication; teamwork; conflict management and negotiation
Systemic	Organization	Objectives-based management; project management; quality orientation
	Enterprising spirit	Creativity; enterprising spirit; innovation
	Leadership	Achievement orientation; leadership

Conclusion

The TTLC approach is not purely conceptual. Its practical relevance, usefulness, and validity have been established through several case studies carried out by Jagoda (2007) in Australia and Sri Lanka. The main advantages of the TTLC approach are the following:

- The TTLC approach ensures that a TT project is considered holistically and incorporates much of the wisdom shared by various researchers and practitioners through their technology transfer models.
- The TTLC approach is structured to enable SMEs avoid many of the problems that they normally face when planning and implementing a TT project.
- It is a good way to incorporate cross-functional cooperation in planning and managing TT projects and also ensures that important activities are not forgotten or carried out carelessly.
- A single empowered team is responsible from start to finish. This avoids turf wars.
- All projects may not have to go through all the stages. Low risk projects may go quickly to the latter stages.
- The approach must not be seen as a bureaucratic system. It actually facilitates the development of a streamlined system with clear agreed upon, and visible, road map.

The knowledge-workers of the twenty-first century require the ability to jump between fields of technical specialization and capture the key issues quickly. A base-level of familiarity with scientific concepts and processes reduces the time taken to master new areas where emerging tasks and work processes occur. Generic skills are not just restricted to their usefulness in the workplace but are equally required across the spectrum of living experience in today's world. Emerging work place described above demands a set of new generic skills for maintaining employability. In addition to job-specific technical competencies, there is a requirement of a set of generic skills, which are generic to a cluster of occupations in order to perform competently as knowledge worker. Generic skills are required by all workers. However, the extent by which these skills need to be possessed varies from one occupational grouping to another. The varying levels of generic skills use needs to be determined, to further guide in developing educational content rich in job-specific and generic skills formation.

The good amount of research works undertaken in studying generic skills are guideposts in formulating educational policies and initiating pedagogical reforms that can bridge positive consequences to the learning outcomes and achievements of the future workforce. Two models, the Diffusion and Infusion models have been suggested to effectively integrate generic skills in the curriculum, with specific focus and application in TVET. Furthermore, hybrid model can also be considered as alternative in making sure that skills formation encompasses wider range of skills requirements and teaching methodologies to acquire them.

While no single list of generic skills can be concluded as conclusive to one job or sector in this constantly changing economic and social landscape, the dominating skills sets and competencies required in 21st century occupations must be consigned to the learner. Doing this needs to utilize appropriate teaching and learning methodologies, integration models and skills formation adapted by educational systems and institutions, at all educational levels. The possession of generic skills, then, will be a flexible passport of the workforce to move from one job to another, and ticket to enter any given condition and environment within 21st century requirements.

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2013 International conference on Technology Transfer

Lifelong Learning, Technology Transfer and Research at Higher Schools of Professional Studies

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Abstract

Systematic and continuing process of learning and education is becoming one of the most important forms of development of human resources in the modern society. Constant need for highly qualified, independent and trained employees and higher necessity of requalification and additional qualification, are widening the field of studying and appliance of knowledge and education.

Keywords: Lifelong learning, research, knowledge transfer;

1. Intoduction

At the plenary session in Lisbon in 2000, The European Panel adopted the Memorandum on Lifelong Learning,(European Commission, Paris, 1996.), which confirms that Europe has entered 'the era of knowledge', with all those implications that this fact has on cultural, economic and social life. European Panel also came to a conclusion that the promotion of lifelong learning is necessary for the successful transition towards society and economy based on an individual's knowledge.
What is needed today, and in the future: The quantity of new knowledge is enlarging at great speed along with the decay of the existing knowledge, since 60% of professions which are to be performed in the next two decades, are not known yet. It is necessary to work constantly on improvement and skills and abilities needed to every individual are embedded in theses –*learn to learn, solving problems, critical point of viewing things, anticipatory learning.*
Taking into consideration education programmes and plans of Higher schools of Professional Studies in Serbia, as well as the variety of education fields included in studying programmes, it can be claimed with certainty that they should take over the task of lifelong training of personnel dealing with practical and direct execution of different kinds of assignments. This way we lead to the direct transfer of knowledge, research and new technologies. (Traffic, Health Care, technology, Postal and telecommunications.)
Transfer of knowledge presupposes lots of activities which include both formal and informal ways of communication, interaction and exchange of students and teachers as well. Companies' involvement in teaching programmes of Higher Schools of Professional Studies is one of the most important mechanisms for the transfer of practical knowledge. Seminar works, final works and those of specialization of students should be based on concrete, real problems of companies. Joint educational programmes, practice and employment of students and graduates make transfer of knowledge possible. Interesting model of transfer of knowledge is reflected in the organization of seminars, symposiums and courses oriented to the companies' needs. The example of it is master course 'Automotive Safety Systems Engineering' developed at the University of Transylvania in cooperation with the company ' Autolive' which deals with the development, sale and delivery of safety systems for cars.
This paperwork will also discuss several forms in which Higher Schools may be viewed as a support to the inner and outer logistic of the companies.

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2. The need for the lifelong learning and the transfer of knowledge

Permanent education has become everyday activity in the developed countries of the West. European Union has set itself the goal which is to be the most competitive and most dynamic world economic community on the market as the 'society of knowledge'. In planning its sustainable development, EU depends on the development of better and working places of higher quality and bigger social cohesion. In accordance with the idea of construction of the 'society of knowledge', as its policy in the area of education, EU points out the need for constant education of people throughout their life, which puts their competency and knowledge to a higher level. Special emphasis is put to the efficient strategy of lifelong learning.
Special programme which supports the lifelong learning has been developed and named 'The Programme of Lifelong Learning 2007-2013'. Therefore, the transition to the society of knowledge puts individual to the centre of attention. Representative of the society of knowledge is an educated person .The education of employees means changes in the specific knowledge, skills, abilities, attitudes and behaviour of employees in order to prepare them for better performance at their working place. It requires planned effort of the organization in order to improve performance of their employees. Since individual is in the centre of the process of education, it is important to pay attention to its relation to education and work.
Of special importance are the attitudes which employees have towards the permanent education. It is important to plan the training at the level of high quality, in order for the employees to feel the training benefits and be fully motivated for learning and permanent education. Higher schools of professional studies should include in their programme programmes for the continuing improvement and additional education of employees from different companies. Since the number of employees had higher education, programmes should involve the additional education for them to make possible their participation in the study programmes based on the Bologna process. The experience of higher schools of Western Europe has shown that the courses of advanced technology are pretty much wanted, whereas in Serbia there is still the demand for courses of information technologies.
'Vocational development through specialization has proved to be a very efficient way of vocational improvement and students' progress' , which is not just our statement, but as well stated by the Commission on Accreditation and Quality Control of National Council of High Education.*[†]
Higher schools should cooperate on the research fields in a variety of forms. Four mutually connected components can be identified in this sense as:

- Research support
- Common research
- Transfer of knowledge and
- Transfer of technologies.

The economy ***supports research*** in higher schools with contributions in money as well as in equipment. This type of contribution is very important, because it provides great flexibility in modernisation of laboratories and development of the programme in certain areas of interest. This mode of cooperation Higher Schools can organize also as a model of cooperation according to which they would give space for companies to organize laboratories, equipment and by standards which are in accordance with their demands and needs. In return, schools will provide different services:

- Student training in the areas and subjects which are of company's interest
- Development of research projects with subjects suggested by the company
- Work with the company as a partner in national and European projects
- Recruitment of human resources

Common research which would be realized by the schools and companies, can be developed through creation of teams for common research with the companies, in order to continue research and development of certain areas of common interest. These centres provide formal structures for the technological progress through different ways of cooperation between schools and companies, in which research contracts play a great part. Common research would make easier transfer of tacit knowledge possible.
The way and success of the ***transfer of knowledge*** depends immensely on the kind of knowledge, i.e. whether it is explicit or implicit (tacit) knowledge. Explicit knowledge is relatively easy transferred through various forms of written reports, text books, books and studies, then through various forms of electronic exchange of information, through faxes, drawings, e-mails and other forms of impersonal communications.
Contrary to the explicit knowledge, tacit knowledge is much harder for the exchange and transfer, since it requires personal communication between individuals. Since tacit knowledge is placed in the experts' heads, it can be transferred only with

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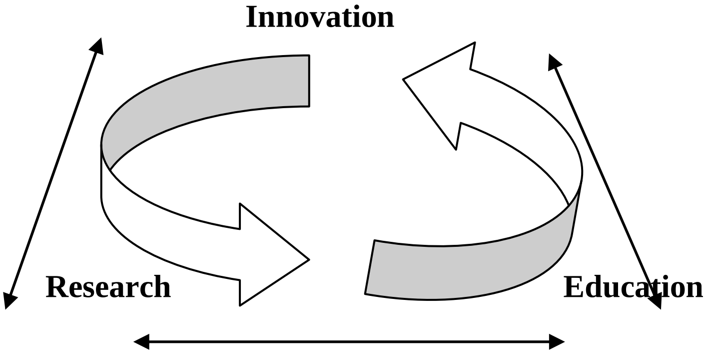
[†] Dr Vera Kovacevic-Vujicic : Critical view of quality control in High Education, International GOMES conference, May 9th,2013. Belgrade

the will of the individual who owns it, through direct and intensive communication with the person to whom tacit knowledge needs to be transferred. That is why the transfer of tacit knowledge can be performed by outside experts towards individuals in the organization, by hiring such experts for the teams for common research. High education basically means three basic segments: innovation-research-education (transfer of knowledge); known also as the triangle of knowledge (Maassen&Stensaker 2011) which has the creation of the 'society of knowledge' as its goal.(Picture 1)
When we speak about the society of knowledge, it is considered to be an important strategic goal, and this kind of attitude has very important political influence in a number of countries



Picture 1. The triangle of knowledge

Innovation
Innovation is successful exploitation (use) of new ideas. If we look more strict at it, innovation may be defined as the process of converting new ideas into commercial success on the market. This definition involves one very important quality of innovation. Namely, innovation is not just the generating of new ideas, but their commercial exploitation as well.
Research
In order to promote new knowledge, research is needed to create new knowledge and improve the existing ones. Knowledge is viewed outside of the context, in order to be learned, tested and applied more or less independently of special context. Brown, Collins & Duguid 1989) .in this way achieved and acquired knowledge is further applied through the second point of the triangle, which is knowledge.
Education (the transfer of knowledge)
With the transfer of knowledge at high quality, educational institutions can nowadays define their place in the society of the best, not just offering education as a 'product' but making themselves as an institution a 'first-class product' which will fulfil all the users' demands, in
this case students. Commitment to the consumers inside of high education has several effects, but none is more important from the one relating to students, their relations with the Universities at which they study, and students' relations with their teachers (Hussey & Smith 2010). This relation is mostly perceived through cooperation of professors and students through studying, work, interaction, taking exams (Bjorklund et al. 2004, Chickering & Ehman 1996), all for the purpose of acquisition of knowledge, since education is acquired knowledge.
For the purpose of development of the activities which will be led on the grounds of the triangle of knowledge, four areas of action stand out:

- European Higher Education Area- EHEA
- European Research Area- ERA
- development of professional education and
- development of the basic and general education.

Technology transfer is usually based on common research of the University and industry. Different models are being developed: business incubators, scientific parks, technological parks etc. Which are created for encouraging entrepreneurship and business development.
At the University of Novi Sad started initiative and projects of business incubators and scientific-technological parks are already being realised. With the adoption of the strategy of scientific-technological development of Serbia for the period 2010-2015. , Serbia got involved in global trends and begun the process of construction of national innovative system which is supposed to make development of technological innovations and transfer of knowledge into society and economy possible, as a prerequisite for the achievement of the defined Vision: economy based on knowledge and sustainable development of Serbian economy.

3. Employees' attitudes towards the lifelong learning and education

In our environment there are negative attitudes when it comes to lifelong learning and you will often hear statements like ' Why would anyone teach me, it's a waste of time' . This kind of statements reflect the prejudice present at most of our people, that the sign of solid character is being able to deal with problems themselves. Science says different. The basic source of support for people in crisis is their social environment. Through social environment people get material, emotional as well as intellectual support. Loss of work or change of working place represent life events which provoke the change in the usual functioning of an individual and cause crisis. The way of overcoming the crisis depends on the personality of the individual and the net of his social environment. If people learn how to exchange experiences, knowledge and skills with others, and if they look on crises like challenges of life, then they have a good potential of overcoming the variety of crises.
For the need of this paperwork and the construction of project of lifelong learning a smaller research has been conducted with the employees of the Serbian Railway. Questions referred to their educational needs, motives, expectations and attitudes. Based on the results it is possible to reflect on contemporary situational, institutional and personal inhibitions whih always follow the process of adult education. From 135 questioned (of different age, sex and all qualifications) 56 or 41,48% had no specialized training after the termination of school for the function-work they performed. It is obvious we are not talking about those employed in the direct process of work in the area of railway traffic. This company has internal professional check and taking of exams, as well as certain preparation for these exams.
It is certain that this kind of education and innovation of knowledge is good and positive, but it doesn't widen the knowledge in the area of new technologies, but only checks the knowledge of existing technologies and process of their work, which is already out of date. When they state their mind on the value of education they had 35 of them or 28,14% didn't reply or couldn't estimate it, obviously because they didn't participate in any of the educations, while the majority of the rest found it worth of participation. This data already show the considerate lack of permanent education at the working place, as well as the positive reverberation of the employees' involvement in the training and specialized programmes.
This start findings are supported with the results got from the questionnaire about lifelong learning and specialisation. Majority of the employees have the desire to get involved in the programmes of training for vocational specialization and find that realised programmes of education help its participants in the more efficient performance and of higher quality (Table 1)

Table 1. Positive attitudes of employees towards education

Question number	Question content	Sample	Reply YES
1.	have you participated in any professional training during your work period?	135	79- 58,5%
2.	I would like to get involved in the future educational programmes for specialization	135	112-82%
3.	I would like to continue vocational specialization at the institution of High education	135	98-72,5%
4.	Additional education is the best way to advance at work	135	89-66%
5.	Realized educational programmes help its participants in more efficient performance at work	135	100-74%

Learning, education and training are the best way to advance at work. We suppose that reasons for which employees see the possibility of advancement in education, lie in the possibility to satisfy various other needs through education, like the need for advancement, curiosity, experience exchange, affirmation.
Beside these positive attitudes of employees towards specialization and education (which have been selected from the questionnaire), we will also state the results got on negative attitudes of employees to education. Number of employees are not satisfied with the offered educational programmes. Percentage in the Table 2 should be viewed in the mutually dependent relation. Percentage of disagreement with the statement (incorrect) is just a little higher than the percentage of agreement which implies that the way of conducting education doesn't motivate learning, because it doesn't provoke curiosity. And taking charge of motivation is the key of taking charge of the human resources.

Table 2.Negative attitudes of employees towards education

Question number	Question content	sample	Reply Yes
6.	Education we have doesn't provoke participants' curiosity	135	71-52,5%
7.	Existing educational programmes are bad and should be changed	135	69-51,1%
8.	Teachers at the educational seminars are not familiar with the problems of our organization	135	97-71,8%

Stated results imply that the very process of adult education must be created in a way that adjusts to the individual needs of participants who have justified demands concerning content and the way of realization of educational programmes and competency of professional assistants, financial availability and concrete advantages which are the outcome of the education.

4. Example of a proposal for lifelong learning on Railway Higher School of Professional Studies in Belgrade

Founding a lifelong learning centre on Railway Higher School of Professional Studies in Belgrade is conditioned by the need to create organizational assumptions for the activity of lifelong education as defined by the School Statute and acts 3,48 and 96 of the Law of High Education.

Lifelong learning is turned towards society as a whole and strives to become a model for the achievement of personal, but social progress as well.

The role of high education institutions is pointed towards promotion of knowledge and skills, creation of innovative culture, permanent improvement and transfer of knowledge to those who work or want to work in the traffic sector.

Lifelong learning involves activities that Higher School of Professional Studies in Belgrade conducts by offering its services to institutions and companies, or vice versa, when it organizes specific course or other ways of training for the employees according to the demands of the user. This way of teaching is in close connection with the business environment and its purpose is to help employees to adjust to new demands and acquire new competencies.

Lifelong education or lifelong learning represents one of the priorities in the society of knowledge, modernization of railway, industrial and city traffic as well as the protection of life environment from the negative influence of the traffic resources, by using new technologies and knowledge.

Acceptance of the concept of lifelong learning (LLL) is connected with the adoption of Bologna declaration postulate to which Serbia approached at:

- The political level, through obligation to integrate lifelong learning into national educational systems by the year of 2013.
- Structural level, through new regulation, financial and institutional frame adjusted to verification and valuing of the efforts in the area of lifelong learning
- Social level, through the promotion of lifelong learning practice as necessary and useful for individual as well as for the society.

The initiative for the foundation of Lifelong Learning Centre at the Railway Higher School of Professional Studies in Belgrade is taken in order to create institutional assumptions for the inclusion of the school into the area of lifelong learning.

4.1. Goals of the Centre foundation

The main goal of the Centre for Lifelong Learning foundation at the Railway Higher School of Professional Studies in Belgrade is including European and world standards into educational system and providing approach to educational process for employees as well as for the widest layers of population.

The main target groups are the employees with specific needs for new skills and competencies, students at the railway Higher School of Professional Studies in Belgrade, adults who gave up education during formal cycle, but have the desire to return to educational process and improve their knowledge and skills.

The goal of the centre is to provide general knowledge for individuals (language, computer literacy), which is not closely connected with their functions at work, and can be transferred as such to different kinds of work; and specific knowledge, which can be directly used at their working positions.

The Centre for Lifelong learning at the Railway Higher School of Professional Studies in Belgrade will , through personal and professional progress of an individual, contribute to the realization of multiple benefits as much for the School, for the wider social community as well through:

- innovation of employees' knowledge and knowledge of those who want additional education and improvement of the existing knowledge;
- development of an open and flexible professional education and improvement system;
- foundation of informative and advisory centre for adults' education in this area;
- involving relevant stakeholders into creation and innovation of teaching materials;
- connecting former students with the School;
- mobility towards other centres for lifelong education in Serbia;
- promotion of the new approach to learning by the School in the wider social community;
- giving innovative way of acquiring new knowledge, which will be formally verified and valued, along with offering students possibility to get into the formal system of education later.

4.2. Centre's Activity

Activities of the Centre will be conducted in accordance with the defined activity area of the Railway Higher School of Professional Studies in Belgrade (Statute act no. _) : adults' education and rest.

Its work will be focused especially to the implementation of the following **key activities:**

1. research and development in the area of lifelong learning

2. creating, defining and conducting trainings, courses and modules in the area of railway, city ,and industrial-rail traffic as well as the life environment protection from this activity

3.preparing and organizing professional trainings for the students of the railway Higher School of Professional Studies in Belgrade;

4. promoting quality and making standards and procedures for programmes and teachers in the area of lifelong learning of these activities;

5. setting and coordinating international cooperation in the area of lifelong learning;

6. supporting the development of small and bigger transport companies through special training programmes for entrepreneurs;

7. organizing seminars and conferences dedicated to lifelong learning;

8. publication of promotional materials, text books, and books for the need of lifelong learning.

Except for these, the other activities of the Centre will embed:

- promotion of lifelong learning and creation of the culture of lifelong learning;
- securing consultants' assistance to the institutions and companies regarding necessary knowledge and skills conditioned by techno-technological and socio-economic environment
- developing new forms of study, based on the appliance of ICT;
- setting network with local partner institutions, like City of Belgrade, Chamber of Commerce and Industry , Employers Union, and National Service of Employment.

4.3. Stages of Centre's development

At the Railway Higher School of Professional Studies in Belgrade the process of the centre's creation will be conducted through several stages:

Stage 1: Creation of the centre

The first stage comprises operational activities of defining space, supply of equipment, and setting management, organization, personnel and other starting points for the beginning of the Centre's work. Beside that, in this stage, strategy of the Centre's development will be defined, as well as the plan of its implementation. One of the steps will also be setting normative acts which will regulate the Centre's work.

Stage 2: Creation of modules and courses

Within the second stage, modules, courses and trainings which will be realized through Centre's work, will be created. First we will conduct the analysis of needs for lifelong learning in accordance with identified and future needs. Important task in this stage will be defining standards and procedures for the teaching in the area of lifelong learning to be of high quality. Based on this important document, programme of training and education will be suggested and given to the Teachers' Council for consideration and adoption.

Stage 3 – Training realization

Training programmes will be coordinated and conducted according to the identified needs of the Labour Market. Training realization will be pointed towards the achievement of set goals and acquiring of key competencies in the defined areas, according to different target groups' demands. Number of students will be in accordance with the specifics of the defined goals.

4.4. The Centre's operational plan

Management

Management structure of the Centre for the lifelong learning of The Railway Higher School of Professional Studies in Belgrade consists of:

- Programme Council
- Head of the Centre
- Accreditation Council

Mandatory term of the Programme Council's members lasts for three years.

Programme Council's area of work is:

- Confirmation of the Centre's strategic plan proposal
- Confirmation of the annual working plan and activity plan proposal of the Centre
- Confirmation of the financial plan proposal of the Centre
- Reports on its work annually to the Teaching Council

The Head of the Centre- manages the work of the Centre for lifelong learning at the Railway Higher School of Professional Studies in Belgrade and is put in charge by the principal of the school.

Accreditation Council has three members from the ranks of teachers and associates.

Their mandatory term is three years.

Accreditation Council's area of work is :

- Confirmation of the training programme and lifelong education programme proposal, which is forwarded for adoption to the Teaching Council
- Defines standards and procedures for the high quality teaching in the area of lifelong learning
- Secures control of the Centre's work quality

Management, organization and supervision of work of the Centre for Lifelong learning on the Railway Higher School of Professional Studies in Belgrade will be defined thoroughly in the Centre's Work Regulations.

4.5. Equipment

Equipment necessary for the beginning of the work of the Centre for Lifelong Learning in the first stage of foundation will be provided from the school's budget, The Ministry, and companies' help.

The overall value of the equipment meant for supply in the Centre is 10,000 €. Specification and use of the equipment is given in the appendix.

4.6. Personnel and location

Teachers and associates of the Railway Higher School of Professional Studies in Belgrade will actively participate in the work of the Centre for lifelong learning, as well as teachers and experts from other faculties in dependence of need of the Centre.
Centre will also actively cooperate with all other institutions which deal with the closely connected areas of work.
The Centre for Lifelong Learning will be located on the Railway Higher School of Professional Studies in Belgrade. For the purpose of teaching process, classrooms will be used according to availability dictated by the teachings at specialized studies. For the need of administration work, School's facilities and service will be used.

4.7. Financing

Centre for lifelong learning is non-profitable organization unit within the Railway Higher School of Professional Studies in Belgrade which operates through a special sub-account of the School. Financing of the Centre will be performed through contracts and projects with international and domestic profitable and non-profitable organizations, state institutions and local municipalities' organs, as well as through contracts with common people. Centre for Lifelong Learning may, within the area of its activity, cooperate with domestic and international non-governmental organizations, receive donations for the development of its activities and is also authorized to participate in domestic and international projects for financing its activities.

5. Conclusion

Lifelong learning is turned towards society as a whole, and as such strives to become a model for the achievement of personal, but social progress as well. Employed, unemployed, employers, students, children, special groups like the poor, handicapped, minorities, refugees, fired in the process of transition, non-qualified workers, independent entrepreneurs , and citizens at the middle age belong to the population part that can potentially benefit the most from the process of lifelong learning.
There are many reasons connected to the globalization, demographic trends, economic, social and cultural needs which point to the necessity of emergent and comprehensive activities in the field of lifelong learning, which must be incorporated into institutional frames, but in the educational system of all countries of EU as well.
Planning of the employees' education is an important part of managing human resources. That is why it is important for the education to be conducted at the high quality level, having in mind that the centre of educational process belongs to an employee's personality. It also must be conducted continually, in accordance with the set goals of the EU as the 'society of knowledge'.
Employees' attitudes testify about their consciousness about permanent education along with their work as a desirable activity, because it raises the level of their competency at work and their self-confidence. It is also important to realise the negative effects of badly planned and conducted education on employees' motivation and their decision to take part in the process of lifelong learning and education.
It is our opinion that the involvement of the employees into planning and estimating the importance of lifelong learning and education will be the best cure for the avoidance of its disadvantages.

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2013 International Conference on Technology Transfer

Information and Communication Literacy - the Need and Necessity

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Abstract

This paper explains the need for a computer (IT) and communication literacy, ranging from pre-school and elementary schools, to higher education in the modern world tendencies in science and everyday life. Of course, it is not bypassed the Internet, as one of the most important features of modern technology in everyday and academic life. Benefits of a large network of resources and the free flow of information are the greater the risk of abuse of the Internet. But the illegal use of the Internet can not be tolerated. The fight against illegal content on the global level, such as child pornography, must be guaranteed. All existing laws shall be also applied to the Internet. Computer and information-communication and Internet literacy must be stimulated in order to strengthen the technical understanding of the importance of software and code. This is necessary in order to leave room for the possibility of defining the future role of the Internet and its position in civil society. Internet literacy must be the primary goal of education in schools. It is necessary to organize training courses for adults.

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Keywords: Internet; Internet services; web sites; chats; forums; downloads; website gallery.

1. Introduction

Today's elementary schools are hotbeds of generations to work the middle of the XXI century. In accordance with the standards has brought the beginning of the third millennium, we may ask the question: “Which IT skills to teach modern pupils and students, and how? What are the functional tasks of the educational process can be developed through the teaching of science? As students prepare for the process of lifelong learning and training? “The role of contemporary modern teachers, among other things, is to direct students to the creative use of information technology [1-2].

In primary schools in the Republic of Serbia, the teaching of informatics was first introduced as an extracurricular activity or an elective for students in upper grade where the technical equipment of schools would allow. A similar situation exists today because of the informatics elective for students from fifth to

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eighth grade, provided that the school has adequate staff and adequate computer (IT) classrooms. It should be noted that ten years ago most of the students did not have a computer at home, and with great interest and desire picked just for your Information Technology elective course to be able to use the computer labs. Today, however, most of the students has a computer at home is better than it has a part of our school. Here we must emphasize that having a good quality computer at home does not mean that students know how to use it properly.

Teaching science and the informatics should be used as a tool to empower students for lifelong learning process. Undoubtedly, the informatics ideal area where pre-school children, we can be encouraged to develop the skills that are actually necessary for continuous learning [2]:

- Developing logical thinking,
- Developing procedural thinking,
- Creativity,
- Learning by trial and error,
- Learning by finding the necessary information to solve a problem.

The most important functional tasks of IT, in addition to those listed above would be:

- To develop creative thinking,
- Finding different ways solution of one problem,
- Constantly updating and correcting their own solutions,
- The use of other sources of knowledge, not just textbooks.

Today, every computer literate teacher want a multimedia classroom library provided with educational software that could refresh his teaching that is now in many cases performed chalk board. Such “computer lab” was the students in the U.S. have more than twenty years. It is necessary to encourage the development of local educational software and provide high-quality translation of foreign software (especially in science). It will be possible that information technology becomes a means of teaching in each subject.

2. What we can do now

Today we can hardly think of any occupation for which we can safely say that for him, does not need any IT knowledge. Any student who now leaves elementary school had to have a “basic computer (IT) skills”.

Basic computer knowledge is interpreted differently by experts, but most agree that it could be [2]:

- Knowledge of basic computer parts,
- Understand the basic logic of the computer (like use some new programming language for the purpose),
- The basic concepts of the Internet,
- e-mail,
- Create a text document,
- Working in a drawing program.

Children receive new technology in a different way than adults, because growing up with new challenges. Adults have the duty to take advantage of new technologies and the way that will raise the level of education in general. It is to enable students to their computer becomes indispensable tool, while teachers of other subjects (“non-IT subjects”), a new teaching tool. And to realize this idea, help should be sought in computer science as a school subject. It should be taken to ensure that the planning of the teaching process should be planned in such a situation in which the students will make their own way to knowledge. The task of the teacher is to determine the most reliable and effective methods, forms of labor, facilities, teaching materials and sources of knowledge.

Learning from different sources of knowledge is particularly important for active learning, which is one of the important features of modern education.

We can fight against ingrained opinions that computers cause many negative effects (not reading, antisocial and violent behavior). The computer is not a toy, not a typewriter, but the means by which we come to new information and knowledge. As the book is not “killed” the living word, so the computer will not “kill” the letter, moreover, may influence that continues to expand, of course, in a different way.

3. The Internet is ...

The Internet is a global collection of computer networks, distributed worldwide, and gateways that use a set of TCP / IP protocol for communication. The premise of the Internet makes the communication lines for high-speed data between major nodes or main computer. The whole system has no centralized control and the exclusion of one or more nodes Internet can threaten the Internet as a whole, or cause to stop communication on the Internet.

Thus, the Internet is “virtual society” computers and computer networks from around the world. With the help of a computer, modem and telephone line, can be easily connected to all parts of the globe. Internet, or as commonly referred to as a “network of networks”, became by far the most popular means of communication. Internet services provide simple, efficient and cost-effective solution for the exchange of information in various forms - content on the internet present in a multimedia way: using text, images and sound. It is available to everyone regardless of location, age, and education - can be used by Internet experts, and those who are not computer literate [6].

Websites, chat, blog, download, forum, web gallery ... these are all terms that today we hear every day in the communication between Internet users. The Internet has for many people become an indispensable part of everyday work (and the rest) and as much technology crept into our lives that one often forgets that all the time actually served and discuss concepts that in reality does not exist - it is a virtual reality which is presented on a computer monitor. Recognize and be aware of these differences when using the internet technology is very important.

However, the Internet along with its benefits, i.e. the positive side, it contains a dark side. There are many victims of a bad guy lurking on the network, whether it is the evil hackers, cyber hooligans, or, in the darkest varieties, pedophiles. It is because of such hazards requiring proper training of all Internet users, especially children. It is necessary to educate all users to be aware of the risks associated with it to be able to properly react when they find themselves in dangerous situations. Children (and adults) need to learn how to properly use the capabilities of the Internet - children should gradually lead to a mature and independent use of the Internet [9-10].

Cyber-bullying and violence through electronic media or electronic devices, is any activity with the ultimate goal of mistreatment of an individual or group of people. These are usually different insults or taking private or false information about a person in order to hurt the person. Often abusers underage persons thus abused other minors. The abuser is usually someone who abused person knows and who wants to take revenge over the Internet or from a mere whim hurt another person.

Children, and adults, when communicating over the Internet have more confidence and courage than is the case when communicating “face to face”. This, on the one hand, can bring positive results, for example child may feel freer to express their own opinions or feelings about a subject or person. However, the person “behind the mask” may feel as if everything is allowed and that do not apply the rules that exist in the real world - because he dares to various verbal assault and harassment. There are many malevolent who are willing to use their own anonymity on the Internet to anyone caused harm.

When we talk about violence among classmates, friends or peers, then this may be: invasion of privacy, harassment, insults, and spreading lies about the person, stirring up hatred on the group, stalking, harassment, discrimination and stirring like. In many cases, when the photos classmates from anonymous people on the Internet in order to mock and insult them, then times when the chat room say a group of people to hate someone from school for having “too smart “, too fat, too thin, comes from another region or country, looks different from the rest of society and the like [7].

Also, it is possible to obtain data theft email or chat account and then another malicious person can send offensive messages and publish information under the name of the victim and also fanning the hatred towards her.

3.1. Which are exposed to all the dangers of children?

- The removal of inappropriate information.
- Sending offensive and disturbing messages.
- Availability of dangerous information, products and activities.
- Theft and misuse of personal data.
- Presentation of private and confidential information, disclosure of false information.
- Threats, insults and harassment.
- Computer viruses and break into computers by the black-hat hackers (bad hackers).
- Impermissible marketing activities using published personal information of an individual.
- Fraud when purchasing over the Internet (e-commerce).
- Victims of pedophiles who will try to lead a child to a personal meeting.
- Impersonation for insulting people, which is a malicious person or to deceive another person [3-5].

3.2. How to protect yourself from these dangers?

Children often know more than their parents about the Internet and new technologies in general and why parents need to listen to them: a parent allow the child to introduce him to your favorite web sites, forums, chat, as well as their cyber friends. Parents can use this information to learn more about your child. With children should be sure to talk about the dangers of the Internet and Internet communication services.

The classic advice that applies to everyday life can be applied to the virtual [5]:

Never talk to strangers, do not take anything to offer us, I do not agree to the offer to escort home ... With a stranger on the internet can casually talk to in order to acquire new acquaintances, however, does not discuss things that we share only with best friends. Can not be disclosed personal information to strangers!

Parents should know the friends and classmates with whom their children are often socialize! Virtual friends do not need to be exception-parents should check their children who often communicate through the Internet.

One must not speak ill of other people! It's not nice to insult other people and someone send inappropriate messages. Except that a child can get into trouble because of these activities, he can take it and get revenge.

You must try to be polite and show respect to other people and their attitudes! You should take into account the “Netiquette”. Chat rooms and forums usually have clearly specified rules of conduct.

Personal Information and the family life are shared only with the best of friends! Such information is not shared to the public and possibly only best friends.

We should never claim what does not belong! On the Internet, content is often protected by copyright law and is punishable to use someone else's property without permission. It’s to be explained to the children.

Generally accepted rules of behavior on the Internet are known as netiquette, but keep in mind that some organizations that offer different services to communicate user can have their own additional internal regulations. The children all believe are curious and eager to explore the relatively new world of computer networks. Therefore, parents should supervise their children and provide them with a healthy spiritual guidance in using the Internet, just as they would do this and the choice of music or movies their children.

4. Life Long Learning (L^3)

Lifelong Learning (permanently (permanent, continuous) education) is defined as an activity of learning throughout life, with the aim of improving knowledge, skills and competences within a personal, civic, social and business prospects [10].

Includes:

- Understanding of education as an ongoing aspect of daily life;
- Acquisition and modernization of all types of abilities, interests, knowledge and skills of pre-school to the time after the end of its service life;
- Promote the development of knowledge and skills that will allow people to customize the “society of knowledge” and active participation in all spheres of social and economic life and influence their own future;
- Recognizing all forms of learning (formal education (college, for example), non-formal education (egg, training on the job) and informal learning, intergenerational learning (knowledge sharing in the family, for example).

5. Conclusion

The digital age will have a significant impact on education and will radically change the existing process of teaching and learning. Many countries have already taken or are taking initiatives that would mark a revolution in the use of new technologies in schools and pre-schools, as well as in secondary and tertiary education. Modern educational technology with multimedia systems, creates conditions for the engagement of all the senses in the process of acquiring new knowledge, develop children's creativity and provides greater activity of children with learning and fun. Therefore, computer science and information technology are major teaching facilities at all levels of education, from kindergarten to university. Undeniably, information literacy is a necessary part of our business literacy. With classical knowledge needed to master the elements of information literacy, and trained for the use, development and understanding of information technology and its diverse applications in economy and society, in other words - are trained to use computers and computer programs. A knowledge gained should be used to know the procedure of collecting and processing information for making correct and effective decisions about the activities that should be followed - this in turn computer literacy.

Information literacy skills include [8]:

- Identifying information needs,
- Finding information ,
- Analysis and evaluation of information,
- The use of information,
- Disclosure.

Contemporary education requires a new model of learning - active learning, based on real-world information resources. Teachers today need to know how to use modern techniques and methods in education. Although what is necessary to change the curriculum and methods of procedure all levels of education, it is especially important that such information comes to the universities, and the universities that educate students - future teachers. Primary education is one of the factors responsible for the development of society, so it is very important to its adaptability to change that now makes digital age. In order to successfully achieve these changes, it is not enough to change and modernize the curriculum, but it is equally important to make changes in teaching methods and define new educational content and standards in teaching computer science. Find the best solution for the education of the young generation that tomorrow should take complex tasks in modern information society; it is very delicate and responsible task. Therefore, they need to provide the best preparation for entry into the modern business environment.

Computer training is an essential prerequisite for inclusion into contemporary trends. The time in which we live is marked by the rapid development of computers and information technology, and therefore imposes the necessity of computer literacy of citizens. More economic and other activities requires a higher level of knowledge in this field, as in the modern information society, information literacy is a prerequisite not only for business but also for everyday life.

There are eight key competences in education prescribed by the European Union. IT competencies lie in fourth place, behind the mother tongue, foreign languages and mathematics. Research shows that Serbia in terms of information literacy is at the very bottom of the list of European countries [8].

What is the importance of “new media”, in which in addition to the Internet, includes television, online magazines, books, movies, games and more, the fact that most countries in the world in addition to its educational system science introduced the subject of “media literacy” wanting to focus critical thinking and behavior in the use of modern media. Because, according to one definition of “contemporary media are neither harmful nor useful, and can be both”.

When it comes to new info-communication technology many experts believe that teachers need to acquire new knowledge, attitudes and approaches, to form new attitudes and a different role in such an environment. Therefore, the need and different forms of professional development for the nature of the educational process in the online sphere conditional nature of new info-communication technology and our ability to understand it - to be written for “electronic alphabet” [1].

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Track 2: University-Industry Cooperation

2013 International Conference on Technology Transfer

Lampert's Review on University–business Cooperation: Selected Excerpts with Relevance for Serbia

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Abstract

This is to recommend to the attention of Serbian academic and business society those passages of the Lampert's Review that have clear relevance for university – business cooperation in Serbia and could serve as an input in the course of drafting of Serbian platform for knowledge triangle synergy. Most of the selected parts of the Review can be immediately applied to the Serbian case while some were rewritten to correspond better to the Serbian environment.

Selection and/or peer-review under responsibility of the organizers of the 2013 International Conference on Technology Transfer

Keywords: university - business cooperation; knowledge triangle; Lampert's review

1. Preamble

The Lambert Review of Business-University Collaboration made a series of recommendations which encouraged universities to identify distinctive strengths in research, and encouraged business to give a greater priority to understanding the opportunities for exploiting innovation and creativity through universities. The author of this outstanding review was the former Director-General of The Confederation of British Industry and the editor of the Financial Times. Currently, he is the chancellor of the Warwick University, Great Britain. He was commissioned by the Department for Education and Skills and the Department for Trade and Industry to write the report, which was published in December 2003. Even though it was produced for university - business cooperation for Great Britain, it has clear relevance for university – business cooperation in Serbia and could serve as an input in the course of drafting of Serbian platform for knowledge triangle synergy.

The Lampert's Review suggests that the most effective forms of knowledge transfer involve human interaction and puts forward a number of ways to bring together people from businesses and universities. It identifies a need for the Government to support university departments which are doing work that industry values and suggests that the development agencies could play a greater role in developing links between business and universities. It proposes ways to simplify negotiations over intellectual property and to improve

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the market signals between employers and students. It suggests that the university sector should develop a code of governance and that the Government should introduce a risk-based approach to the regulation of universities.

Businesses around the world are changing their approach to research and development (R&D). For sound commercial and economic reasons, companies everywhere are cutting back their corporate laboratories and building collaborative research programmes with other partners –most particularly, with universities.

Global competition is having an impact on the way that both business and universities are approaching R&D. Multinationals are locating their research centres in their most important markets: their home country is no longer the automatic first choice.

These trends have implications for companies, for the university system, and for public policy. The issues which they raise are the subject of the Lampert's Review.

2. Introduction

Companies and universities are not natural partners: their cultures and their missions are different. Universities and governments also find it hard to work together. Academics value their freedom and independence, resent their reliance on public funding and feel their efforts are not properly appreciated. An overriding aim of this Review is to suggest that there are benefits to be gained for business, the universities, and the economy as a whole by improving communications and developing a more trusting approach by all those involved.

The biggest challenge identified lies on the demand side. Compared with other countries, Serbian business is not research intensive, and its record of investment in R&D in recent years has been unimpressive. Serbian business research is concentrated in a narrow range of industrial sectors. All this helps to explain the productivity gap between the Serbia and other comparable economies.

In addition, there has been a marked culture change in the Serbian universities over the past decade. Most of them are actively seeking to play a more visible role in R&D, regionally and nationally. The quality of their research in science and technology has been continuously improving comparing against international benchmarks.

All stakeholders in the process of technology transfer have their own responsibilities: the Universities have to get better at identifying their areas of competitive strength in research. Government has to do more to support business-university collaboration. Businesses have to learn how to exploit the innovative ideas that are being developed in the university sector.

Serbia actively participates in the pre-accession process and therefore this is a right time to look at the question of business-university collaboration.

3. Main issues in fostering university–business cooperation

3.1. Demand for research from business

The main challenge for Serbia is not about how to increase the supply of commercial ideas from the universities into business. Instead, the question is about how to raise the overall level of demand by business for research from all sources. Measured against developed countries, the research intensity of Serbian business is low – and the position has been deteriorating in recent decades. This could have an adverse impact on the overall productivity of the Serbian economy.

3.2. Knowledge transfer

The best forms of knowledge transfer involve human interaction, and the Lampert's Review makes several recommendations designed to encourage more frequent and easy communications between business people and academics. It suggests that research collaborations might be made easier to agree if model contracts could be developed on a voluntary basis to cover the ownership and exploitation of intellectual property (IP).

3.3. Technology transfer

Serbian universities have fairly strong science base, and there is significant potential to transfer this knowledge to business in the form of IP. These transfers take a range of different forms and could grow at a rapid pace in years that come. Most universities plan to develop technology transfer offices, but the main problem would be lack of trained and motivated staff.

However, there are a number of barriers to commercialising university IP. One is a lack of clarity over the ownership of IP in research collaborations. This makes negotiations longer and more expensive than otherwise would be the case, and it sometimes prevents deals from being completed.

Public funding for basic research, and for the development of technology transfer offices, is intended to benefit the economy as a whole rather than to create significant new sources of revenue for the universities. The most universities in Serbia tend to generate some amounts of money from their third stream activities, instead of acknowledge that their reason for engaging in technology transfer is to serve the public good.

A considerable barrier to commercialising university IP lies in the questionable quality of technology transfer offices. Most universities run their own technology transfer operations, but only a few have a strong enough research base to be able to build high-quality offices on their own.

Finally, it seems that there has been too much emphasis on developing university spinouts, a good number of which may not prove to be sustainable, and not enough on licensing technology to industry. It puts forward ideas for changing the balance in the future.

3.4. Intellectual property

It is important that the rewards from research collaboration should reflect the relative contributions of the parties to the partnership. Companies should have secure rights to the IP they want to commercialise, but it is also important that any deal on IP should not unreasonably constrain the university from publishing the results in a timely fashion, from doing further research in the same area, or from developing other applications of the same IP in different fields of use. It follows from both these points that there should be as much flexibility as possible in the distribution of IP rights between universities and business.

3.5. Regional issues

Universities are playing an increasingly important role in regional economic development, and development agencies are taking an active role in building bridges between business and universities across the regions and nations.

The Government should encourage the development of shared services in technology transfer on a regional basis and improve the recruitment and training of technology transfer staff.

3.6. Funding university research and public-private partnership

Higher education needs to be properly funded. According to the Lambert Review the European Union countries currently invest about 1.2 per cent of their gross domestic product in this area. A figure nearer to 2 per cent would be required to make the EU an effective competitor with the best in the world. The important difference between Europe and just about every other developed economy is that private finance plays a very modest role in its university funding. Thus public funding for higher education represents about 1 per cent of GDP for the 25 EU countries; roughly the same proportion as in the US. But private funding in the US amounts to a further 1.4 per cent of GDP and the average in countries of the Organisation for Economic Co-operation and Development is 0.8 per cent, compared with only 0.1 per cent for Europe.

If Universities are to be supported increasingly by private funding, from business, endowment, and third stream activity, it is important that the hard won autonomy from the state is not replaced by limitations imposed by private finance. A new form of buffer might be needed through good governance to effect this.

3.7. Skills and people

Companies are broadly satisfied with the quality of the graduates they recruit, although there are some mismatches between their needs and the courses offered by some universities. Prospective students would benefit from clearer market signals that are now available about what has happened to graduates from particular courses, in terms of their employability and pay.

Workplace experience is important to students, as is the opportunity to develop entrepreneurial skills. The Lamperts's review highlights a number of good schemes that are designed with this in mind, and suggests that universities could be doing more to provide continuing professional development to business employees.

3.8. Contract research, collaborative research and consultancy

Contract research, collaborative research and consultancy are three forms of collaboration between business and universities. In contract research, the business pays the university researchers to undertake a specific piece of research on its behalf. The business will receive the results of the research but is not actively involved in the work other than in commissioning it. Companies often use contract research for specific pieces of near-market research and testing, and universities will tend to charge at least the full economic cost for this work.

In collaborative research, the business and university researchers work together on a shared problem. Collaborative research tends to be more fundamental or pre-competitive in nature than contract research. Industry scientists and engineers will work alongside academic scientists and engineers on the research project. The research is co-funded by business and the university or a public sector body such as one of the Research Councils.

Consultancy takes the form of expert advice or analysis services. In practice the difference between consultancy and contract research is blurred – but the general distinction is that in consultancy the academic provides advice to the business rather than actually conducting research

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2013 International Conference on Technology Transfer

Summary of Recommendations Leading to the Knowledge Triangle Platform Based on Selected Excerpts From Lampert's Review and Smart Specialisation Platform

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Abstract

At the most basic level, universities can be anchor institutions in local economies as major employers across a wide range of occupations, purchasers of local goods and services, and contributors to cultural life and the built environment of towns and cities. Regional investment in the infrastructure of a university to support its core business of research and teaching can therefore have a significant passive regional multiplier effect even if the university is not actively supporting regional development. This article is to recommend to the attention of Serbian academic and business society some recommendations from the Lampert's Review and Smart Specialisation Platform that have relevance for Serbia concerning university–business cooperation. Most of the selected recommendations of the Review can be immediately applied to the Serbian case while some were rewritten to correspond better to the Serbian environment.

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Keywords: Smart Specialisation Platform; Knowledge Triangle; Lampert's review

1. Introductions

In terms of sustainable growth, universities as regional anchor institutions will need to mobilise a wide range of disciplines to inform the policies and practices of regional businesses, public authorities and households. The regionally engaged university can bring this diverse activity together by corporately responding to major societal challenges and in this way act as a bridge between the global and the local. Tackling these challenges will involve working with business and the regional community in the co-production of knowledge in living laboratories that foster social as well as business innovation and plugging into national and European policies regarding, for example, the digital and green agendas, entrepreneurship and social innovation. But to realise this potential to change the world outside of academia, universities will need to develop themselves as learning organisations by investing in their own human capital, particularly in those performing a boundary-spanning role.

Furthermore, enhancing the universities' capacity to reach out to regional business and the community will fail if sufficient capacity for innovation is not in place within the region. This will be a particular challenge in

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some less favoured regions where investment in the capacity of business, community organisations and public authorities to reach into universities will be required. This may involve regional public authorities encouraging co-operation between different actors in the higher education sector (universities, polytechnics, research and special purpose institutions, community colleges) to establish an appropriate division of labour that plays to the strength of each.

In order to achieve this, the following actions are recommended.

2. Demand for research from business

1. Recommendation

Government should seek ways of directing a higher proportion of its support for business R&D towards SMEs.

2. Recommendation

A priority should be to identify non-collaborating SMEs that have the potential to gain significant benefits from working with universities.

3. Recommendation

Government should establish Knowledge Transfer Partnerships programmes and market them to businesses. Increasing the regional focus of the scheme would allow it to be tailored more closely to the needs of local businesses.

Knowledge transfer

4. Recommendation

Universities and Technology Transfer Offices in Serbia should establish a database of academics with relevant qualifications who are interested in becoming non-executive directors on company boards and should arrange training for them in this role.

5. Recommendation

Universities, departments and faculties should develop their alumni networks in order to build closer relationships with their graduates working in the business community.

6. Recommendation

A range of model agreements should be developed, setting out various approaches to IP ownership, management and exploitation rights including, but not limited to, ownership of the IP by the university with non-exclusive licensing or exclusive licensing to industry.

Intellectual property and technology transfer

7. Recommendation

The Ministry of Education, Science and Technology Development and National Council for Science and Technological Development of the Republic of Serbia, in consultation with universities, industry representatives, should agree a protocol for the ownership of IP in research collaborations.

8. Recommendation

Concerning the IP protocol:

• The common starting point for negotiations on research collaboration terms should be that universities own any resulting IP, with industry free to negotiate license terms to exploit it.
• If industry makes a significant contribution it could own the IP.
• Whoever owns the IP, the following conditions need to be met:
1. The university is not restricted in its future research capability.
2. All applications of the IP are developed by the company in a timely manner.
3. The substantive results of the research are published within an agreed period.
• The protocol should recommend flexibility where possible to help ensure that the deal is completed.
• The Ministry of Education and Research and Technology Development and National Council for Science and Technological Development of the Republic of Serbia should require universities to apply the protocol in research collaborations involving any public funding.

9. Recommendation

The Government should increase the level of funding for technology transfer and knowledge transfer training to stimulate the development of new training courses.

10. Recommendation

As third stream funding increases, university technology transfer offices should actively seek to recruit individuals with industry background and experience.

Regional issues

11. Recommendation

Regional Development Agencies (RDAs) should be established to promote building business-university collaboration. They should set a specific milestone for building business-university links.

12. Recommendation

The Government should build a region's infrastructure for collaborative R&D projects with universities.

13. Recommendation

It is recommended that a partnership is established in the region to specifically address the issues of engagement between universities and regions and particular attention is given to ensuring the sustainability of partnerships in the longer term, independently of funding cycles.

Funding university research

14. Recommendation

The Government should take stock of the proposals in the review of research assessment and in the review of the sustainability of university research. It should consider the conclusions of these two reviews together when deciding on the future direction of research funding and policy.

From a business perspective, there are some principles that the Government should take into account in assessing the proposals contained in these reviews.

- There should be significantly more business input into the priority setting, decision-making and assessment panels of both of the peer review processes.
- The processes should be flexible and dynamic, capable of supporting new ideas and talent wherever they are found.
- Funding should be allocated in a way that actively supports multi-disciplinary research.

- The processes should be as simple and unbureaucratic as possible and should support the long-term sustainability of the research base.

15. Recommendation

Greater weight should be attached to the importance of disseminating research to a wider audience outside academia in an accessible format.

16. Recommendation

The Government should create a significant new stream of business-relevant research funding, which would be available to support university departments that can demonstrate strong support from business.

Skills and people

17. Recommendation

Ministry of Education, Science and Technology Development should require universities to publish information in their prospectuses on graduate and postgraduate employability for each department.

This information should include:

- Employability statistics and first destination data – to allow students to see whether particular courses are likely to be useful for specific careers.
- Starting salary data – to give students an indication of the value that employers place on graduates from particular courses.
- Other information relevant to specific disciplines.

Connecting Universities to Regional Growth

18. Recommendation

There should be an active attempt to a shift from 'transactional' to 'transformational' interventions with a greater emphasis on programmes rather than one-off discrete projects.

19. Recommendation

Universities, business communities and other public sector authorities should demonstrate their commitment to the process by investing in their own development.

20. Recommendation

Regional Partnerships should consider participating in the OECD programme of regional reviews in order to help identify their current strengths and areas that may require capacity building.

Acknowledgements

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2013 International Conference on Technology Transfer

New Regional Model of University-enterprise Cooperation

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Abstract

The paper deals with the aspects of university-enterprise cooperation, ranging from the preview of EU initiatives and programmes to the state of this area in the WBC region and identified needs, limitations and barriers. Within the WBC-VMnet project, a new WBC model of university-enterprise cooperation was developed. Accordingly, this paper briefly presents the new model with seven suggested strategy measures for establishing the sustainable cooperation between business and academy sector, as well as the results of its implementation in the WBC region. Additionally, some general recommendations and future steps for its further successful implementation and development are given which would lead to economic growth and development of Western Balkan region in the process of its transition to creation of "Innovating Region".

Keywords: University-enterprise cooperation; WBC region; knowledge triangle

1. Introduction

As pointed out in many EU strategic documents and policies, universities are key players for the successful integration of knowledge triangle, and transition of Europe into knowledge-based society. Having this in mind, there is a strong need for them to modernize in order to respond adequately to the market demands. They need to establish and maintain close cooperation with business world in general.

The importance of universities has increased during the last few decades, since they have become more accessible to significantly large number of people. At the same time, the labor market has undergone significant changes as well. It moved from industry to services, from production to research, design and development, influencing further changes in higher education and demanding new competences and profiles.

A clear picture of the present state has been reported at "EU Forum for University Business Dialogue" [1]: "*Universities, with their triple roles as providers of the highest levels of education, advanced research and path-breaking innovation, are at the heart of Europe's knowledge triangle. They have the potential to be crucial drivers of Europe's ambition to be the world's leading knowledge-based economy and society*."

Great efforts have been invested in initiating these interactions and in establishing and strengthening the university-enterprise links by tuning studies and academic education according to labor markets; feeding local economies with industry oriented research; and, defining industrial collaborations to find private partners as alternative means of founding.

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2. Review of past experience

2.1 Policies, strategies and legislation

University-enterprise cooperation has been recognized as strategically essential in the knowledge-based society, so European Union has initiated various programmes and initiatives, trying to actively involve all three interest groups in the achievement of mutually relevant objectives. EU's Lisbon strategy [2] includes strategically important part related to Policies for Education and Training. This important issue was raised by the Heads of States and Government, asking for not only a radical transformation of the European economy, but also a challenging program for education system modernization. The Bonn Declaration [3] appeals for the empowerment of all involved stakeholders. It emphasized that for sustainable and effective university-enterprise cooperation, its key actors must be actively engaged in structured dialogues and decision-making, which will ultimately lead to a better understanding of the knowledge society dynamics. Additionally, at the informal summit at Hampton Court in October 2005 [4], and at 2006 Spring European Council [5], it was highlighted that university plays a primary role as foundation of European competitiveness, and that additional actions were needed in the context of the renewed partnership for growth and employment. As a concrete action of such policy is Life-long Learning Programme 2007-2013 [6] (Erasmus strand), whose main objective is to help create educational and training systems that would fully respond to the industry and labor market needs and thus strengthen the link between academia and industry. In the Vision 2020 for European Research Area [7] (Brussels, 2 December 2008) the Competitiveness Council stressed the vital importance of intensified interaction between policy areas, notably higher education, research and innovation.

These themes were also presented as the main topic of the conference The Knowledge Triangle: Shaping the Future of Europe [8], focused on the central role the higher education in the knowledge triangle and for European competitiveness. The conference emphasized the need for continued political decision-making regarding the European Research Area and for development of the European Innovation Plan with main focus on the interaction between education, research and innovation at national and European policy level.

Horizon 2020 [9] is initiative aimed at securing Europe's competitiveness. As one of its main objectives, it envisages helping to bridge the gap between research and the market by creating innovative enterprises. This approach will include sustainable partnerships between universities as leading research entities and enterprises as mediums in the process of transformation of research into a product with a market potential.

To support the development of sustainable public-private partnership, European Commission has also produced several legal documents. According to specific field of their application and in particular with regard to university-enterprise cooperation, four main groups of actions can be identified: European Union policy in the field of research and innovation; Recognition of diplomas and qualifications in the European Union; Employment and Lisbon Strategy [10]. Within the Lisbon strategy the Commission has proposed the modernization of universities and since then the Modernization Agenda [11] has been the one of the subject of global knowledge-based economy. Those actions gather many legislative instruments, preparatory acts and court judgments covering almost all most important aspects relevant for the successful establishment of the university-enterprise cooperation, such as establishment of technology institutes, support to small and medium enterprises, funding, management of intellectual property in knowledge transfer activities, etc.

2.2 Past experience

Since the 1980s, the European Commission has been actively working on facilitation and reinforcement of university-enterprise cooperation through various programs for the promotion of education and training.

Thus, in 1986 the European Commission launched the Comett program [12] in order to strengthen the cooperation between universities and enterprises in the field of training and technology. One of the best examples of this project implementation was a partnership with European Centre for the Strategic Management of Universities, Educonsult, Europe & Projects, Sanon Developement International, and Austrian, Dutch, Finnish, French, Hungarian, Lithuanian, Norwegian and Portuguese national agencies. This project team analyzed about 200 participants from previously EU-funded projects, to identify barriers of transnational university-enterprise cooperation and define critical success factors.

By the 2006 Spring European Council the Commission proposed the establishment of the European Institute of Technology [13]. The idea was that this Institute contributes to the improvement of Europe's capacity for scientific education, research and innovation, by encouraging multi-disciplinary approach and developing the strong partnerships with business.

In the manufacturing field an important reference is given by the European Technology Platform Manufuture [14]. The mission of Manufuture is to develop and implement a strategy based on research and innovation, securing high added value employment and winning a major share of world manufacturing output in the future knowledge driven economy.

The summary of some experiences in university-enterprise cooperation was provided in 2007 within the project "University-enterprise cooperation: building on new challenges from past experiences" (in the framework of Socrates Accompanying Measure) [15]. It was run by the German Academic Exchange Service (DAAD) in a consortium with ESMU (European Centre for Strategic Management of Universities), and National Socrates/Leonardo Agencies from nine countries (Austria, Finland, France, Hungary, Lithuania, Netherlands, Norway, Poland and Portugal) and with the contribution of several European universities. The project analyzed the position of university-enterprise cooperation in EU education and training policies, in order to assess how universities have integrated this dimension in their strategic developments and activities, and to formulate recommendations on how the university-enterprise dimension can be further stimulated.

Within the Tempus programme, WBC-VMnet project [16] established efficient and effective mechanisms and structures of collaboration between key actors for the knowledge triangle throughout the WBC region – HE institutions, enterprises (especially SMEs), research and innovation centers, local and regional authorities. The project contributed to the improvement of modernization of HE capacity in the area of virtual manufacturing technologies, as condition for success of renewed Lisbon strategy (Figure 1).

Since the WBC-VMnet project was recognized as an example of good practice and received very positive response from the European Commission, the University of Kragujevac granted with new project WBCInno [17] started in October 2012. The main objective is to contribute to the modernization of the universities in the Western Balkans through the strengthening of its management structures and services for cooperation with the world of business, in the areas of knowledge transfer, research and innovation. This will ultimately lead to creation of strong entrepreneurial universities and innovative regions and increased number of start-ups, spin-offs, and new projects/services/businesses.

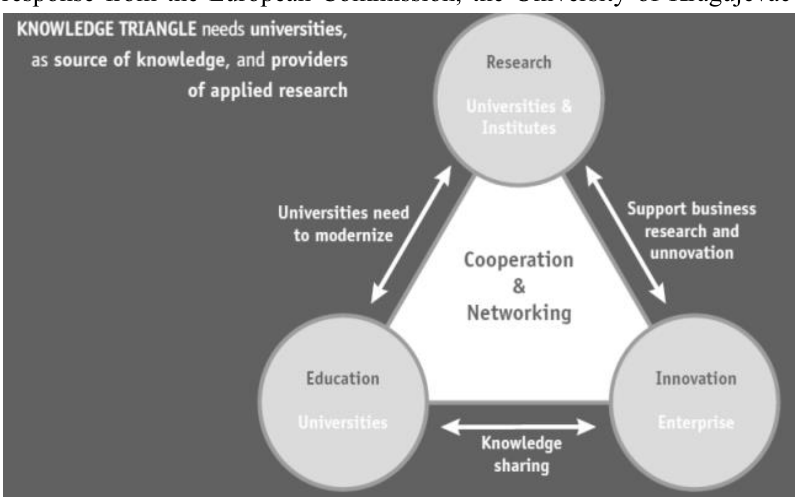

Fig. 1. Knowledge triangle

Additional example is KNOWTS [18] Tempus project resulted as the joint action of four Serbian universities. As the essential part of such initiative was establishing the platform and organizational structures for knowledge triangle at main Serbian universities and developing links between policy-making bodies, higher education, research institutions and companies.

3. Current state in WBC region

In the publication “WBC Regional model of university-enterprise cooperation” [19], a comprehensive analysis of regional and national background was carried out. Based on its results and the results of previous initiatives and similar projects, the following problems and needs relevant for the university – enterprise cooperation were identified:

- Although universities and enterprises already have policies in their mission statements where the need for such cooperation is recognized as significant, there is still a lack of effective links between them. This is mainly because efficient legal and policy arrangements that could provide a sound and supportive environment for such cooperation do not yet seem to have been established.
- Cooperation takes place mainly with large companies, because these have a critical mass of qualified staff who can find a common language with teachers and researchers, and who have better equipment and infrastructure, longer-term strategies and more financial resources.
- Universities find it difficult to attract other stakeholders, such as Ministries, Chambers of Commerce, Regional Agencies to be more involved in the facilitation of the cooperation among key actors.
- Despite the fact that universities consider SMEs the most relevant partners, cooperation with them is not so active since they do not have the same long-term perspective and usually look for immediate practical solutions.
- Since enterprises are generally not involved in the definition of higher education programmes, universities are mainly focused on theoretical knowledge that is insufficiently oriented towards professional practice and industry needs.
- Cooperation between universities and enterprises is generally at a very low level in terms of technology innovations and transfer; there are few support structures and platforms, and little dissemination of good practices for existing cooperation.
- Main barrier to the provision of services and trainings to enterprises and to more intensive knowledge and technology transfer is lack of finance.

4. Features of university-enterprise activities

Cooperation of universities and enterprises can be analyzed from different aspects, depending on which joint activities both sides are included in, and the effect they have on the key features of their successful cooperation. Features that characterize university-enterprise cooperation are listed below:

1. A clear policy, mission and vision of university-enterprise cooperation
2. Existence of functional structures/services for support, promotion and implementation of university-enterprise cooperation.
3. Involvement of enterprises in upgrading and updating the curriculum
4. Transfer of knowledge and technologies, joint university-enterprise research
5. Giving support to enterprise foundation and development of entrepreneurship
6. Mobility activities
7. University Involvement in local and regional development

5. New WBC model and its implementation

Universities and enterprises should be closely connected to and cooperate with each other for the common goal of pursuing social development. However, there are some cultural differences that should be resolved in order to make such cooperation sustainable. On one hand, university research is driven by individual curiosity and the desire to extend the boundaries of knowledge. The mission of most universities is teaching, research and outreach. So they foster a culture which supports sharing of information with colleagues and publication of the research results in peer-reviewed journals. On the other hand, contrary to universities, companies use science to develop products that can be sold and that can generate profit (as presented in Figure 2).

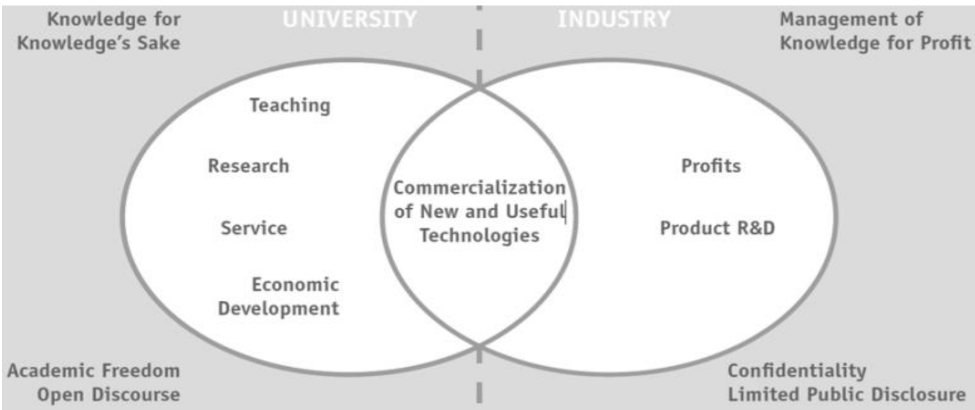

Fig. 2. Bridging and linking different cultures of academic and industrial sectors

But however great these differences may seem, the modern knowledge-based society and thus economy growth cannot be achieved without close cooperation between those two sides. Their symbiosis is essential and it leads to commercialization of scientific and technological knowledge produced in public funded research institutions and thus has a fundamental role in wealth creation, economic growth and technological innovations.

In order to develop higher education as fully integrated and adjusted to the needs of high technology industry and wider economic and social environment, countries in the Western Balkan region need to adapt their universities to rapidly changing knowledge and technology. Due to the specificity of WBC region, the new WBC model of university-enterprise cooperation is combination of the following seven strategic measures:

1. Establishment of Science and Technology parks in regional university centers;
2. Organization of WBC regional industrial clusters depending on field of research and business;
3. Forming University-enterprises consortia for joint participation in EU funded projects;
4. Establishment of regional Collaborative training and/or Life-long learning centres;
5. Setting up of Open Innovation Networks with SMEs;
6. Practical placements for students in industry;
7. Industrial fellowship programme for graduates and/or employees from enterprises.

5.1 Establishment of Science and Technology parks in regional university centers

Establishment of Science and Technology Parks (STP) should provide favorable environment and infrastructure in order to support the creation and development of new enterprises which commercialize

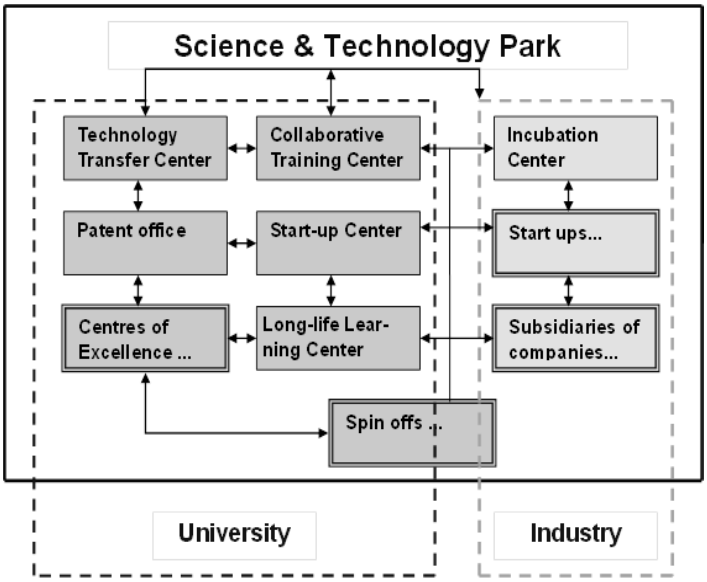

Fig. 3. Proposed scheme of Science and Technology Park structure

innovations from universities or research institutes

Within their scope of activity, STPs can offer the entire set of services (trainings, consulting, etc.) to tenant companies to help them survive on the research and development market. Fully developed, these parks can incorporate units such as Technology transfer center, Incubation center, Centers of excellence, Collaborative-training center, Patent or IPR support office, Start-up center; as well as Offices for start-ups, spin-offs and subsidiaries of large companies (as illustrated in Figure 3):

In Western Balkan region Science and Technology Parks can be also effective mechanisms for attracting foreign investment in order to create jobs in the field of high technology as well as for increasing the governmental budget. One of the important goals is also to prevent brain-drain phenomenon which has recently become specific for WB countries.

5.2 Organization of WBC regional industrial clusters depending on field of research and business

Organization of WBC Industrial Clusters has been recently recognized as successful model of universities-enterprises cooperation which increases mutual understanding and facilitates economic strength and competitiveness of the region. They represent the geographic concentration of economic activities in a specific field connected through different types of linkages, from knowledge share to the use of a common labor market. Their main objective is to promote knowledge and technology transfer among their members, including skills and expertise transfer from universities and research institutes to enterprises on one side, and enterprises' influence on the development of new courses at universities on the other side.

5.3 Forming University-enterprises consortia for joint participation in EU funded projects

Joint participation in EU projects is also extremely important for sustainable academy-industry collaboration. The vast majority of EU funded programmes support collaborative R&D actions between enterprises, universities and other research institutes across Europe. This is an outstanding opportunity for WBC institutions to link to and learn from the leading European research organizations and companies. Special contributions have been made within FP6 and FP7 programmes that resulted in achieving closer relationship between two sectors through their active involvement in activities on joint project ideas.

Another very important model of university-enterprise cooperation is collaborative research, mobility and networking through FP7 (Cooperation, People – ITN, IAPP and Capacity) and CIP projects, specially devoted to WBC region or convergence regions. Through participation in these projects, enterprises can achieve research synergies with universities and research centers, keep up with major technological developments and exploit benefits of R&D cost sharing. The increase in their knowledge base is the greatest reported benefit from such collaboration.

Cooperation between universities and enterprises can also be established within specially designed EU program EUREKA, helping make WB region economically strong and socially sound. EUREKA is the leading platform for R&D-performing entrepreneurs in Europe, gathering more than 40 member countries. It is industry-led, close-to-market initiative – with tangible results and visible benefits. It promotes international, market-oriented research and innovation through introducing new products, processes and services to market.

Collaborative Training Center of University of Kragujevac established in 2011 VRPM (Virtual/Rapid Prototyping/Manufacturing, https://cordis.europa.eu/partners/web/vrpm-group#) group at CORDIS portal, with the aim to propose and implement joint FP7/HORIZON projects with enterprises, SMEs, in the area of rapid and virtual product development and manufacturing. The VRPM group has 72 members from more than 20 countries, gathering 12 SMEs from Serbia and 15 Serbian researchers and R&D groups.

5.4 Establishment of regional Collaborative training and/or Life-long learning centres

Establishment of regional Collaborative training and/or Life-long Learning centers at university level provides efficient and sustainable cooperation within the knowledge triangle. Within WBC-VMnet project, four Collaborative Training Centers [20] were established in the WBC region (Kragujevac, Rijeka, Banja Luka, Podgorica). Their objectives are:

- o establish sustainable links between universities and enterprises through the development of a new regional model of cooperation based on the proven successful EU models;
- to provide services for improvement of existing and development of new innovative products, processes and tools for companies, small and medium-sized enterprises;
- to provide quality and useful research result, which will launch funding of innovation in enterprises
- to develop new and modernize existing vocational training programs in accordance with the needs of enterprises and labor market;
- to play an active role in the spreading WBC VMnet Network;
- to enable students to gain practical knowledge and skills in the industry;
- to create opportunities for involvement in a number of international projects.

One of the activities of the CTC centers within WBC-VMnet Tempus project was to develop and implement a comprehensive Training & Service Needs Analysis (TSNA) [21] in countries of the WBC region. The main goal was to identify knowledge and skills gaps, weaknesses and new competence requirements in regional enterprises (especially SMEs) and labor market. The analysis carried out in 2009 according to the proposed five-step methodology, covered a sample of 49 enterprises in Serbia, 31 enterprises in Croatia, 18 in Montenegro and 19 in Bosnia and Herzegovina, from different sectors. For that purpose, more than 800 questionnaires were collected, which gave a clear insight into the strategic objectives of the enterprises, their organizational and innovative potential, position on domestic and foreign market as well as analysis of skills and knowledge of employees necessary for products and processes development.

TSNA results showed that there is a lack of information on the available trainings, because more than 70% of the surveyed answered that they weren't familiar with who carried out the trainings they needed, while only 17% declared that the offered trainings met their needs. 72% of managers plan their own development in the application of new technologies through collaboration with local teams of experts, and 96% of them would send their employees to trainings related to new technologies in the development of products and processes. Based on these results, CTC centers developed the 18 customized trainings to respond directly to the needs of enterprises and labor market. Almost 300 engineers from industry and unemployed have been trained until now.

Fig.4. Collaborative environment for rapid product development

CTC centres develop and apply virtual engineering technologies in collaborative environment for rapid product development (Fig.4), consisting of:

- Computer aided design and manufacturing
- Rapid prototyping and manufacturing
- Virtual manufacturing based on non-liner Finite element and Finite volume methods
- Optimization of production process
- Virtual Reality applications in engineering and medicine.

3D model of a product/tool can be also rapidly generated in digital form using reverse engineering, remodelled and exported to one of the systems for rapid prototyping, rapid tooling or rapid manufacturing (RM). Virtual and rapid prototypes obtained in this way can be used for testing the functionality of product or assembly and different concepts in the early stage of design without expensive and long-term trial-and-error attempts in traditional design and production.

5.5 Setting up of Open Innovation Networks with SMEs

Setting up of Open Innovation Networks with SMEs is a well-tested method in European countries for effective transfer of knowledge and technologies. Active exchange of experience within a network is a priority in fostering cooperation between industry and university, and among different enterprises in the same supply chain and even among competitors. Involvement of university structures in development and managing of innovation networks can be facilitator of mutual cooperation in future, as well as efficient tool for modernization of university towards society needs. In line with this, Centre for Virtual Manufacturing at Faculty of Engineering University of Kragujevac established Virtual Manufacturing Network – VMnet [22] as efficient industrial-science link, which has more than 1380 members (large companies, SMEs, R&D organizations, NGO, Agencies for SMEs, entrepreneurs, managers, engineers, researchers, students etc.) and 18 experts from WBC region. Apart from expertise of 18 experts offered within VMnet, enterprises can also get quality, timely and inexpensive development cycle and may optimize the existing products and processes, as precondition for increasing their competitiveness on the market (Fig 5).

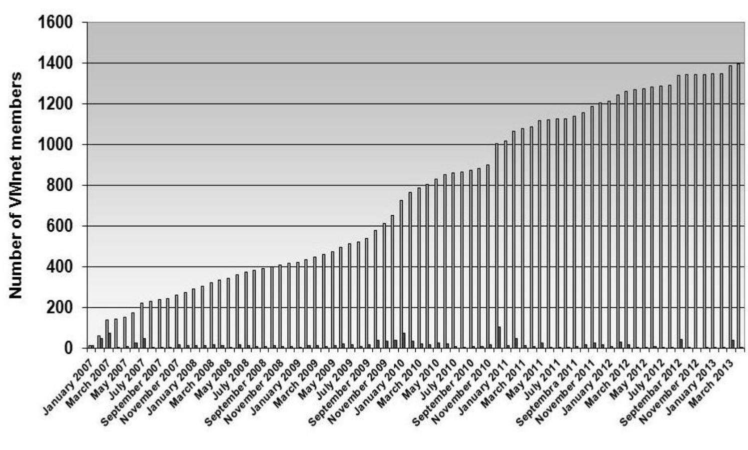

Fig.5. Growth of WBC VMnet network in WBC region

5.6 Practical placements for students in industry

Although practical placements of students in industry have been incorporated in the engineering study curricula, during the last ten years, there was an significant decline in higher education-industry relations, thus students did not have quality organized practical placements. In order to improve existing practical placement realization at WBC engineering area, WBC-VMnet project developed and implemented

Practical Placement Programme (PPP) [23], providing the opportunity for students to gain practical experience and further develop their professional, technical and interpersonal skills. In this way, enterprises could benefit from the input of fresh ideas and skills, developing links with universities and the opportunity to assess prospective employees, and students could gain through obtaining a well-rounded degree, having chance to apply their theoretical knowledge to real industry situations. During the period 2010-2012, 10 student PPPs were realized in EU countries, 12 PPPs in other WBC countries and more than 200 PPPs at local/nation level.

5.7 Industrial fellowship programme for graduates and/or employees from enterprises

Industrial fellowship programme (IFP) for graduates and/or employees from enterprises is intended to establish sustainable partnerships between universities, enterprises and graduates. Highly qualified graduates or employed engineers (industrial fellows) spend minimum 6 months to 2 years at University research and/or excellence centers, for professional development, participating in specific research projects targeted to industry needs and company business. As an example of good practice, a successful IFP program was developed within WBC-VMnet project [24]. Since it started with realization in 2011 within four CTC centers in the WBC region, the total of 30 industrial fellows have participated within different areas of Working programmes, in accordance with their companies' needs and agreement with the CTC centers.

6. Conclusions and future steps

The suggested regional model of university-enterprise cooperation is not the traditional linear model, based on the transfer of research results to industry through publication or mobility of graduates but rather so-called "Assisted Linear Model" comprising a variety of interlocking mechanisms, defined as seven strategic measures such as: 1) Establishment of Science and Technology Parks (STP); 2) Organization of WBC Industrial Clusters; 3) Joint participation in EU projects; 4) Establishment of regional Collaborative training and/or Life-long Learning centers; 5) Setting up of Open Innovation Networks; 6) Practical placements of students in industry and 7) Industrial fellowship programme

The proposed new regional model of university-enterprise cooperation has been successfully implemented since its launching. From previously described mechanisms and existing structures of new WBC model of university- enterprise cooperation, the following recommendations can be summarized:

- transition of researchers from academic sphere to enterprises should be accelerated through a greater emphasis on the mobility aspects of the best young researchers;
- appropriate tax incentives should be introduced for projects involving knowledge transfer from universities to enterprises in order to encourage innovation in SMEs;
- establishment of Science and Technology Parks should be encouraged with activities to promote networking between their tenants;
- industrial clusters should be encouraged to move to internationalization so that they develop an outward exporting orientation and link up with international systems of innovation;
- universities should boost their incubation centers to provide more support to researchers to commercialize their application oriented research results though the creation of new spin-off enterprises;

- Technology Transfer Centers should be established to handle property rights issues and the licensing of inventions and innovations created in university laboratories and to encourage patenting and licensing of technologies to enterprises;
- universities should focus more on applied research activities.

An important future step towards strengthening the cooperation between academia and industry is to incorporate the proposed WBC model in corresponding strategic documents such as Regional Development Plans or Scientific and Technological development Strategies or university memoranda, etc. Furthermore, it is necessary to establish new institutional arrangements of university–enterprise–government relations.

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Serbian National Technology Platforms as an Effective Framework of Technology Transfer for Sustainable Industrialization of Serbia – Part 1

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Abstract

This two part paper presents general information about the Program of National Technology Platforms of Serbia (NTPS), which was initiated and implemented by Academy of Engineering Sciences of Serbia. This program is based on European Technology Platforms, (ETP). ETP program was developed ten years ago by European Commission as new political instrument focused on three main targets: 1) Provide a framework for stakeholders, led by industry, to define research and development priorities, 2) Ensuring an adequate focus of research funding on areas with a high degree of industrial relevance, and 3) Address technological challenges that can potentially contribute to a number of key policy objectives which are essential for Europe's future competitiveness. Following the ETP approach AINS was developed a national equivalent, which is closely related to specific needs of Serbian industry, national research and technology priorities, as well as the European integration processes of Serbia. This paper covers general information about NTPS program, its structure, organization and implementation plan, and in particular, development of network of individual platforms carefully designed to optimally support industry recovery process and its future sustainable growth base on extensive technology development and technology transfer.

"Keywords: European technology platforms; Knowledge and technology transfer; Industrialization;"

1. Introduction

For more than two decades Serbian economy is under intensive process of deindustrialization. However, political attention, the new industry policy [1], as well as the strategy for growth and economical development of Serbia (Serbia 2020 document, [2]) are strongly focused on industrial development, recognizing industry as a vital element of the national economy.

During the transition period, especially in the past decade, Serbia has adopted market economy. Although it was not as effective as expected, privatization process of industrial infrastructure is almost finished. Industrial

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development policy which Government effectively applies in practice is almost exclusively limited on providing the ambient for attracting foreign investments. The key competitive advantages are low wages, financial stimulations for every newly opened workplace as well as other types of financial measures that stimulate business. But this approach has not shown its effectiveness in practice as expected. Even more, deeper analysis easily shows that this approach is not sustainable on a long-term basis. This is true, either socially or technologically. Focusing to the financial supporting instruments only is necessary, but not sufficient for the future. Current industrial policy should recognize the value of technology.

Serbia cannot compete on the costs alone. The engineering and scientific knowledge of industrial technologies should have a central role to play in helping industry to recover, especially to recover its technological and structural foundations and by that to adjust to the pressures of globalization. It is essential that all sectors are important, regardless of their technology intensity, including low-technology sectors where traditional industry in Serbia is located mainly. In this context, fostering innovation, retaining and developing highly skilled human resources, especially engineers and young researchers that are closely connected with manufacturing technologies, are of crucial importance.

Economic globalization refers to increasing economic interdependence of national economies across the world through a rapid increase in cross-border movement of goods, service, technology and capital. It is a paradox that in a globalised economy location remains a crucial factor for research and innovation. This is the chance for Serbia, especially for Serbia in future, when it becomes a part of European community.

At the Lisbon European Council on 23 and 24 March 2000, the Heads of State or Government resolved to make Europe's economy the most competitive knowledge-based economy in the world, working on increasing jobs, greater social cohesion, and on economic growth until 2010. Following the Lisbon agenda, and later stated Barcelona target of 3% GERD (Gross Domestic Expenditure on R&D) by 2010, European Commission has developed a new instrument with the mandate of helping to further mobilize private and public R&D investments in research and innovation. This instrument is named European Technology Platforms (ETPs).

This paper starts with general information about European technology platforms. Then, in the Part 2 of this paper, the text is addressed to the Program of National Technology Platforms of Serbia (NTPS), providing the information on its general concept, its rational as well as its roadmap for the future actions, together with pilot actions which are already initiated or which should be started in close future. In particular, in the second part of this paper is presented the first individual national platform NTPS-Production, which is focused on recovery of Serbian industry and made it ready, in technological sense, for European integration processes.

2. European technology platforms Error! Bookmark not defined.

ETPs were first introduced officially in the EC Communication "Industrial Policy in an enlarged Europe" [3] in December 2002. In this document is exactly stated: "Technological platforms could be considered to foster marketplaces for cooperation among stakeholders and work out a long-term strategic plan for R&D for specific technologies involving major economic or societal challenges, such as the advent of hydrogen as a new source of energy. They would ensure synergy among public authorities, users, regulators, industry, consumers, and poles of excellence viewed as places where basic research and technology transfer are closely linked. There is a need for coherence between research, which can create new opportunities, and the downstream regulatory framework in which these technologies can be developed and marketed."

The ambition was to bring together R&D-relevant stakeholders with various backgrounds (e.g. regulatory bodies at various geo-political levels, industry, public authorities, research institutes and the academic community, the financial world and civil society) who would develop a long-term R&D strategy in areas of interest to Europe. The set up of an ETP follows a bottom-up approach in which the stakeholders take the initiative and where the European Commission evaluates and guides the process, [4].

After almost then years of existence, and systematically collected experience from development of respective number of individual platforms, each of them targeted to specific EU societal challenges, the concept of ETP that was outlined in its very beginning has been largely confirmed, [5], [7], [8]. Recent development activities are focused into two directions, both straightening the role of ETP concept, [8], [9]:

- Tackling the grand societal challenges – ETP and European research community must focus on the challenges (such as global warming, tightening supplies of energy, water and food, ageing societies, public health, pandemics and security, as well as the overarching challenge of turning Europe into an eco-efficient economy) that European society faces in the 21st century, moving beyond currently present rigid RTD thematic approaches, and
- Straightening interaction between European Technology Platforms and national research actors.

The later one is of high importance for Serbia, because it makes a room for setting-up a comprehensive national program of establishing technology platforms that is well concentrated on Serbian societal challenges and well aligned with national specificities, starting from historical and geographical aspects, up to the current economy situation as well as adopted priorities within actual research and industry policies.

2.1. Three stage bottom-up process

European Technology Platforms are an effective means of defining research and development priorities, timeframes and action plans on a number of strategically important issues where achieving future growth, competitiveness and sustainability objectives is dependent on major research and technological advances in the medium to long term. ETPs focus on areas of significant economic impact and high societal relevance where there is high public interest. EPTs are focused on three main targets:

- Provide a framework for stakeholders, led by industry, to define research and development priorities, timeframes and action plans on a number of strategically important issues where achieving Europe's future growth, competitiveness and sustainability objectives is dependent upon major research and technological advances in the medium to long term,
- Ensuring an adequate focus of research funding on areas with a high degree of industrial relevance, by covering the whole economic value chain and by mobilizing public authorities at national and regional levels,
- Address technological challenges that can potentially contribute to a number of key policy objectives which are essential for Europe's future competitiveness.

The development of European Technology Platforms is essentially a “bottom-up” process, [4]. Hence, it is the stakeholders themselves who take the initiative to set up a European Technology Platform, with the support and guidance of the European Commission, as appropriate.

In practice, the ETP concept is performing as a set of individual technology platforms. Each individual platform has its own origins and approach and its own particular way of working. In most cases individual technology platforms follow a three-stage process and that successful completion of each is a prerequisite for effective implementation of the subsequent stages (Figure 1).

Stage 1 - Emergence and Setting Up: In this stage, stakeholders are brought together. Industry plays an initiating role in this regard with the aim of achieving consensus on the way forward. The main deliverable is a strategic vision document reflecting this consensus and endorsed by top executives from leading companies in the sector. The vision document explains the strategic importance of the activity and gives an outline of the desired medium and long term development objectives of the platform. It also explains why action at European level is required. At this stage, the main principles for the governance of the platform have to be established.

Stage 2 - Definition of a Strategic Research Agenda: The Strategic Research Agenda is the key deliverable of a technology platform. It should set out research and technological development priorities for the medium to long term, including measures for enhancing networking and clustering of the RTD capacity and resources in Europe. The definition of a Strategic Research Agenda is commonly co-ordinated by an advisory council that includes representation from a wide range of stakeholders. In many cases, the active involvement of Member States is channeled through a "mirror group" that reflects their views as the Strategic Research Agenda takes shape. Steering panels undertake the detailed work of defining the Strategic Research Agenda, often supported by specialized working groups.

In parallel with the definition of a Strategic Research Agenda, European Technology Platforms begin to specify a deployment strategy at this stage. The deployment strategy anticipates the key elements required in order to implement the Strategic Research Agenda effectively with the aim of bridging the gap between the current state of development of a given technology and its eventual deployment. It should take into account, for example, the need for mechanisms to mobilize private and public investments, strategies to implement optimal demonstration activities, actions related to education and training and the establishment of an ongoing communication process. It should also capitalize on possible synergies with other European Technology Platforms and address any possible overlap or duplication of activities across platforms.

Stage 3 - Implementation of the Strategic Research Agenda: During this phase, the Strategic Research Agendas defined within European Technology Platforms are implemented with the support of Community research programs as appropriate, where they are compatible with the objectives of European research and competitiveness policies, together with other policies where relevant. At the same time, the Strategic Research Agendas will make an important contribution to the preparation of the Commission's proposals for future research programs. It is, however, important to stress that the implementation of Strategic Research Agendas is likely to involve support from a range of sources, including the Framework Program, other sources of European funding, national research programs, industry funding and third-party private finance.

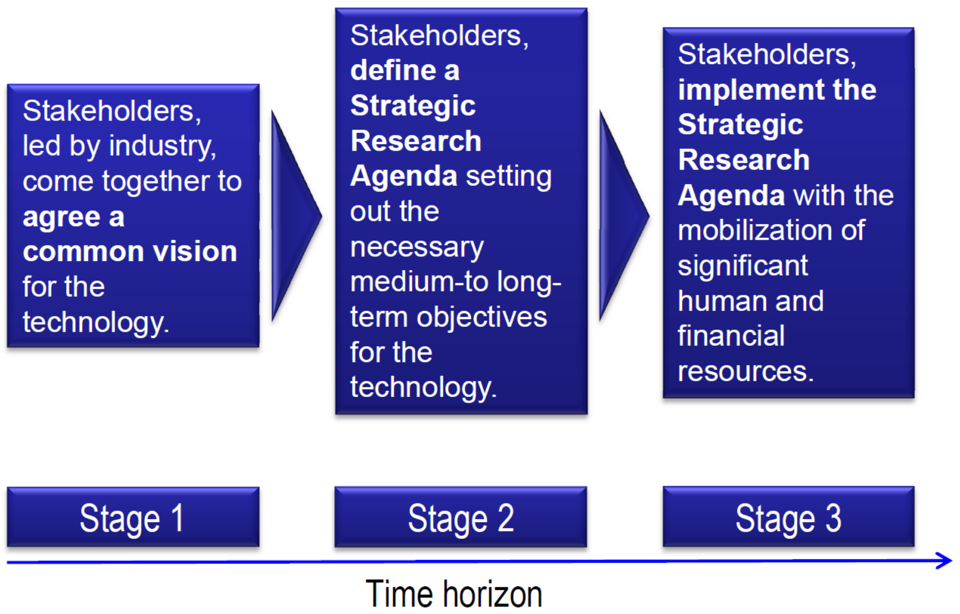

Fig. 1. Evolution stages in setting-up individual technology platforms, [6]

As the shape of a European Technology Platform evolves through these three stages, it remains flexible and open to entities joining or leaving the platform as well as to the integration of new initiatives. Thus, as it moves from the vision and strategy phases to the implementation phase, its character and structure can also change.

There are currently 36 individual European technology platforms at various stages of development (ref. ETP web-site):

ACARE	-	Advisory Council for Aeronautics Research in Europe
ARTEMIS	-	Embedded Computing Systems
Biofuels	-	European Biofuels Technology Platform
ECTP	-	European Construction Technology Platform
eMobility	-	Mobile and Wireless Communications
ENIAC	-	European Nanoelectronics Initiative Advisory Council
EPoSS	-	European Technology Platform on Smart Systems Integration
ERRAC	-	European Rail Research Advisory Council
ERTRAC	-	European Road Transport Research Advisory Council
ESTEP	-	European Steel Technology Platform
ESTP	-	European Space Technology Platform
ETP SMR	-	European Technology Platform on Sustainable Mineral Resources
EuMaT	-	Advanced Engineering Materials and Technologies
EUROP	-	European Robotics Technology Platform
FABRE TP	-	Farm Animal Breeding and Reproduction Technology Platform
Food	-	Food for Life
Forestry	-	Forest based sector Technology Platform
FTC	-	Future Textiles and Clothing - FTC
GAH	-	Global Animal Health
ETPIS	-	Industrial Safety ETP
ISI	-	Integral Satcom Initiative
Manufuture	-	Future Manufacturing Technologies
NanoMedicine	-	Nanotechnologies for Medical Applications
NEM	-	Networked and Electronic Media
NESSI	-	Networked European Software and Services Initiative
Photonics21	-	European Technology Platform for Photonics
Photovoltaics	-	European Photovoltaic Technology Platform
Plants	-	Plants for the Future
RHC	-	Renewable Heating & Cooling
SmartGrids	-	European Technology Platform for the Electricity Networks of the Future
SNETP	-	Sustainable Nuclear Energy Technology Platform
SusChem	-	European Technology Platform for Sustainable Chemistry
TPWind	-	European Technology Platform for Wind Energy
Waterborne	-	Waterborne European Technology Platform
WSSTP	-	Water Supply and Sanitation Technology Platform
ZEP	-	Zero Emission Fossil Fuel Power Plants

2.2. The role of European commission

In the course of the development of the technology platforms, the European Commission has the role which is defined by following clarifications [11]:

- The Commission is not the owner of technology platforms, nor is it directing the way in which they are undertaking their activities.

- The Commission is however encouraging bottom-up, industry-led approach to defining medium to long-term research needs through:
    - Its active participation as an observer in many of the platforms;
    - Playing a guiding role where necessary;
    - Providing limited Community financial support for operational entities (for example a Secretariat) to some of the platforms where their objectives and activities correspond closely with the thematic areas of actual research programs; and
    - Maintaining the Community's sponsoring role through the continued funding, where appropriate, of collaborative research projects in many of the areas concerned.
- Whilst not bound by the views of technology platforms, the Commission services are closely co-ordinating their activities in this area, monitoring developments on an ongoing basis and, where appropriate, using their deliverables in the course of developing research policy.

2.3. Openness and transparency

The issue of openness and transparency has been identified as of crucial importance for the successful development of technology platforms. At a seminar held on 15, December 2004 in Brussels, the industrial leaders of the existing and emerging platforms committed themselves to respect a voluntary code of conduct on openness and transparency. For their individual platforms, they will set and make public clear and transparent rules of participation (including rotation of members in key bodies) and ensure full transparency (web-site, conferences, reports and other documentation).

Each platform is free to decide for itself how to implement these principles and a range of initiatives have been taken in this respect.

An open and transparent platform is one which respects three key principles [10]:

Openness refers to the degree to which a European Technology Platform encourages and allows the participation of a broad range of stakeholders in its activities. It also relates to the level of cooperation with national and regional public authorities, as well as with other platforms.

Accountability refers to the existence and clarity of rules and procedures within the European Technology Platform structure, as well as to the process for monitoring and adapting platforms' activities according to changing priorities and circumstances.

Transparency refers to the measures taken by European Technology Platforms to communicate openly with their target audiences, including the general public, and to provide full and up-to-date information about their current status and activities.

Openness and transparency are key to the success of European Technology Platforms. The involvement of a broad range of stakeholders in defining their common vision and research agendas will increase commitment to these objectives and, hence, the platforms' effectiveness.

2.4. National and regional dimension

Using Mirror Groups instrument, ETP concept was extended to the national level. Member States deployed Mirror Groups widely. Mirror Groups are normally composed of experts nominated by the Member States and aim to facilitate coordination and provide an effective two-way interface between ETPs and complementary activities at a national level. Parallel to the Mirror groups, national platforms started to emerge based on NRTP mechanism, typically focusing on a part of the research agenda of interest to national research players. Currently, national TPs exist in different forms. In most cases they have been set up following a national call for proposals, with varying degrees of involvement of European TPs in the process. Some national TPs operate as national branches of the corresponding ETP, but other are mainly coordinated with their national government. Some countries have a very high number of national TPs because they have decided that the concept serves them well for national policy purposes. Other countries, however, have chosen a limited number of research and social priorities and have promoted the establishment of the corresponding TPs. In this way, public authorities are actively involved in ETPs in their roles as policy-makers and funding agencies, and as promoters and consumers of technologies, focusing on those ETPs which are more relevant for their national industries, research organizations and academia.

Outside the EU community, there are also activities which are related to the process of building up national system of technology platforms, following the core ideas of the ETP concept.

In the year 2011, pursuant to the Resolution of the Governmental Commission for High Technologies and Innovations the Ministry of Economic Development of the Russian Federation in cooperation with the Ministry of Education and Science of the Russian Federation, established 30 Technology Platforms on the priority spheres of developing science and technology seen as a new driver of innovation growth of the Russian economy. In 2012 three more Technology Platforms were submitted for approval. Currently, these self-organizing structures involve hundreds of industrial enterprises, organizations of applied and academic science, higher educational institutions, and initiative groups of developers. The Technology Platforms have achieved significant successes in forming and implementing the strategic research programmes and defining the long-term priorities of the economy with regard to their core business. Russian Foundation for Technological Development and the Ministry of Economic Development provide financial contribution to the projects developed by the Technology Platform member-organizations. The Foundation organizes and conducts the competitive selection of the innovative projects, included into the Road Maps and Strategic Research Programmes; 10 projects presented by seven Technology Platforms have been already financed for a total amount of 1,134 million rubles (app. 28 million EUR), [12]. Russian technology platform for manufacturing is formally organized under the technology platform named: 'Simulation and operation practice of high-tech systems (industry of the future)', [13]. This platform was established by 21 industry and scientific organizations in February 2012 (accomplished precisely formulated procedure and approved by Decree of the Presidium of the Government Commission for High Technologies and Innovations) and has strong cooperation with ETP ManuFUTURE platform.

For Serbia, particularly important activities are in the Western Balkan region, where already established national technology platforms are, following the model of ETP. Croatian government has established their national technology platforms program in 2009 under the name: Hrvatske tehnologijske platforme (established Povjerenstvo za tehnološke platforme Republike Hrvatske). The program is developing through the specialized scientific institution: Hrvatski institut za tehnologiju – HIT. The process of establishing and developing national program of technology platforms in Slovenia was more intensive then in Croatia, mostly due to the role of Janez Potočnik, who was the European Commissioner for Science and Research, and who was personally engaged in development and implementation of ETP program. As an EU member, Slovenia established their own national program of technology platforms in 2005, when Slovenian government, i.e., their Ministry for Higher Education, Science and Technology, following the ETP model, launched a call for proposals for formation of the national technology platforms, suggesting the model based on cooperation with individual European technology platforms.

3. Concluding remarks

In this two part paper are presented basic aspects of European technology platforms, as a new instrument that was established by the European Commission with the aim to strengthen interaction of industry and research area which was recognized as the key factor for the creation and development of knowledge-based society. European technological platform has demonstrated their full effectiveness and potential in practice.

Serbian economy is faced with crisis that lasts almost two decades. Its excessive length hardly destroyed the national economy, especially industry. Industry data show horrifying consequences. Industrial growth and technological development that existed in the period before the crisis were almost completely stopped. The industrial production volume has been reduced to the level of the seventies, the contribution of industry to national GDP was halved, and the number of industrial workers has been reduced to 1/3. The way out of the crisis requires economic growth, but the economic growth is impossible without a strong, productive and competitive industry. The strong industry requires a strong and dynamic technological base. Recognizing these needs, the Academy of Engineering Sciences of Serbia has conceptualized and developed a program of national technology platforms, i.e., NTPS Program. In its basis, NTPS Program is derived from the concept of European technology platforms. Although it is in its beginning, significance of the NTPS Program was recognized by the relevant public authorities and embedded in the industrial policy 2020 as one of strategic pillars, dedicated for recovering of technological basis of Serbian industry and for rising high technology content in all industrial activities. The NTPS Program was started its implementation stage by launching the first individual technology platform NTPS-Production as a pilot action, aimed to show practical value of the NTPS concept and to prove potential of the NTPS Program in whole under the real industrial scenario.

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Serbian National Technology Platforms as an Effective Framework of Technology Transfer for Sustainable Industrialization of Serbia – Part 2

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Abstract

This two part paper presents general information about the Program of National Technology Platforms of Serbia (NTPS), which was initiated and implemented by Academy of Engineering Sciences of Serbia. This program is based on European Technology Platforms (ETP). This program was developed ten years ago by European Commission as new political instrument focused on three main targets: 1) Provide a framework for stakeholders, led by industry, to define research and development priorities, 2) Ensuring an adequate focus of research funding on areas with a high degree of industrial relevance, and 3) Address technological challenges that can potentially contribute to a number of key policy objectives which are essential for Europe's future competitiveness. Following the ETP approach AINS was developed a national equivalent, which is closely related to specific needs of Serbian industry, national research and technology priorities, as well as the European integration processes of Serbia. This paper covers general information about NTPS program, its structure, organization and implementation plan, and in particular, development of network of individual platforms carefully designed to optimally support industry recovery process and its future sustainable growth base on extensive technology development and technology transfer.

Keywords: European technology platforms; Knowledge and technology transfer; Industrialization;

1. Serbian national technology platforms programm

The program of the national technology platforms was initiated and developed by the Serbian Academy of Engineering Sciences with the aim of introducing technological dimensions and engineering to the process of recovery and development of Serbian industry, which is recognized as a vital element of the national economy, equally in the past as in the future. This process is planned to be achieved through comprehensive and interdisciplinary set of activities which should be carried out within the development triangle, consisting of three nodes: industry, research and investment.

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The development triangle (Figure 1) can actually be seen as a special kind of a transformation machine, with extreme complexity, which transforms money into knowledge, knowledge into innovation and innovation into money through high added value product delivered to the market. This circular mechanism of functioning is the very essence. Full circular functionality of the development triangle provides the basis for achieving industrial growth, creating a helix of development in time and maintaining sustainability of such processes on a long-term basis, equally in the social, economical and environmental plane. Society, in which the nodes of this triangle are equally developed, operational and mutually interactive, renders the development triangle functional, i.e., it becomes the money making machine which generates social welfare and prosperity.

NTPS Program is nested within the development triangle and its mission is to harmonize its internal processes, focusing on the engineering and technological aspects only. At the moment, the development triangle of Serbian economy is unbalanced and nonfunctional. Its nodes are asymmetrically developed, and the interconnections between them are weak or even broken. The dysfunctionality of the development triangle is one among the most important reasons for stagnation of the Serbian economy, especially the Serbian industry, creating economic difficulties, social problems and poverty that Serbia faces a number of years.

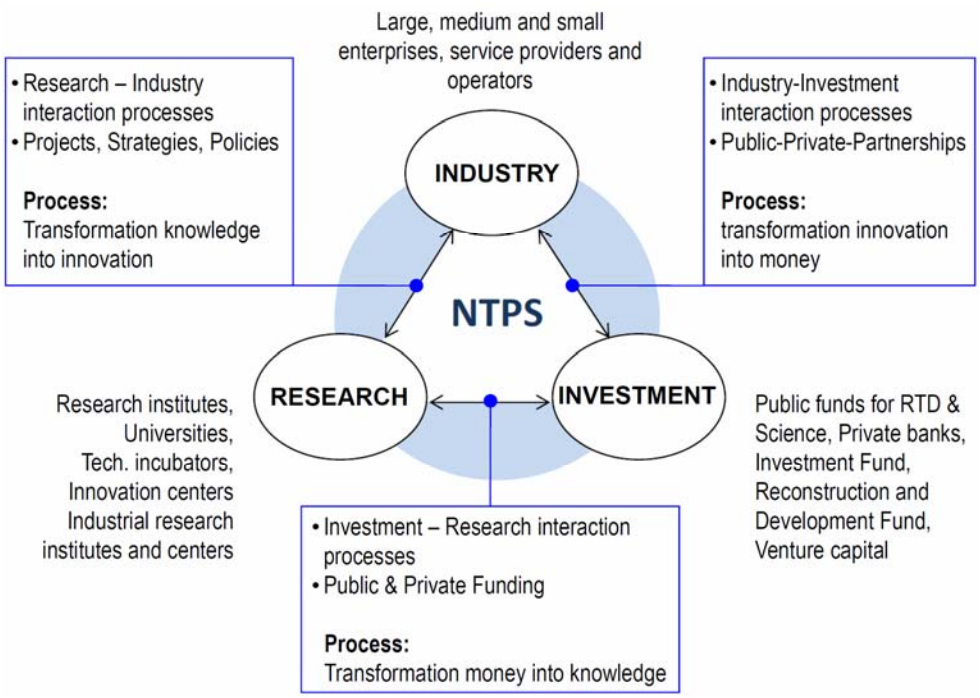

Fig. 1. Technology development triangle

NTPS Program was formally launched in the year 2010 and for its development and implementation is responsible the AINS Committee for technology platforms, i.e. NTPS Committee, which has multidisciplinary engineering structure, composed of eminent professors and researchers appointed by the Council of the Serbian Academy of Engineering Sciences. NTPS Committee has the mandate to conceptualize the basic framework of the NTPS program, taking into account both national and international aspects, and also to stimulate and monitor the implementation of this program in the research and industrial area of Serbia. NTPS program is generally based on the concept of European Technology Platforms and in all aspects of its activity is tightly focused on establishing and developing various forms of cooperation, especially with individual technology platforms having strategic research agendas complementary with research and development priorities of Serbia. The NTPS program is a link to the European Technology Platforms.

NTPS Program is recognized by Serbian Ministry of Science and Education as a program of strategic importance for technology development, technology transfer and innovation system development. Moreover,

NTPS Program is incorporated in Serbian industrial policy 2020 as a pillar of strategic importance for growing high technology content in Serbian industry through extensive cooperation between scientific institutions and industry [1].

1.1. Basic objectives

NTPS program has four basic objectives:

- Providing a new formal framework for smart and systemic transformation of technological basis of Serbian industry;
- Strengthening Science - Industry interaction by focusing of RTD programs and funding to areas of high relevance to Serbian industry and stops the situation in which investment in R&D often produces fewer than expected;
- Focus on technology as important component for European integration process;
- Recognition of technology challenges that can potentially contribute to the realization of key societal priorities and challenges and delivers benefits to the Serbian citizen.

Regarding the methodological framework, NTPS program draws its foundations from the respective national potential for technology research and development (well developed educational system and extensive RTD infrastructure), the respective industrial tradition that spreads out for nearly two centuries, and also cultural and regional specificities. Besides previously mentioned, the methodological framework of action of the NTPS Program includes as follows:

- Transfer of ETP concept into Serbian industry, ETP scaled down to the national level;
- Synergies with the EU level through a extensive cooperative relationships with the individual ETPs;
- Broad mobilization of industrial companies, industry associations, RTD institutions and universities, public authorities and the holders of investment capital;
- Partnership with Government and other state regulatory bodies in creating a stimulating environment for industry recovery and growth - strong political support;

1.2. Structure and guiding principles

Although the European technology platforms are designed as bottom-up instrument, experience shows that pure bottom-up approach is not quite suitable for its use in the economies of Eastern European countries (Polish Technology platforms for instance). To make it really effective it is necessary to ensure sizeable participation of state regulatory bodies and other state institutions. That is the essential difference and this difference is very important. Therefore, from the beginning, when AINS started to consider how to establish the program of national technology platforms which will be truly functional and capable to generate benefit to Serbian industry and research community, decision was made that this program should be a compromise, combination between top-down and bottom-up approach. It means that the program must have one strong central entity which will define the general framework and later on continuously supervise implementation of this framework, ready to react immediately if the development of the program starts to decline from its general principles. However, it doesn't mean that the bottom-up approach is not still dominant and top-down activities hinder the freedom of stakeholders to play an essential role and act autonomously.

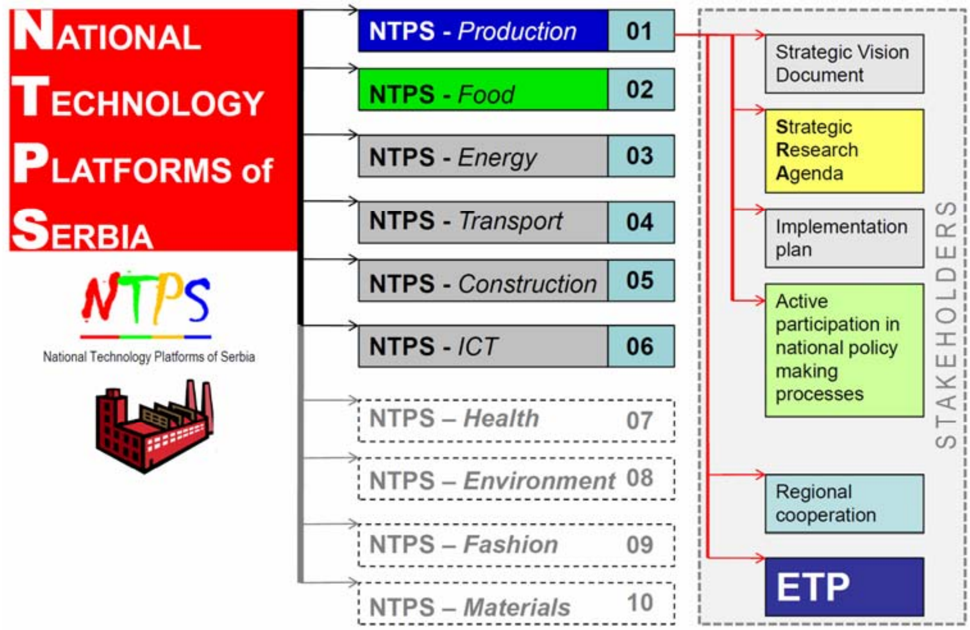

Fig.2. NTPS organizational structure – system composed of NTPS Core and a set of up to 10 individual technology platforms

As a result of such approach, the NTPS program was conceptualized as a structure that is composed of two hierarchical levels: NTPS Core, which is located in the Serbian Academy of Engineering Sciences and governed by the NTPS Committee, and NTPS Individual Platforms, a set of up to 10 individual platforms (in order to maintain a critical mass of resources to be sufficiently representative) that emerges from the NTPS Core as a system of mutually complementary, networked and highly interacting entities. These individual platforms are in their construction and principles of operation very similar to European individual technology platforms. Figure 2 shows the general functional structure of the NTPS Program.

There are five guiding principles which are adopted by NTPS program that should be used to decide whether an individual platform should be established or not. These guiding principles are of equal importance for stakeholders, i.e., industry, research and educational institutions, investors, but also for national regulatory bodies that are in some way responsible for the issue of technological development, research, education and other aspects related to industrial development. Any of the NTPS individual technology platforms should be:

- A Response to Major National Challenges: The Platforms are mission oriented and address major national economic – environmental – technical – social challenges. NTPS is not a short-term, problem solving instrument.
- A Strategic National Initiative: Platforms should be set up only when there is a well-defined, national strategic need for such an instrument, and national added value can be clearly justified.
- Politically Highly Visible: To affect change across national, industrial, technological boundaries, the NTPS individual platforms must create strong political support and be highly visible at a national, European, and even at a global level.
- Industry Led: To be effective, the NTPS individual platforms must be driven by actors from the applications / problem end of the innovation process. Individual platforms should not become too academic and the most relevant stakeholders in the sector should be included. The governing bodies of the platforms must be lead by a person who is coming from industrial domain.

- Well planned and executed: There must be a Road Map with a long-term vision, a sound strategy for achieving this vision and a detailed action-plan for carrying out the necessary activities. The platform must be big enough to be representative.

The NTPS program in whole is not and in any case or under any circumstances should not become a new vehicle for personal promotion of any scientist or institution. This program also should not become isolated from the industry in its implementation, especially in terms of satisfying its needs and decision-making on matters affecting the industry on any issue.

1.3. NTPS rationale – Serbian industry data

Due to the crisis that has lasted almost continuously for two decades, Serbian industry is currently in very difficult situation. Stagnation in all sectors has been present since the nineties, and this process is associated with the aftermath of the disintegration of former socialist Yugoslavia and all related causes that have had serious impact on the overall economy, especially industry.

Quantification of this process can be achieved based on the analysis of three main indicators: 1) The index of industrial production, 2) The number of industrial workers, and 3) The share of industry in GDP creation. The Index of Production (IoP) measures the volume of production of the manufacturing, mining and quarrying, and energy supply industries. The IoP is a major contributor to the National Accounts. GDP measures the sum of the value added created through the production of goods and services within the economy.

Contrary to common practice to analyze above mentioned indicators quarterly, yearly or for a short period of several years, in a study which was carried out by the NTPS Committee, a significantly broader time period of fifty years was considered. This approach stems from the fact that all industrial processes are very complex, mostly asynchronous, and inherently slow. Industry is intrinsically very inert system. Therefore, for their full understanding it is necessary to consider very broad time frames. Such standpoint holds even in the case of new and emerging technologies. Time dependences of considered industry indicators are shown graphically in Figure 3 (source: Republic Development Bureau, Republic of Serbia).

Statistical trends given in Figure 3 show the evidence for sudden collapse of industry output, huge loss of human resources, and marginalization of the role of industry. In fact, the crisis from the nineties has triggered the process of intensive deindustrialization of Serbian economy. To figure out these graphs objectively it is important to consider the information related to the socio-political ambient in which the industry was operated. In the period of five decades, it is possible to identify three characteristic stages:

- 1960 – 1990 The context before the crisis: Serbia in the former socialist Yugoslavia; Stable industry development; Rapid industrial development, average growth rate for 3 decades: 7.8% per year.
  Basic data for the year 1990: IoP_1990 = 100, 998.000 workers, 28.6 % GDP;
- 1990 – 2000 Collapse of former Yugoslavia: Massive disintegration processes and ethnic conflicts; Severe economic downturn, enormous inflation and collapse of national fiscal system, extensive fragmentation of the industrial system, UN economic sanctions, etc., all together was created serious consequences and severely damaged the industry.
  Basic data for the year 2000: IoP_1990 = 43.3, 643.000 workers, 24.7 % GDP;
- 2000 – 2010 Democratic changes: Emerging Republic of Serbia; Economic liberalization process / market economy; Extensive privatization process (almost completed); Openness for foreign direct investments; Global economy crisis in 2008.
  Basic data for the year 2010: IoP_1990 = 45.9, 312.000 workers, 15.9 % GDP;

For more comprehensive insight in the industry condition it is necessary to introduce another indicator that refers to the quantification of industry sectoral technology content, i.e., industry technological profile. Industry technological profile is defined by the sectoral classification of investment intensity in research and development (products, processes and / or business systems), i.e., R&D expenditure as defined in [2] and [3].

This indicator is not systematically monitored in Serbia, but it can be derived from the industry statistical data that are collected regularly. Figure 4 shows the sectoral technological profile of Serbian industry for year 2008 (source: Republic Development Bureau, Republic of Serbia). For comparison, in Figure 4 are also given the sectoral technological profiles for two leading world economies, the U.S. and EU, expressed through R&D investment of industrial companies (the investment funded by the companies themselves and for their own technological development, [4]). The differences are almost dramatic, and clearly show high degree of technological erosion that was occurred. It is clear that in past two decades the process of technological development had inverse character, i.e., downward development helix that has transformed former highly dynamic and technology intensive industry into recourse based and low adding value industry.

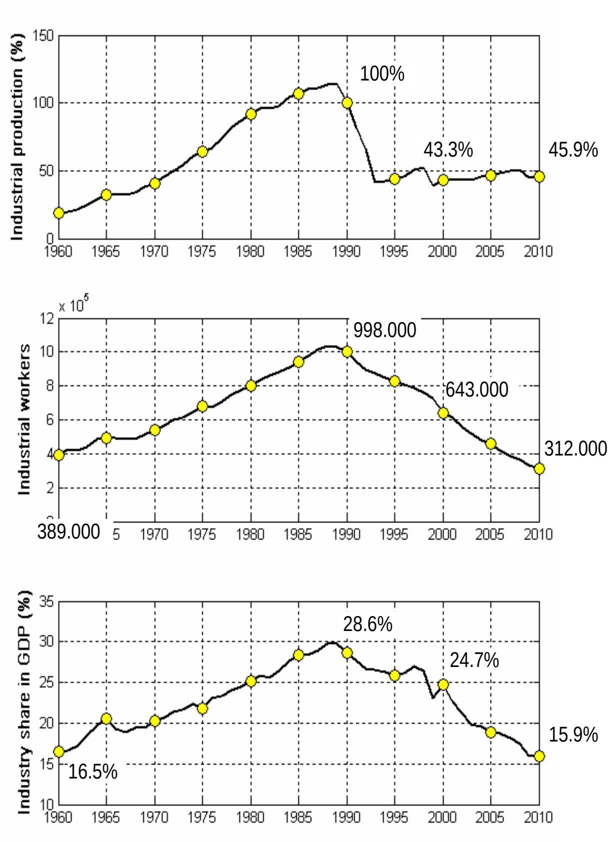

Fig.3. The index of production (indexed to 1990), industrial workers, and total industry share in GDP creation within the past five decades

2. NTPS-Production

NTPS-Production is the first individual platform that is derived from NTPS program and put into operation. It is an industry-lead voluntary association of stakeholders in the field of industrial production in Serbia.

The NTPS-Production platform was launched in May 2011 as a pilot action with the twofold mission: 1) to constitute a functional system, i.e., association, composed of referent national actors in the field of manufacturing industry and production engineering (leading industrial companies and systems, leading RTD institutions in the field of production engineering, and investors) that should provide strategic support to the national regulatory bodies in facing with the one of the most important and the most urgent grand societal challenges of Serbia, i.e., industry recovery and systematic revitalization / reinforcement of its technological foundations, and 2) to prove practical applicability of the NTPS concept in general and improve it if necessary.

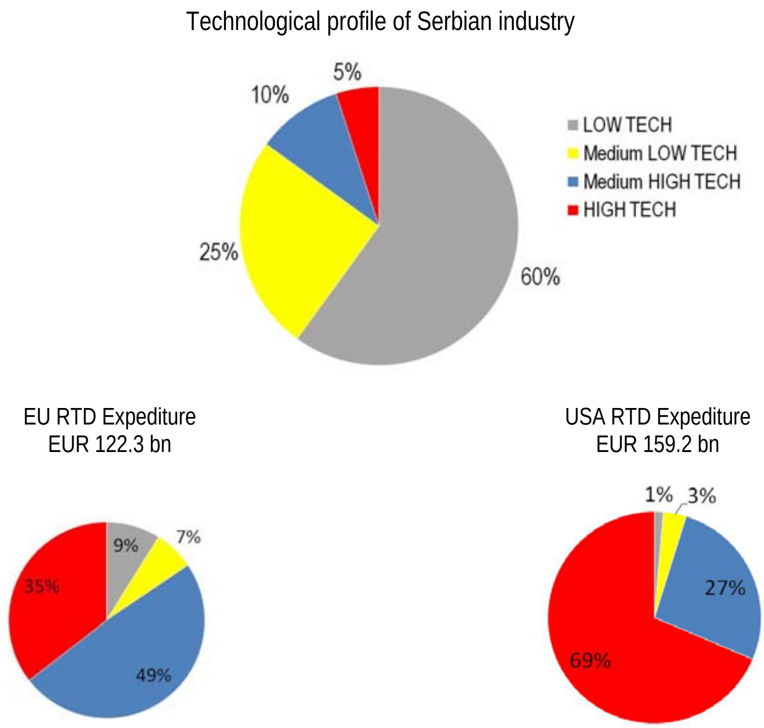

Fig.4. Sectoral profile of Serbian industry in accordance to technology intensity for the year 2008 (up), and RTD technology investment profile of industrial companies in EU and USA (down)

The overall mission of the NTPS-Production platform is the concerted strategic planning, the coordination and the facilitation of pre-competitive industrial and research activities in the field of production technologies, encompassing education, basic research, applied / industrial research and development. To this end, NTPS-Production platform will discuss industrial, scientific, technical, political, social and economic objectives.

In addition to activities that are planned to be carried out at the national level, intensive cooperation activities are also planned at the regional and EU level. A key activity is to establish synergistic relationships with relevant individual technology platforms at EU level, including membership and close collaboration. This vertical action is of highest importance to the NTPS Program in general. For NTPS Production platform of special importance is the cooperation with the following ETPs: ManuFuture: Future Manufacturing Technologies, [9], EUROP: European Robotics Platform, MINAM: European Platform on Micro- and Nanomanufacturing, ARTEMIS: The European Technology Platform for Advanced Research and Technology for Embedded Intelligence and Systems, EPoSS: European Platform on Smart Systems integration.

The organizational model of the NTPS-Production platform is shown in Figure 5. This model has four hierarchical strata: Level 1 - Stakeholders / members level, Level 2 - Operational core level, Level 3 - Decision-making level, and Level 4 - Managing level of TP.

The stakeholder level in form of General Assembly composed of representatives of the platform member organizations and associated representatives of Business Interest Groups (BOS) forms the basis of the technology platform. Business Interest Groups are composed of partner organizations with goals synergistic with the goals of the NTPS-Production platform or representatives of public bodies, organizations or initiatives whose activities have a bearing on meeting the goals of NTPS-Production but who are not members of NTPS-Production platform.

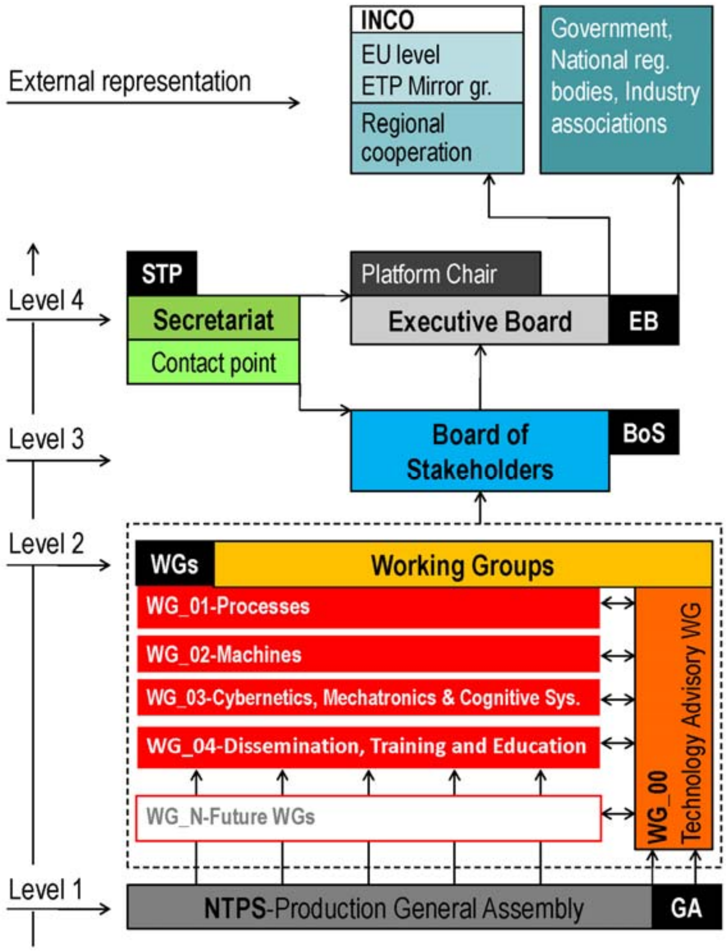

Fig.5. Organizational structure of NTPS-Production individual technology platform

Membership in NTPS-Production platform is open to all organizations or entities concerned with industrial or research activities in the field of the production, in particular: manufacturing and associated services, robotics, automation, ICT supporting production including mechatronics, Web and Internet-based services, and cognitive systems enabling the concept of Factories of Future – FoF (launched under the European Economic Recovery Plan in November 2008), [6], [7]. Particularly important in this respect are those activities that have a great potential to affect innovation in many different industrial sectors and fields of application, i.e., key enabling technologies (KETs) that include a high demand for RTD, skills and capital expenditure, a multidisciplinary approach cutting across many technology areas, and long time horizons between basic research results and implementable innovations, [5], [8].

Members shall contribute to the mission and to the activities of the technology platform, participating actively in the Working Groups (each member is assigned to at least one Working Group according to his/her preference). A complete list of the NTPS-Production membership will be publicly available on the official NTPS-Production platform website.

The operational core level is composed of the NTPS-Production Working Groups (WGs) that are the main centres of activities within the technology platform. They are focused on domain-specific or cross-disciplinary, technological or application-oriented issues, or on specific tasks related to production technologies, including various forms of dissemination outcomes produced by Platform activities. The following issues are related to the Platform operational core level: 1) Working Groups can be established or discontinued by the Board of Stakeholders on request of the Working Group itself, NTPS-Production Stakeholders, or the associated Business Interest Groups (BIG); 2) The Working Group Chairs (WG Chairs) are elected within the Working Group from NTPS-Production Members participating in the Working Group; 3)The composition of a Working Group will be established under the responsibility of its Chairperson, who will represent the Working Group at the Executive Board and report annually and upon request to the Executive Board; and 4) Working Group Chairs become members of the EB and become BoS members, unless his/her election is opposed by the NTPS-Production General Assembly.

At the current stage of the Platform development the Executive Board has been adopted initial set of working groups that should be constituted and put in operation immediately. This set of working groups consists of: WG_00 – Technology advisory working group; WG_01 – Production Processes working group; WG_02 – Machines and Equipment working group; WG_03 – Cybernetics, Mechatronic and Cognitive Systems (including Robotics) working group; and WG_04 – Dissemination, Training and Education working group. This is the initial set of working groups and is subject to modifications if the need for different solutions arises through its implementation in practice.

The decision making level consists of Board of Stakeholders (BoS) that is the main decision-making body of the platform. In particular, the BoS bears responsibility for: 1) The determination of all matters related to NTPS-Production platform, unless otherwise stated within the Platform constitutive documents; 2) Defining, pursuing and implementing the objectives of NTPS-Production according to its mission; and 3) Establishing or discontinuing Working Groups; The BoS will appoint an organization to establish a platform office, i.e., the NTPS-Production Secretariat, which shall provide organizational and operational support to the BoS, to the EB and to the WGs. The NTPS-Production Secretariat acts on behalf of, and reports to, the EB.

The managing level consists of Executive Board (EB) that is the main managing body of the platform. The EB is responsible for the coordination and execution of the platform operations, for the preparation and the implementation of the decisions of the BoS and for the external representation of the platform (national end international collaborative actions and initiatives). The EB is composed of the Chair, the Working Group (WG) Chairs and the SME representative. The EB Chair will be elected by the BoS from amongst its own members. At least one representative of the Secretariat will be delegated as non-voting member of the EB.

With minor variations, this model should be applied in future for other individual platforms that emerges within the NTPS Program.

3. Concluding Remarks

In this two part paper are presented basic aspects of European technology platforms, as a new instrument that was established by the European Commission with the aim to strengthen interaction of industry and research area which was recognized as the key factor for the creation and development of knowledge-based society. European technological platform has demonstrated their full effectiveness and potential in practice.

Serbian economy is faced with crisis that lasts almost two decades. Its excessive length hardly destroyed the national economy, especially industry. Industry data show horrifying consequences. Industrial growth and technological development that existed in the period before the crisis were almost completely stopped. The industrial production volume has been reduced to the level of the seventies, the contribution of industry to national GDP was halved, and the number of industrial workers has been reduced to 1/3. The way out of the crisis requires economic growth, but the economic growth is impossible without a strong, productive and competitive industry. The strong industry requires a strong and dynamic technological base. Recognizing these needs, the Academy of Engineering Sciences of Serbia has conceptualized and developed a program of national technology platforms, i.e., NTPS Program. In its basis, NTPS Program is derived from the concept of European technology platforms. Although it is in its beginning, significance of the NTPS Program was recognized by the relevant public authorities and embedded in the industrial policy 2020 as one of strategic pillars, dedicated for recovering of technological basis of Serbian industry and for rising high technology content in all industrial activities. The NTPS Program was started its implementation stage by launching the first individual technology platform NTPS-Production as a pilot action, aimed to show practical value of the NTPS concept and to prove potential of the NTPS Program in whole under the real industrial scenario.

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A Practical Approach for Research-Based Start-ups Formation: INESC-ID Case Study

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Abstract

Technology transfer, in its general terms, can be defined as transmission of the invention, knowledge or intellectual property from non-profit R&D institutions to profit-oriented companies. Although this process can be theoretically accomplished in many different ways, in this paper we focus on presenting and analyzing a highly practical approach for creation of start-ups, as one of the most efficient mechanisms for direct technology transfer, within one of the largest research institutes in Portugal, i.e., INESC-ID. The presented model for launching start-ups allows to efficiently transfer the existing technology and intellectual property generated inside INESC-ID by favoring the creation of start-ups based on the research previously developed at the institution, in order to achieve specific goals of INESC-ID in the process of technology transfer. The evaluation and analysis of success was conducted by presenting the outcomes of 6 start-up companies created by relying on the presented model. The efficiency of technology transfer process is evident not only in patenting, but also in joint participation of INESC-ID and start-ups in several international and national collaborative projects. Moreover, further gains for INESC-ID (in financial terms) are also expected in the future period, as soon as the exits are performed by created start-ups.

Keywords: Technology transfer, Start-up formation model, University-industry relations

1. Introduction

The increasing commercialization of university and institute research has received considerable attention over last decades. In this scope, the technology transfer is often considered as an evidence of the increasing contribution of the research and education to the economy, but also as a potential source for the universities and research centers revenues [1, 2]. Additionally, it was observed that the technology transfer positively influences the curriculum of the scientists and Research and Development (R&D) institutions, and helps in promoting the research to potential young researchers and students and also to provide additional industrial support. Due to the fact that the high quality research from universities and R&D institutions has not been still sufficiently translated into commercial applications, the EU and national governments have undertaken a number of initiatives to increase the transfer of research to industry [3, 4, 5]. In the process of overcoming this gap in research-industry collaboration within the EU, the exchange of practical experience and analysis of the technology transfer models are the subjects of great importance.

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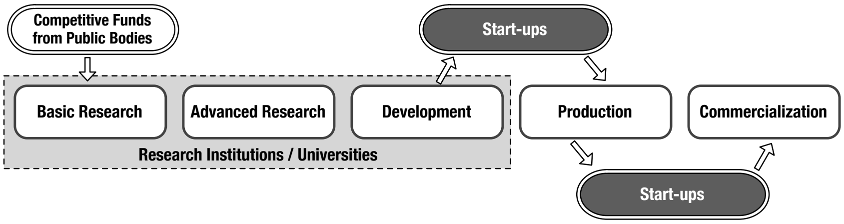

Fig. 1. Start-ups in technology transfer.

In general, technology transfer can be understood as a transmission of the invention, knowledge or the intellectual property (such as patents, copyrights, know-how), from the non-profit R&D laboratories to the profit-oriented companies, which carry out the technology commercialization. This process of research-industry collaboration can occur in several ways, such as licensing of research intellectual property (IP), collaboration in the R&D projects either on a bi-lateral or consortium basis, know-how based consulting, creating of new research based enterprises, etc [6]. However, the technology transfer is a complex process that takes place in several phases and practically embraces the entire life cycle of the product/service, from the initial idea to the sale. Commonly, two perspectives can be distinguished in the process of research invention commercialization, namely: i) *science driven innovation*, where the research with promising business perspectives represents a "driving force" for the technology transfer; and ii) *market driven innovation*, where the market demands for innovation shape the collaboration interface between the research and industry [7, 8]. In this paper, we mainly analyze the science driven innovation strategy, which is in the most direct form applied in creation of entrepreneurial start-ups [9].

A start-up represents a newly created company mainly oriented to research and development of innovative ideas and successful placement of the developed products to the market. The creation of such a company usually involves certain business risks, mainly related to the success of highly innovative aspect of the enterprise, as well as its positioning in the market especially in the case of companies in embryonic stage of development. On the other hand, start-ups usually have a low initial cost, and posses a high business scalability, i.e., high expectation of growth in the case of success. These companies, usually technology-based, have a strong entrepreneurial spirit and are in a constant search for an innovative business model to generate the value, i.e., to translate their work into wealth. Due to the uncertain environment in which the business is developed, the investment risk can represent an initial barrier for the progress of the company. Therefore, a start-up with an initial breakthrough idea possesses a greater chance of success in finding investors. The critical factors of success for the entrepreneurial start-ups are mainly related to their ability to quickly adapt to the changes in the market, and the leadership of technologically educated self-managing multidisciplinary teams.

Involvement of start-ups in technology transfer usually occurs in its "vertical" direction, i.e., within the process of transferring pure academic R&D to a commercial environment [7, 8]. As depicted in Figure 1, this process begins with invention at specific Research Institutions or Universities, which results from an academic research usually supported by public fundings. It does not only include the process of advancing in research, but also development of new technologies, as well as the phases of prototyping and initial testing. In fact, the resulting intellectual property and its successful transition are the initial steps towards creation of the start-ups. Hence, it is usually responsibility of Research Institutions or Universities to deal with the issues related to the management of intellectual property rights in order to secure their interest and benefits from potential commercialization. On the other hand, newly created start-ups may rely their further production and development on this IP and know-how to translate the research into finished products, and may also require initial investments from other institutions or companies. The placement of finished products to the market is designated as commercialization, which usually involves marketing of new products/services. As it can be observed, business creation is a highly cooperative process between academia and industry, where universities can also act as agents of economic development by providing internal and external resources from already existing collaborative networks.

Instituto de Engenharia de Sistemas e Computadores, Investigação e Desenvolvimento (INESC-ID), a Portuguese research institute of excellence, takes an active role in innovation and development of new technologies, by providing an unique knowledge network and environment to stimulate the growth of new ideas with high com-

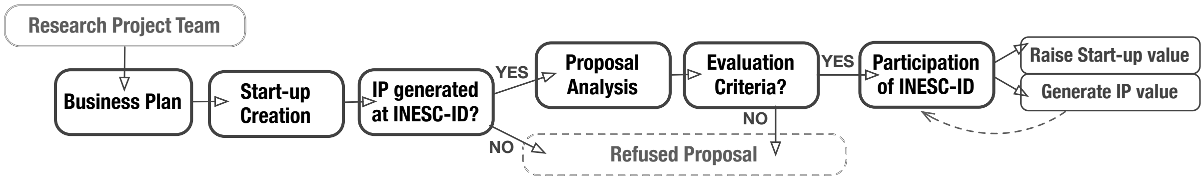

Fig. 2. INESC-ID model for launching start-ups.

mercial potential. As a result, several entrepreneurial start-ups have been created with the support of INESC-ID, with the aim to commercialize the knowledge and technology obtained/developed at this research institute. In fact, although created as completely independent companies, a common practice is that created start-ups continue to maintain strong connections with INESC-ID, either by their genesis, or by monitoring and lasting cooperation. In this paper we present and analyze INESC-ID start-up formation model trough several created companies, as a practical experience of the technology transfer process from the R&D institution to the industry. Furthermore, we provide a specific evaluation of the success of the technology transfer carried out in this way, in what concerns the benefits for the parent research institution and the entrepreneurs.

The rest of the paper is organized as follows. In Section II we present the INESC-ID start-up creation model. Section III contains the information about several start-ups created with the support of INESC-ID and the evaluation of this technology transfer, while Section IV provides the final conclusions.

2. Start-up Formation Model: INESC-ID Case Study

INESC-ID is a non-profit, privately owned institution founded in 2000, which is officially declared as an institution of public interest in Portugal and awarded with the status of national "Laboratório Associado" in 2004. It is dedicated to R&D in the fields of information technology, electronics and telecommunications, involving activities of basic research, applied research and advanced education. In fact, INESC-ID integrates competences from researchers in electrical engineering and computer science dedicated to advancing the state of the art in the above-mentioned areas. Currently, more than 200 post-graduate students and 90 researchers with PhD are involved in research activities performed within the following main action lines: computer systems and communication networks, embedded electronic systems, energy systems, information and decision support systems, and interactive intelligent systems.

Technology transfer at INESC-ID is usually performed in cooperation with other institutions, and it incorporates creation of technology based start-ups and provision of technical support. Several start-up companies have been initiated at INESC-ID by researchers and ex-students over the past years. In order to sustain their efficient creation, INESC-ID setup a model for launching start-ups, presented in Figure 2, which is based on intellectual property generated inside the research institute. In detail, after the outcomes of an academic research performed within INESC-ID are designated as potentially valuable to be commercialized, the research team is required to develop a detailed business plan regarding start-up creation, which includes the roadmap, initial assessment of expected financial gains and the overall influence to the market. As it can be noticed in Figure 2, start-ups creation initiatives that are taken into consideration for support and/or financing by INESC-ID must rely on intellectual property previously generated at the institution. The major rationale behind adopting this strict policy lies in the fact that INESC-ID tends to favor the creation of start-ups originating from the research previously developed at the institute, thus securing the the future developments are inline with the prime interests of the institution. Furthermore, this strategy also allows to focus the investments on the start-ups created by research teams whose capabilities and potentials are already known within the institution, thus also reducing the investment risks.

In order to evaluate and take the decision to participate or to create a startup, the board of directors assesses three main aspects: the idea and/or the prototype; the business plan and the potential to generate profits; and the involvement and the interest of INESC-ID in this process. In cases when venture capital companies are also involved in the process, meetings occur between INESC-ID and these companies, and the experience shows that it is the ideal situation to get a real assessment by taking in consideration all the dimensions of the market, overall analysis of risk indicators and what are the expected results and achievements of the startup. At the end of this

Table 1. Statistical analysis of created start-ups

	PETsys	SiliconGate	HeartGenetics	NWC Lda	Coreworks	VoiceInteraction
Employees	4	14	7	7	10	5
Employees with PhD	3	1	3	0	2	1
Patents	2	0	0	1	2	0
Revenues in 2012 (in €)	-	≈800k	-	<100k	<400k	<600k
Research Projects w/ INESC-ID	1 national (QREN)	1 contract (bilateral)	0	0	1 national (QREN)	2 European (FP7) / 1 national (QREN)
INESC-ID participation	6%	2%	2%	8%	5%	20%

procedure, owners of INESC-ID, i.e., Instituto Superior Técnico (IST) and INESC, are consulted to formally approve the conditions under which INESC-ID participates in each of these companies individually.

The direct INESC-ID investments in start-ups are generally two-fold. In addition to real financial investments, INESC-ID also participates with the value of the IP, which is evaluated in a case by case manner. Hence, on the top of determined IP value, INESC-ID provides a similar amount of financial investments, and these two components together support the acquisition of the equities in the corresponding amount. In brief, the general goals of the technology transfer at INESC-ID are to enrich intellectual property, to add value to the unique ideas previously generated within the institution and, as a consequence, to generate interest from the invested capital. Supporting the research developed in this specific environment does not only allow to pursue financial gains, but also to provide a greater visibly and dissemination of the institution research achievements to a wider industry-oriented audience. Furthermore, supporting technology-based start-ups also provides better employment opportunities for PhD researchers originating from INESC-ID, as it allows them not only to pursue academic carrier, but also to have a firsthand approach to this industry market.

Finally, specific goals of INESC-ID in technology transfer process can be summarized as follows: *i)* transferring technology that in other way wouldnt be productive and/or profitable; *ii)* adding value to intellectual property generated in the institution; *iii)* adding value to the investment initially made; *iv)* expanding promotion of institution's general activities; *v)* getting the market attention; *vi)* opening new collaboration possibilities for competitive funding with the startups; and *vii)* opening new labor market opportunities for former PhD and MSc students. It is worth to emphasize that after the company is fully launched, the start-up exit is expected to occur within the period of seven to ten years. Furthermore, the start-up exit is expected to result in a return of the capital initially invested in the early beginnings of the start-up, as well as in positive returns to the investors.

3. Created Spin-Offs: Characteristics and Benefits

In this Section, we present a brief description and analysis of success for start-ups supported by INESC-ID, which are created according to the model presented in Section 2. In all considered cases INESC-ID has converted intellectual property rights into start-up equity. A short description of the main activities and achievements for each start-up is provided in the rest of this Section, while some of the most interesting indicators of achieved industrial/technology impact and collaboration with INESC-ID are presented in Table 1.

VoiceInteraction start-up was founded in 2008 by researchers from the Spoken Language Systems Lab of INESC-ID, following the work developed in TECNOVOZ, a technology transfer project funded by the Portuguese Innovation Agency (AdI). Based on a solid background of R&D, *VoiceInteraction* offers innovative solutions in the area of speech processing. Their solutions are based on speech recognition, speech synthesis, 3D facial animation, and spoken dialogue systems technologies. The applications cover different areas, such as subtitling systems for RTP (public national TV broadcaster), media clipping, dictation systems for hospitals, spoken dialogue systems for kiosks in monuments. As it can be observed in Table 1, participation of INESC-ID in the initial capital of *VoiceInteraction* is around 20% (10% in IP and the other 10% as financial support), which represents the highest share of INESC-ID comparing to all other created start-ups. Currently, it has 5 permanent employees (one of them with PhD). Continuos involvement and collaboration of this start-up with INESC-ID can be seen through 2 ongoing international FP7 projects and 1 national QREN project for stimulating the development of new companies. It is worth emphasizing that these projects also include participation of other research institutions and companies, besides INESC-ID and *VoiceInteraction*, thus allowing better visibility of the outcomes from both parties to a wider market.

PETsys SA was established in 2008 to exploit the results of a research project, started in 2003, on PET (positron emission tomography) systems for mammography. The shareholders are 5 institutions, and 15 individuals that participated in the project, together with a Belgium business angel. *PETsys* has acquired the rights to use the internationally patented PET scanner technology that allows early cancer detection with higher resolution (1-2 mm against 5-10 mm) and higher sensitivity (x10) than with standard devices. As presented in Table 1, INESC-ID participated with 6% in the initial capital of this start-up (with equal share of provided IP and financial investments). Three out of four employees are with PhD that actively participate in collaborative research performed within 1 national QREN project with direct involvement of INESC-ID. Moreover, one of the measurable results of efficient technology transfer can be seen in 2 patents filled in the period after the start-up creation.

SiliconGate operates in the field of microelectronics and develops and licenses high performance power management blocks that are key elements in any mobile equipment. Funded in 2008, *SiliconGate* brought together the experience of senior designers from industry with the research expertise of an INESC-ID research group and it currently counts 14 employees (one of them being INESC-ID PhD researcher). Recently, Wolfson Microelectronics plc, a global leader in high-performance mixed-signal semiconductor solutions for the consumer electronics market, has selected *SiliconGate* to provide high-performance power management IP in a four year contract. INESC-ID participates in the initial capital of *SiliconGate* with 2%, and their collaboration is regulated via a bilateral contract. Due to its high impact to the market and as evidenced in Table 1, this start-up is capable of obtaining higher revenues when compared to the other start-ups.

Coreworks, founded in 2001 by two researchers of INESC-ID, is a provider of Semiconductor Intellectual Property (SIP) for multi-standard multimedia and communications applications, such as digital television, internet protocol television (IPTV), portable audio players, mobile Internet devices, and software defined radio. Their products have been implemented in a wide variety of technologies, for more than 30 customers worldwide. The company received an A-series investment round from Espírito Santo Ventures in 2006, and it currently has 10 employees. INESC-ID participates with 5% in the initial start-up capital, and their collaborative research engagement is established trough 1 national QREN project. The efficiency of performed technology transfer can also be evidenced in 2 filled patents in the period from the start-up creation.

NWC Network Concept, Lda was founded in 2008. It has origin in a joint project by IST and INESC-ID to develop a software multi-services platform, Kelius. Kelius integrates all the services in residential or professional environments, including Internet, video surveillance, television, and telephone. The control is performed through an interface implemented in a computer or in a Personal Digital Assistant (PDA). The new methods and techniques behind this platform are patented. INESC-ID initially participated with 8% in the founding capital of the start-up, which currently has 7 employees.

HeartGenetics was founded in 2013, by three PhD researchers, one of them from INESC-ID, and it currently has 7 employees. In addition to improving hypertrophic cardiomyopathy (HCM) gene-based diagnosis, *HeartGenetics* developed a bioinformatics software package aimed at helping the clinician to define the relations between gene mutations and the clinical features associated with this condition. Their goal is to play a leading role in changing the status quo of genetics, by bringing up important knowledge that will help physicians to improve heart medicine. INESC-ID participates with 2% in the initial capital of this start-up, where 1% is intellectual property, and the other 1% represents the direct funding.

Despite evidenced efficiency of technology transfer process via patenting and joint participation of INESC-ID and start-ups in several international and national collaborative projects, the financial gains for INESC-ID are also expected in the future period, as soon as the first exit is performed by any of created start-ups. In brief, for all start-ups at least the return of the initial investment is expected, but in practice the gain might be higher depending on the market value of the start-up at the moment of sale and the share of INESC-ID in its initial capital.

4. Conclusions

Technology transfer can be perceived as an efficient way of directly exposing the contributions of purely academic research and innovation to the industry, which has high potential to provide additional financial revenues for universities and research centers. However, to date there is no clear consensus in the existing literature on the most efficient mechanism to establish this process. In this paper, we present and analyze a highly practical approach for creation of start-ups, as the means for direct technology transfer, within one of the largest research institutes in Portugal, i.e., INESC-ID. The model for launching start-ups, which is presented herein, allows to efficiently transfer the existing technology and intellectual property generated inside INESC-ID by favoring the creation of start-ups based on the research previously developed at the institution. The presented model allows to achieve specific goals of INESC-ID in technology transfer process by transferring technology that in other way wouldn't be productive and/or profitable; adding value to intellectual property generated in the institution and to the initially made investment; expanding promotion of institutions general activities; getting the market attention; opening new collaboration possibilities for competitive funding with the startups; and providing new labor market opportunities for former PhD and MSc students. The evaluation and analysis of success was conducted by presenting the outcomes of 6 start-up companies created by relying on the presented model. The efficiency of technology transfer process is evidenced not only in patenting, but also in joint participation of INESC-ID and start-ups in several international and national collaborative projects. Moreover, further gains for INESC-ID (in financial terms) are also expected in the future period, as soon as the exits are performed by created start-ups.

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A Case study of Technology Push and Market Pull Strategies: Magnomics Start-up and Livedrive Spin-off

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Abstract

University start-ups and entrepreneur spin-offs are the most common strategies to carry out the technology transfer from R&D institutions, such as universities and research institutes, to market. In this paper we analyze and evaluate different strategies to perform technology transfer, namely, technology push and market pull, by considered two case studies: Magnomics start-up and Livedrive spin-off, whose core technology was transferred from INESC-ID Lisbon Portuguese national institute. The results show that transferring more innovative research via technology push approach (Magnomics) can result in higher expected revenues when compared to spin-offs created with market pull strategy (Livedrive). However, technology push also involves significantly higher risks and uncertain financial gains than companies based on market pull.

Keywords: Knowledge Transfer; Technology Transfer; Spin-off; Start-up; Technology Push; Market Pull;

1. Introduction

The increasing importance of knowledge-based economy in stimulating economic growth has led to a change in the role of universities and public Research and Development (R&D) institutes and in their interaction with the business community through the transfer of technology from academia to market [1]. The technology transfer itself can be defined as a transmission process from the source that possesses specialized technical skills and knowledge, such as R&D institutions and universities, to receptors who do not possess such skills and who do not create the technology themselves, i.e. customers [2, 3].

However, this process that starts with a new idea and ends with the placement of a new technology in the market, takes place in several sequential phases, which influence each other and have different characteristics. In theory, there are several ways to model the technology transfer [4, 5, 6], among which the simplest and the most frequently applied one is the linear model of innovation [5]. This model considers a linear connection between the sequential innovation phases, and it is usually described through two different classes of innovation strategies, namely, *technology push* and *market pull*.

In the *technology push* strategy, new products emerge through the development of new technologies that are presented to the market from the developers themselves (e.g., by university researchers) and without a clear previous market request for it. It is usually conducted through start-ups, which are stand-alone companies with no prior

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employment or financial relationships to established firms in the industry [7]. On the other hand, the *market pull* strategy considers that products are developed in response to market demand for novel and innovative products. It is usually initiated by entrepreneurs employed in a company with the aim to provide more efficient transfer of the obtained technology to the customers via entrepreneurial spin-offs [8, 9, 10]. However, the technology itself is not necessarily developed within the initial company, but may also be based on the technology developed in public R&D centers. In this case, the R&D groups are usually contracted by the entrepreneurs, in order to participate in the technology transfer through the newly created spin-offs.

In general, the success of the technology transfer highly depends on the characteristics of the technology itself and on the marketing skills of the leading team. However, considering their different characteristics, these two approaches include different advantages and risks, and, consequently, may result in different academic and financial gains. Hence, the proper analysis of these two strategies through different case studies can help in estimating the technology transfer outputs, and expected fulfillment of the initial motivations of the participants when starting the technology transfer process. The productivity of the technology transfer can be analyzed from several points of view, such as meeting the expected economic growth (e.g., from the perspective of the government that can stimulate one or another strategy by specific policies [11]), or from several different social effects. However, in this paper we mainly focus on expected benefits for the direct participants in the technology transfer, which play the key role in this process, and on which its success mainly depends. The transfer of the technology and knowledge obtained in the R&D institutions to the market includes two key participants, namely, the R&D scientists, as the initial developers of the technology, and the entrepreneurs (which may also be one or a group of R&D institution scientists) that lead the technology transfer process. However, the technology transfer mechanism also considers the transfer of intellectual property, e.g. patents and research agreements, usually carried out by Technology Transfer Office (TTO) within the R&D institution, which can be considered as the third participant.

A primary objective of R&D groups in the technology transfer process is usually related to the promotion of developed research within the scientific community and obtaining of additional research funding, which typically considers publications in top-tier journals, presentations at prestigious conferences, and research grants. The R&D scientists may also be motivated by personal financial gain and/or a desire to secure additional funding for graduate students and laboratory equipment [8]. On the other hand, the primary objective of the TTO and R&D institution administration is to protect the intellectual property, while ensuring its efficient transfer to newly created spin-offs. Despite an intrinsic desire to promote technological diffusion, secondary objectives may include securing additional funding via licensing fees, sponsored research agreements, etc. Finally, the primary objective of firms and entrepreneurs is to commercialize R&D-based technologies for financial gain by usually requesting exclusive rights and maintaining proprietary control to the generated technologies. Moreover, firms and entrepreneurs are also greatly concerned with expected *time to market*, since the ultimate benefits from developed product highly depend on the ability to manufacture and commercialize it before the competitors do.

In this paper we analyze the advantages and risks imposed by technology push and market pull strategies to transfer the technology developed at an R&D institution, i.e., Instituto de Engenharia de Sistemas e Computadores Investigação e Desenvolvimento (INESC-ID) in Portugal, by examining two case studies, namely, Magnomics start-up and Livedrive spin-off. Both firms are based on the technology developed at this R&D institution, but they took two different paths to transfer the developed technology to the market.

The rest of the paper is organized as follows. In Section 2, we introduce and analyze the technology push and market pull technology transfer strategies. Section 3 presents the two companies adopted as case studies, i.e., Magnomics and Livedrive, while their further evaluation and analysis is provided in Section 4. Finally, the conclusions of this paper are presented in Section 5.

2. Technology Pull and Market Push strategies

The linear model of innovation shows the linear connection between several phases in the innovation process in the time domain. Even though often considered as a traditional model, the linear innovation model is very popular due to the clearly defined linkage between specific types of policy measures (investment in research programs) and visible outputs (e.g., new products), as well as its comprehensibility in modeling the innovation changes in time domain [4, 5]. By adopting this model we intend to describe two different approaches that can be followed

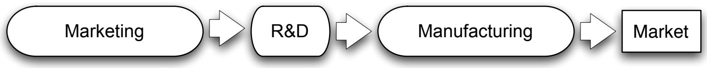

Fig. 2. Market pull technology transfer model

when developing new technology in an R&D institution and transferring it to the market, namely, the technology push and the market pull.

Technology push is a technology-driven approach where an emerging technology or a new combination of existing technologies provide the driving force for an innovative product and/or problem solution in the market. The sequence of phases in the technology push strategy is presented in Fig. 1. This strategy is initiated by a discovery or an idea that originates in the basic research, when the scientists realize advantages of the new technology for the final customers. The R&D phase includes the designing of a new product and making the prototypes for further testing. After the successful testing, different ways of manufacturing are analyzed and the most efficient one is adopted for the final product. Finally, in the marketing phase the product is promoted to the market.

In this scenario, the producer needs to learn and deeply understand the customers' problems, to be able to realize the advantages to the costumer, and create both the technology and a demand for technology. The producer uses unique methods, technology and/or approaches to better fulfill the unmet costumer's needs in ways that even the consumer may not initially recognize. In short, technology push product development is based on the belief that the producer recognizes a market need even before the market does, and, practically, educates the customer. A main characteristic of this approach is the increasing importance of science in the innovation process and strong correlations between R&D and innovative output [12]. This consequently leads to the increasing complexity of the innovation itself, and requirements for a long-term view. On the other hand, this implies the inherent uncertainty of the innovation process, and the possibility that strongly R&D-oriented company (with no necessary market experience) becomes both spatially and organizationally isolated, which may lead to lose market perspective.

Market pull is a customer need-driven approach, which is based on close interactions between the marketing team and the customers. This process is initiated by the Marketing informing the R&D department about customers needs. After that, the R&D designs and engineers the new products, followed by the manufacturing of the final product, which is finally placed to the market. This model can be found in Fig. 2. The market pull approach considers that the innovation process has its origins in latent customer needs that are still not satisfied in the market. The identification of these needs occurs first, and it is followed by the required development activities. In contrast to the technology push strategy, in this scenario the customer has a large impact in the direction of product development and the final solution and, practically, educates the producer. In the market pull, the market desire is well calculated, and the financial feedback is expected in much shorter period, when compared to the technology push. On the other hand, the main focus is on promoting the existing product, often without questioning the technological relevance behind the development. This approach may lead to limited, short term market perspectives.

Different characteristics of market pull and technology push strategies also lead to different expectations and approaches to the market [13]. The technology push is usually evaluated as a more risky and R&D-centered approach, with strong technological base, which in the best case scenario may result in very innovative products with great financial feedback. On the other hand, the market pull is the consumer-centered approach, which is expected to be a safer investment, but may be limited regarding the innovation aspect and final financial gains.

3. Case Studies: Magnomics start-up and Livedrive spin-off

In this section, the technology push and market pull strategies for the technology transfer process are analyzed following the example of two different companies, which involve the Portuguese national institute INESC-ID Lisbon as a participant in the technology transfer process. These two technology transfer case studies were initiated by different types of the organizations and follow different development paths.

3.1. Technology Pull example: Magnomics start-up

Magnomics is a molecular diagnostic start-up committed to deliver new generation diagnostic tests to the market in the field of healthcare. It is a typical technology push example that bridges more than eight years experience gained in INESC-ID research institute in nanotechnology, physics, biotechnology and electronic engineering to develop a point-of-care diagnostic prototype, aiming at the detection of biomarkers [14]. The initial research was performed within several projects co-financed by European Committee (EC) and Fundação para a Ciência e a Tecnologia (FCT) and carried out through a collaboration of two Portuguese research institutes, namely, INESC-ID and INESC Microsistemas e Nanotecnologia (INESC MN). In the scope of this research, INESC-ID developed a biochip reading platform to exploit the magnetoresistive biochips developed by INESC MN. This compact autonomous system is capable of on-site biorecognition assays without the need of other instrumentation. Only a laptop is required for the user interface, while the biochip driving, reading and feature extraction is performed in the embedded system. The full prototype consists on a cartridge that includes the interface with the biochip, the box with the control electronics, and a software program to interface with the user. This platform is able to measure biosignals with an amplitude 10 times lower than state-of-the-art laboratory equipment. The prototype system has been successfully used for four years by the INESC MN to aid the development of new magnetoresistive biochips, both at sensor design and biorecognition level.

The first technology transfer project was Platform for Magnetoresistive Biochip Research and Development (Biomag PLT), which was an international two years project financed by International Iberian Nanotechnology Laboratory (INL). After this project, the Magnomics start-up is initiated by the group of scientists as a respond to the observed market challenge of developing a rapid diagnostic tool for the detection of Methicillin-resistant Staphylococcus aureus (MRSA), a bacterium that resists to the majority of the antibiotics developed so far. Namely, it was observed that in the United States that about 40,000 people die from this infection per year. Furthermore, hospital costs associated to MRSA are 4 billion dollars/year and the hospitals are fully charged for it. On the other hand, traditional technologies can not help in a relevant way because they require too much time to identify an MRSA infection, thus even enabling the spreading of the infection, and the faster technologies are still not portable and therefore cannot be used in a near patient testing.

Currently, Magnomics founders are in the process of gathering investment, venture capital and innovation aid programs, to develop fully working commercial prototype. Additionally, a veterinarian application (which also consists on the detection an infection causing agent) is being studied, to allow a faster entry in the market. In the meanwhile, an FCT research project is also supporting the project evolution, targeting the development of high throughput biological assays using the same base technology.

3.2. Market Pull example: Livedrive spin-off

Livedrive is a market push example and was initiated by the employees of the Internet, Tecnologias e Desenvolvimento de Software SA (ITDS) company, which contracted the INESC-ID to develop a specific device by relying on the knowledge obtained during the four years research project Nanoelectronics for Safe, Fuel Efficient and Environment Friendly Automotive Solutions (SE2A). This project was co-financed by EC and FCT, and included a participation of a consortium of several international companies and research institutes. The main objective of this project, in what respects the participation of INESC-ID in SE2A, was to design and implement an embedded system able to simultaneously acquire signals from a set of sensors required to implement an Inertial Navigation System (INS). The device contains dedicated electronics needed to operate the inertial sensors. It includes read-out electronics to provide signal in the form needed by the navigation processor and low power processor. The included sensors are accelerometers, gyroscopes and a digital compass. The information extracted from the signals permits the INS to determine the movements (position, velocity) and attitudes of the unit.

Led by the good outcomes from the SE2A, which are evidenced in several journal and conference publications and working prototypes, the entrepreneurs from the ITDS contacted INESC-ID researchers and proposed a contract for specialized R&D in the scope the innovation commercial project *I2D - Intelligence to Drive*. The two year project aimed to develop a device able of collecting, on-board of a vehicle, a set of data that is usable for

Table 1. Overall comparison of Magnomics start-up and Livedrive spin-off

	Magnomics (technology push)	Livedrive Lda. (market pull)
Initial R&D duration	8 years	4 years
Initial R&D costs	1M€	400k€
International journal publications	14	3
International conference publications	15	1
Patents	2 submitted PCTs	-
INESC-ID participation	company share	R&D contracts
Required funding	470k€ (2013, 1st round), 6M€ (2015, 2nd round)	< 2M€ (confidential)
Expected market entry	2015 (R&D); 2016 (commercial)	2014
Break even	4 years	confidential
Expected revenues (2019)	29M€	< 8M€ (confidential)

various applications: estimation of fuel consumption and emissions, production of indicators in terms of safety and comfort, maintenance and fault records, or simply to obtain data for the evaluation and qualification of driving behavior. The device processes the collected information, stores it in flash memory and transmits it over a bidirectional data link via mobile network (GPRS) using IP (Internet Protocol) to a server in the Internet. The device is connected to the vehicle data port, from which receives power supply and collects the information available in accordance with the standard EOBD. It also has additional sensors to measure atmospheric pressure (altimeter), vehicle acceleration in three axes and a GPS receiver. The device also supports Bluetooth and USB connectivity.

At this stage, several prototype versions have been developed and the system is now being produced in a small scale production run where 300 units are being assembled in a fully automated production line. The entrepreneurs are now negotiating with private investors and have applied for other funding programs in order to gather funding to take the next step and start the commercialization of the device.

4. Evaluation of the Case Studies

This section presents a practical evaluation of two companies considered in Section 3, namely, Magnomics start-up and Livedrive spin-off, which adopt different strategies for technology transfer, i.e., technology push and market pull, respectively. Table 1 presents the comparative analysis that provides general overview regarding duration, already achieved and expected outcomes in scientific and financial terms, as well as the estimated involvement of the R&D institution (INESC-ID).

As it can be observed, due to its strictly research-based origin, Magnomics start-up required longer period for initial research and development when compared to the market-driven Livedrive spin-off, namely, 8 years (Magnomics) versus 4 years (Livedrive) development period. As previously referred, this result was expected since Magnomics relies on technology push strategy, where entirely new ideas originated from purely academic research with no clear commercialization goals. On the other hand, clearly defined market-oriented demands and specifications of the final product, implied much shorter R&D period for Livedrive spin-off. This can also be evidenced in the estimated cost during the initial R&D period, where the amount of investments (see initial R&D costs in Table 1) in Magnomics is almost 2.5 times higher than the investments for Livedrive. The presented costs include fundings from different projects and additional costs during the initial R&D process. Consequently, more innovative research performed prior to Magnomics formation resulted in the submission of several international patents and in larger number of publications in international journals and conferences, thus fulfilling the main academic motives of the involved R&D institution.

Focusing process that lead to the creation of companies, the participation of INESC-ID is different depending on the adopted technology transfer strategy and the needs of newly created company. In case of Livedrive spin-off, INESC-ID actively participates trough R&D contracts, whereas in Magnomics it also participates in company share by providing both the financial support and intellectual property. Furthermore, the estimated required funding, for the period between the creation of the company and its entry to the market, is significantly higher for Magnomics than for Livedrive. Despite different levels of innovation, this can also be explained by different targeted markets for these two companies. For example, the estimated funding of 470k€ is required in Magnomics start-up for development of initial prototype, while 6M€ are estimated for the second round of development that includes product commercialization and FDA/CE approval, with the expected break even period of 4 years.

Finally, market pull technology transfer strategy behind Livedrive spin-off is expected to result in a much shorter period of entering to the market when compared to Magnomics start-up with technology push strategy. In detail, 2014 is expected year of market entry for Livedrive, whereas Magnomics is expected to firstly enter the R&D market area in 2015, followed by its wide commercialization in 2016. The major rationale behind this two-step market entry for Magnomics start-up can be explained by extended period of FDA and CE approval, which is not required for R&D purposes. It is worth to emphasize that both companies required similar amount of financial support per year during the initial R&D period, i.e., 125k€/year for Magnomics and 100k€/year for Livedrive, and the financial growth in the observed time period (2013-2019) is expected to result in similar ratios comparing to the amount of initial investment, i.e., 4.5 times for Magnomics and 4 times for Livedrive. Nevertheless, Magnomics is expected to result in a more than 3.5 times higher revenue than Livedrive in the same timeframe, which is a clear consequence of transferring research with higher degree of innovation to the market. On the other hand, the technology push (Magnomics) is usually evaluated as a more risky approach with uncertain financial feedback, whereas the market pull (Livedrive) is the consumer-centered approach, which is expected to be a safer investment, but may be limited regarding the innovation aspect and total financial gains.

5. Conclusions

In this paper we analyzed two different approaches for technology transfer from an R&D institution to the market, namely, the technology pull and the market pull. These strategies were analyzed through two different entrepreneurship case studies, based on the technology developed in the INESC-ID Lisbon, Portuguese national research institute. The presented analysis provides practical and descriptive examples of the technology transfer process, and evaluates their productivity regarding the fulfilling of the initial participants expectations, duration, achieved and expected outcomes in scientific and financial terms, as well as INESC-ID involvement. The results show that transferring more innovative research with technology push can result in higher expected revenues but with more risks and uncertain financial gains, when compared to a spin-off created with market pull strategy.

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FUNDEC: A Successful Experience in Academic Engagement in Civil Engineering

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Abstract

Academic engagement usually refers to involvement of academic scientists in the process of university-industry knowledge transfer, which includes collaborative research, contract research, consulting and informal relationships. Despite being a predecessor to efficient commercialization, academic engagement has already proven its capabilities not only in attracting significantly larger percentage of university researches, but also in generating more revenues when directly compared to the outcomes of pure commercialization. Although the empirical assessment of engagement effects is not an easy task, in this paper we focus on analyzing the efficiency of practically applied methods for both formal and informal knowledge transfer in one of the largest technical universities in Portugal. In particular, we specifically target the academic engagement mechanisms within FUNDEC association as a case study, where the knowledge transfer efficiency is evaluated from different aspects, by following the outcomes of organized specialized training courses and provided services that directly aim at fostering the links between university and industry. In brief, evaluation results show that, in the period between 1998 and 2011, the largest portion of course attendees originated from the industry sector (around 72%), whereas the largest number of lecturers (56%) originated from universities. Hence, an evident trend of knowledge transfer from university to industry can be observed, as well as an indisputably high interest of industry in this process, which can be mainly attributed to the high quality of FUNDEC courses and selection of topics.

Keywords: Knowledge transfer, Academic engagement, University-industry relations

1. Introduction

In addition to their traditional role in education, universities are organizations that also carry out research and technological activities to produce knowledge, innovation and to provide scientific and technical services to the community. In the current literature, one of the mostly considered channels to transfer university research to industrial domain is commercialization of academic knowledge. Commercialization mostly refers to patenting and licensing of inventions and academic entrepreneurship, whose practical realization is usually achieved via specially created and regulated structures at universities, such as technology transfer offices, science parks and enterprise incubators [1, 2]. Although very important, due to the measurable economic impact of academic

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research, commercialization is certainly not the only way to efficiently transfer the knowledge generated at universities [3, 4].

Academic engagement represents an important way for transferring university knowledge to industrial domain and it can be defined as knowledge-related collaboration by academic researchers with non-academic organizations [3]. Depending on its nature and practical accomplishment, academic engagement can be generally seen as *formal engagement*, such as collaborative research, contract research, and consulting, or *informal engagement*, which usually refers to activities such as advising, information sharing or networking. Although academic engagement can be pursued to attain multiple objectives, the main reasons for engagement (in general) can be found in securing the access to important resources for further university research (such as additional funds, equipment or support for students) or it can be motived by practical applicability and expansion of already developed research (such as field-testing, learning opportunities or obtaining the new insights) [5]. As such, the academia might not strictly seek for financial gains, but it might achieve non-financial benefits, such as access to materials or data for academic research projects, or it might get valuable insights and new ideas on how to direct further university research according to the market needs. For example, engagement might be motivated by the expansion of university research from pure academic publishing to the areas of its practical application and utilization by non-academic partners. On the other hand, the academics may offer the expertise to provide new ideas on application-oriented issues, solve problems and suggest solutions to collaborating organizations. However, academic engagement do not exclude financial aspects.

As previously mentioned, in contrast to commercialization that mainly exploits the academic inventions to achieve financial gains, academic engagement is usually broader. Engagement can be generally perceived as a natural extension of purely publication-driven academic research to non-academic domains. On the other hand, commercialization usually represents a disruptive approach in university research towards academic entrepreneurship. In addition to research activities, involvement of academics in commercialization requires to deal with industry and management related issues, and it also brings to practice subjective effects (such as fear of failure) cased by involvement in commercialization activities with higher risks of failure. In fact, several studies conducted in different European counties [6, 7] show that, during their professional career, more than half of academics usually pursue different forms of academic engagement, whereas about 10-20% of investigators are involved in commercialization-related activities. Therefore, it is not surprising that financial gains from academic engagement can significantly surpass the incomes from intellectual property [8] and that many companies consider the academic engagement as significantly more important than licensing [9]. As a result, academic engagement can be generally considered as the preliminary step towards commercialization, i.e., it precedes commercialization in time, and it can provide valuable inputs for establishing efficient technology transfer.

In [3], Perkmann *et. al.* survey the existing scientific studies to analyze the antecedents of academic engagement from several aspects, namely: *i) individual characteristics*, such as demographics, age, previous commercialization experience and researchers' seniority; *ii) organizational context*, which is investigated trough quality of university/department, peer effects or organizational support and commercialization experience; *iii) institutional context*, which analyzes the affiliation to a specific discipline and the effects of specific national regulations and policies; and *iv) consequences of academic engagement* via scientific and commercial productivity, research shift towards applied sciences, and increased secrecy and collaborative behavior at the level of individual academics. The key findings from [3] indicate that efficient academic engagement is more related with individual characteristics of researches (such as higher scientific productivity and seniority), than with specific country regulations/policies or organizational support structures at universities/departments. Furthermore, it is observed that institutions with higher rankings are usually less engaged in this knowledge exchange process, thus suggesting that academic engagement can serve as a very effective substitute to achieve similar scientific productivity and research quality at lower ranked institutions, by mobilizing needed resources and learning opportunities from non-academic partners. Finally, the authors in [3] conclude that, although academic engagement is more widely practiced than commercialization, it is more difficult to empirically detect and measure the effects and outcomes of academic engagement due to the lack of standardized methodology for its assessment and public availability of statistical data (if it is even possible to record it in practice).

In this paper, the authors provide a highly practical analysis regarding the efficiency of academic engagement in civil engineering at one of the largest technical universities in Portugal, i.e., Instituto Superior Técnico (IST), by examining the methods for fostering links between university and industry offered by FUNDEC [10] association (followed herein as a case study). The paper is organized as follows. Section 2 presents a brief overview of the organizational and basic engagement principles adopted within FUNDEC association. Evaluation of the adopted knowledge exchange principles is provided in Section 3 by examining their efficiency at different levels of granularity and from different aspects, in period from FUNDEC creation in 1996 until 2012. Furthermore, concluding remarks are given in Section 4.

2. FUNDEC: Basic Engagement Principles and Organization

Instituto Superior Técnico, founded in 1911, is the largest and most reputed school of engineering, science and technology in Portugal. Despite its traditional role in higher education trough the organization of teaching programs and award of degrees and titles, one of the main goals of IST is to carry out research and technological activities in order to produce knowledge, innovation and to provide scientific and technical services to the community. In order to disseminate the produced knowledge one of the applied methods is to create specialization, as well as vocational and lifelong training programs, either in the context of IST itself or of other national or international academic and non-academic institutions. These programs can additionally provide the practical means to establish and further strengthen the university engagement with the industry, which greatly exceeds the purely educational purposes. To this respect, with the major support and participation of IST, FUNDEC (*Associação para a Formação e o Desenvolvimento em Engenharia Civil e Arquitectura*) [10] was created in 1995 to deeply relate the activities and provide cooperation between the Department of Civil Engineering, Architecture and Geo-resources (DECivil) from IST, on one side, and some of the most important Portuguese civil engineering companies, on the other side.

FUNDEC is a nonprofit association and one of its main objectives is to institutionalize training and development in the area of civil engineering and architecture, i.e., it is intended to supplement, update and upgrade the training of civil engineers and architects through innovation in materials and contents in order to ensure a real professional development. In order to achieve these goals, FUNDEC is responsible for promoting, organizing and providing professional training and specialized courses, as well as studies and services, aiming to fulfill the needs of the technical community and to improve professional skills and attributes. Therefore, the training courses organized by FUNDEC aim to cover all areas of expertise not only in the field of civil engineering but also in architecture, namely, *(i)* Construction; *(ii)* Structures; *(iii)* Geotechnics; *(iv)* Hydraulics, Water Resources and Environment; *(v)* Geographic Information Systems; *(vi)* Systems and Management; *(vii)* Transportation and Transport Infrastructures; and *(viii)* Urban Planning and Architecture. Besides the standard specialized courses, FUNDEC is also able to respond to the needs of companies through training and tailored specialized courses, which either represent the adaptation of already existing courses or development of completely new courses. Furthermore, innovation and improvement of the processes and activities is usually conducted following the state-of-the-art developments in European Union and international markets that are perceived as the most relevant to the progress of civil engineering in Portugal. In addition, FUNDEC is also devoted to promotion of the international cooperation, in particular with Portuguese-speaking countries.

In order to ensure the efficient cooperation and knowledge transfer between the university and industry, FUNDEC relies on the support of its associated members, not only for organization, presentation and participation in the training courses, but also for the discussion and approval of the administrative aspects and activity plans. In detail, associated members are classified in four distinct groups, i.e., full, founding, observer and honorary members. The members of each group are designated by FUNDEC and involve not only universities and public institutions, but also companies and individual members (with IST as the only permanent full member). In contrast to the observers and honorary members, full and founding members play an active role in shaping the activities, organization and administration of FUNDEC. Currently, the list of 14 founding members include different education and public institutions, design offices and construction companies, as well as 11 individual members. The financial sustainability is ensured with annual fees for founding members, participation fees for the course attendees and FUNDEC-provided services. The tight relations with IST and participation of the university staff in the training courses is granted by automatically promoting all DECivil coordinators and presidents of specific departments to observer members, which are exempted from paying the annual fees. On the other hand, the members usually benefit from the full support and special discount rates not only for training courses, but also for provided services and developed specialized studies, plans and reports. The additional FUNDEC services are usually related to innovation and development of the new methods, as well as the application of the already existing techniques developed at the university to the real-world problems. The special relations between FUNDEC and the other public institutions and companies are regulated with collaboration protocols, which usually require mutual support and cooperation in terms of organizing and promoting the specialized courses.

As previously referred, one of the main goals of FUNDEC association is to connect university and industry in such a way that they can transfer knowledge, share information and make collaborations trough the organization of specialized courses. In practice, this transfer is not strictly tight to a particular transfer direction, e.g., strictly from university to industry, but it rather follows the bidirectional and mixed knowledge transfer mechanisms. In detail, depending on the origin of the research and innovation, as well as the affiliation of the lecturers, the courses can be classified in three separate groups: *(i)* purely university-based courses; *(ii)* purely industry-based courses; and *(iii)* mixed university-industry courses. The courses from the first group are aimed at promoting the outcomes of purely university-based research to the industry, in order to investigate the opportunities for its further extension or to sustain its applicability to the real-world problems. Purely industry-based courses usually present the open problems and needs for the efficient solutions related to the highly practical problems, which can serve as valuable inputs for shaping university research or to establish university-industry cooperation. Furthermore, mixed university-industry courses are aimed at either presenting the results of the research conducted with direct involvement of both university and industry, or they are made in order to further extend the knowledge of both parties in fundamental areas of civil engineering (such as training courses that present current technical rules and standards, and analyze their practical application). Finally, it is worth to emphasize that according to the analysis presented in Section 3, the type of the course does not significantly influence the overall affiliation share of the course attendees, i.e., the trainees attendance is usually governed by the practical interest, thus they come from different areas of affiliation irrespectively of the course type.

3. Evaluation of FUNDEC-based University-Industry Engagement

In order to assess the practical impacts of the methods for university-industry engagement presented in Section 2, the statistical analysis conducted herein relies on the data derived from the official and publicly available FUNDEC records. In particular, we specifically focus on engagement at two different levels of granularity: *(i)* engagement at the level of a single training course; and *(ii)* the overall influence of FUNDEC engagement methods in the period from 1996 to 2012. It is worth to emphasize that although the academic engagement (in its formal and informal sense) is more widely practiced than commercialization, it is more difficult to empirically measure and detect its outcomes. In contrast, the effects of commercialization are usually easily tractable (e.g., via the number of created spin-offs, submitted patents etc.). Moreover, in a recently published study by Perkmann *et. al.* [3], the authors clearly demonstrate the lack of standardized methodology to empirically assess the academic engagement in the currently available state-of-the-art and they also express the need to develop further methods to improve the quality and comparability of studies. To that respect, the authors attempt herein to detect and evaluate the effects of academic engagement by analyzing the statistical data that can be tightly coupled with its practical occurrence.

3.1. Engagement at a single course level

As an example of a purely university-based course, the FUNDEC training course held in February 2012 by some of the authors of this manuscript "*Nonlinear Static Methods (Pushover Analysis) for Design/Assessment of Structures*" [11] is herein specifically focused on. The main goal of this course was to provide the theoretical overview of the current and extended nonlinear static methods for the seismic assessment and design of structures, which was followed by a step-by-step explanation of the applied procedures when modeling the real-world examples. The course was organized in order to favor the direct involvement of the trainees and lecturers not only in discussion, but also in the process of practical modeling with SAP2000 [12]. Since the major contributions of the university-based research within the 3DISP project [11] were presented, the course was naturally thought by lecturers with the predominately university background, i.e., one professor and two researchers from IST, and one invited professor from a foreign university. On the other hand, around 20 trainees who attended the course were from different provenances, with very balanced share (around 50/50) of attendees originating from university and

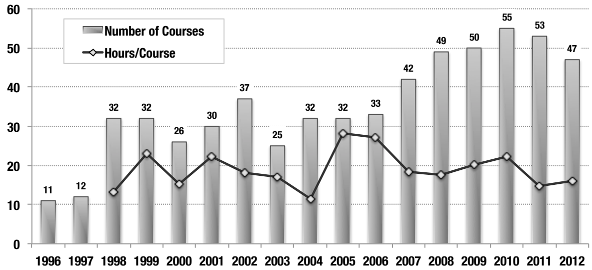

Fig. 1. Number and intensity of organized courses per year.

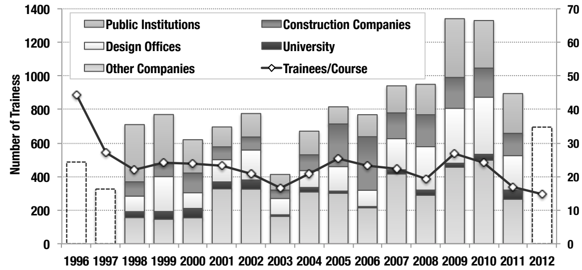

Fig. 2. Total number and average number of trainees per course.

industry. The relatively large number of trainees from industry is not surprising, since the presented research is highly related to the practical problems, i.e., it can provide the means to the seismic assessment and retrofitting (repair) of structures. In fact, this course resulted in an informal engagement of the course coordinator with the representatives of one of the most successful construction companies in Portugal, which is expected to expand from professional consulting into the official project collaboration in the very near future.

Following the success of the above-mentioned training, an additional course is planned in 2013, i.e.,"*Seismic Evaluation and Reinforcement of Ancient Masonry Buildings*". The main goal of this course is to present the latest findings from the university-based research in the scope of SEVERES project [13], which aims at identifying the mechanical characteristics and seismic behavior of old masonry Portuguese buildings trough extensive experimental testing. Due to the limited number of experimental studies currently available in the literature, the results of this research are very important for analyzing and retrofitting the old buildings, since they are still used for housing and services, and especially important for the companies that preform these reparations. In fact, this course is expected to expand existing and create new collaborations with industry, mainly by confirming and applying the laboratory-based methodology to the in-situ testing on real buildings. Hence, different solutions for rehabilitation and strengthening of masonry buildings will be discussed at this course in order to help companies when choosing the best solution for retrofitting. Finally, the presentation of this course will be held by three professors and three researches from IST, one professor from a foreign university and one invited speaker from the industry.

3.2. *Overall Statistical Analysis of FUNDEC-based Engagement*

In order to further evaluate the efficiency of the methods for university and industry engagement within FUNDEC association, this paper focuses herein on statistical analysis based on the official and publicly available records regarding the number and intensity of courses, the total number and affiliation structure (share) of both trainees and lecturers, as well as the number of provided services, in the period from FUNDEC creation in 1996 until 2012.

Figure 1 presents the total number of organized courses per year, in the period between 1996 and 2012. As it can be observed, the number of courses shows an overall increasing trend, which can be evidenced in the peak number of 55 courses held in 2011 versus 11 (12) courses organized in the first years of FUNDEC creation in 1996 (1997). Furthermore, in the observed period, in average 35 courses are prepared per year. In order to depict the intensity of the organized courses, the average number of hours required to complete a course in a certain year is additionally presented (see line in Figure 1). The course intensity measure is adopted herein in order to represent the average course duration, which shows the amount of time devoted for involvement of both lecturers and trainees. As it can be noticed, the courses of lowest intensity were organized in 2004 (in average 11.5 hours per course), immediately followed by two years period of the most intensive courses that required in average 28.3 (in 2005) and 27.1 (in 2006) hours to complete a course. The intensity of the courses in all other years is near the average intensity of 19 hours per course (in the period between 1998 and 2012).

Figure 2 shows the total number of trainees that attended the courses organized in each year, their affiliations and the average number of trainees per course. As expected, the number of trainees usually is proportional to the number of organized courses in each year (see Figure 1), thus reaching the maximum of 1330 attendees in 2010. In the observed period between 1996 and 2012, 777 trainees attended the organized courses in average

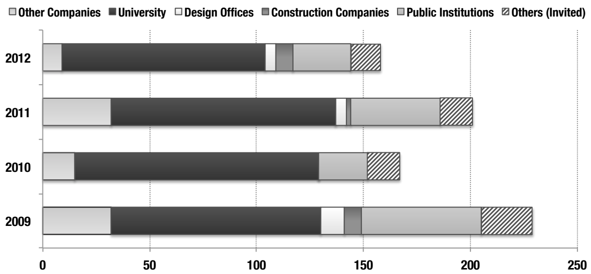

Fig. 3. Total number and affiliation of lecturers per year.

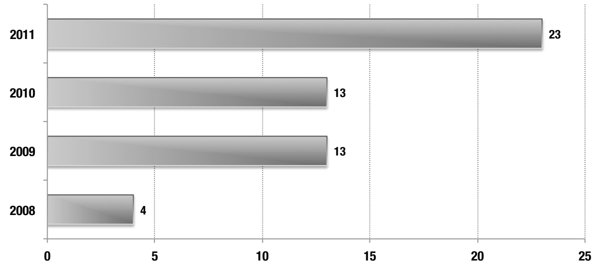

Fig. 4. Total number of provided services per year.

per year. It is interesting to observe a decreasing trend in the total number of trainees for the last two years, i.e., in 2011 and 2012, which is expected and can mainly be attributed to the economic slowdown in the sector of civil engineering due to the overall crisis in Portugal. This slowdown has an immediate effect on financial availability of companies to promote, participate and use FUNDEC services. Furthermore, in Figure 2, the total number of trainees per year is sub-partitioned according to the their affiliation, thus representing the number of trainees belonging to University, Public Institutions, and industry sector (Construction Companies, Design Offices and Other Companies). In addition, the average number of trainees per course for each year is presented (see line in Figure 2). Despite an obvious outlier for 1996 when the courses were introduced for the first time, thus resulting in the greatest interest, for the subsequent years an average attendance rate of 23 trainees per course can be observed. It is worth to note that no clear relation between the course intensity and the number of attendees can be spotted, which suggests that the high quality of organized courses is actually more important for attracting the trainees from different sectors than its duration. However, the above-mentioned financial crises also influenced the achieved results for the last two years, i.e., 2011 and 2012, where large number of courses with moderate intensity resulted in below average attendance.

In Figure 3 the total number of lecturers per year is presented and, as expected and evidenced in Figures 1 and 2, their total number directly depends on the number of organized courses. In addition, the lecturers are subdivided and represented according to their affiliations, in order to depict whether the teachers originate from Universities, Public Institutions or they belong to the industry sector (Construction Companies, Design Offices and Other Companies). An additional group of lecturers can also be spotted, i.e., Others (Invited), that represents the invited independent researchers or experts for the presentation of certain courses.

Figure 4 presents the total number of services provided by FUNDEC in the period between 2008 and 2011. These services designate the engagement of FUNDEC and its members in performing evaluations and analysis, feasibility studies, reports, project developments or actual construction works, which are usually requested by third parties (such as companies, public institutions, or individuals). In contrast to the decreasing trend in the last two years regarding the total number of courses and trainees (see Figures 1 and 2), the number of provided services is significantly increasing in the observed period. This can be explained by rapid expansion of FUNDEC area of activities that includes not only provision of training courses, but also the means for practical engagement of university and industry in solving the real-world problems.

Finally, Figures 5 and 6 present the average share of trainees' and lecturers' affiliations in the organized courses, respectively. As it can be seen, in the period from 1998 to 2011, the largest portion of course attendees originated from the industry sector (around 72%), in contrast to 24% from public institutions and only 4% of trainees from universities. On the other hand, in the period between 2009 and 2012, the largest number of lecturers (56%) originated from universities, followed by 19% from public institutions, and around 16% of presenters from the industry sector. Although the presented charts do not cover the same period, it is worth to emphasize that the affiliation share of trainees does not significantly vary even when narrowing down the period of observation. Hence, it can be concluded that the quality of organized FUNDEC courses and especially selection of topics was capable of attracting a very large percentage of trainees from the industry. This is even more important when taking into account that the largest portion of these courses is held by the university staff, thus an evident trend of knowledge transfer from the university to the industry can be observed, as well as an indisputably high interest of

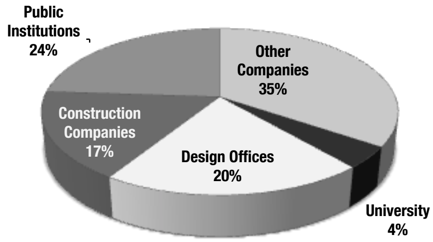

Fig. 5. Average share of trainees affiliations (period: 1998-2011).

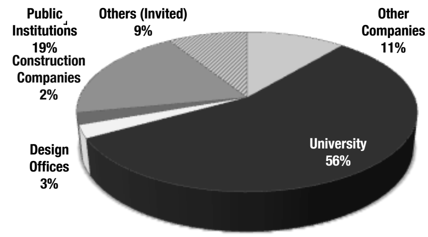

Fig. 6. Average share of lecturers affiliations (period: 2009-2012).

industry in this process. It is also worth to note that this knowledge transfer does not only reflect the presentation of university research, but it also includes the specialized courses for enhancement of fundamental knowledge in different areas of civil engineering and architecture. As a result, organization of training courses and provision of services in the scope of FUNDEC association can be perceived as very efficient methods for establishing university-industry engagement in both formal and informal sense. However, the lower number of lecturers from industry sector suggests that purely industry-based courses are covered to a smaller extent comparing to purely university-based or mixed courses, which are crucial to establish even more efficient knowledge transfer in the other direction, i.e., from industry to university, and also to shape further university research according to the industry needs.

4. Conclusions

Academic engagement, as one of the most efficient mechanisms for transferring academic knowledge to industrial domain, represents knowledge-related collaboration by academic researchers with non-academic organizations. In formal terms, it mainly refers to collaborative research, contract research and consulting, while informal engagement involves activities such as advising, information sharing or networking. Its importance can be evidenced in the ability to attract a large portion of academics and in generating more financial gains, when directly compared to the pure commercialization. Moreover, academic engagement is generally considered as the initial step towards the efficient commercialization.

Although it is more difficult to empirically assess the effects of engagement, in this paper the authors specifically focused on analyzing the efficiency of practically applied methods for both formal and informal knowledge transfer in one of the largest technical universities in Portugal. In particular, the academic engagement methods within FUNDEC association as a case study were targeted, which aims at strengthening university-industry relations through organization of specialized training courses and provision of practical services. In order to assess the efficiency of these mechanisms for university-industry engagement, the statistical analysis was conducted by relying on the data derived from the official and publicly available FUNDEC records. In detail, the analysis provided herein covered the engagement at two different levels of granularity: *i)* engagement at the level of a single training course; and *ii)* the overall influence of FUNDEC engagement methods in the period from 1996 to 2012.

Evaluation results show that, in the observed period, the largest portion of course attendees originated from the industry sector (around 72%), whereas the largest number of lecturers (56%) originated from universities. Hence, an evident trend of knowledge transfer from university to industry can be observed, as well as an indisputably high interest of industry in this process, which can be mainly attributed to the high quality of organized FUNDEC courses and selection of topics. On the other hand, a significantly lower number of purely industry-based courses suggests that, in order to provide more efficient bidirectional knowledge transfer and to further shape university research according to the industry needs, the presence of lecturers from industrial domain should be increased.

Acknowledgements

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Role of the Universities in Technology Transfer in Serbia

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Abstract

The basic idea of present paper is to put light on communication between both industry and academia, bringing both "industrial practices into the classroom" and "academic labs into the factory". It aims at delivering a detailed conceptualization and implementation study validating the concept through pilot runs and setting up an extended partnership to promote its future implementation

This involves close cooperation between researchers, students, innovators and entrepreneurs. This can be achieved if the company closely involved in education in order to participate in it and defining its need for highly trained and skilled labour force.

Here we are discussed the most important role of the universities in processes of regional development and technology transfer in Serbia.

Keywords: Technology transfer; Knowledge Triangle; University influence; Regional development;

1. Introduction

Role of the University in technology transfer in Europe Union is described in a guide [1] to help improve the contribution of universities to regional development, with a view to strengthening economic, social and

territorial cohesion, in a sustainable way. The renewed Lisbon agenda aims to turn Europe into a modern, dynamic, outwardlooking knowledge economy. It acknowledges that this is the most effective means of delivering the economic growth and jobs required across Europe. Research, Education and Innovation – Europe's knowledge triangle - lie at the heart of achieving these goals.

The value of the knowledge triangle has been highlighted in many documents of the work of the Expert Groups on research and development and innovation. The substantial increase in funds available to the 7th Framework Programme, the incorporation of new approaches into the programme and the establishment of a European Research Council further recognise the role research, innovation and education can play in achieving the ambitions of the renewed Lisbon agenda. Many reports [2] have also emphasised the means of realising the economic benefits of increasing investments and enhancing the synergy in the knowledge triangle.

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Relating education, science, and production is a substantial prerequisite for economic development and the encouragement of innovative processes [3]. It is difficult to make new technologies, open new positions and enter new markets without the help of universities. That is the reason why the role of the universities are so important.

For instance, each document of the European Union on the strategic economic development plan brings into the focus of politics and measures for encouraging small and medium enterprise development activities aiming at innovations, starting small and medium enterprises, networking, and cluster development in particular. This is a common practice since small and medium enterprises account for 99% of the total number of all economically active subjects on the territory of EU.

2. Serbian Universities in light of EU demands

In Serbia financing research and development activities such as complete financial schemes, payment procedures and the control of infrastructure comes under the responsibility of the Ministry for Education and Science.

Sectors of (former) MSTD are: Department for basic research in natural sciences and medicine, Department for technological development system, Department for international cooperation and European integrations, Department for human resources development in science.

According to Innovation Law, Innovation policy, implemented through innovation activity programmes, is established by the Government for a five-year period, upon proposal of the ministry in charge of the innovation activity. The Ministry maintains electronic and publicly available database and record database on the registered innovation activity subjects, innovation and development projects and innovation activities.

Disintegration of the Universities is one of the biggest problems of the Serbia's academic research and development community in which faculties are independent legal units, which means that the concept of a fully integrated university has still not been embraced. That is why is not possible directly to implement the experience of our partners from the west countries. In spite of that, to universities are given certain integrative functions such as establishment of unified standards of work of departments and services, and unified standards for creating data bases of all units, strategic planning; adoption of study programmes; quality assurance and control; enrolment policy; election of teachers; issuance of diplomas and supplement diplomas; international cooperation; investment planning; etc.

3. Pedagogical Reforms and Technology Transfer Improvement

In the higher education system is needed to develop modules that enable young professionals to manage the entire cycle of enterprise development and implementation of new technologies. From the initial idea development, implementation of necessary technology and research, through creating action strategies, credible marketing and sales materials, construction team of employees, partners and investors, to production management, finance and operations.

Increase of a company or sector profitability, lead to increasing the need for peopl capable for faster adaptation to change, and it is necessary that companies are equipped with business tools to respond to market changes in the application of technological knowledge.

Group of skills and knowledge that should be achieved by studying at universities are:

- Starting and running businesses,
- entrepreneurial business skills,
- marketing and organization of marketing,

- sales and sales organization,
- finance and investment,
- planning,
- management and organization of people,
- project management,
- personal negotiation skills,
- leadership,
- proper decision-making in the business environment,
- the business use of information technology and foreign languages,
- preparation of pre-conditions and ways of applying new technologies,
- and so on.

Young academics should train skills that can help in motivating and leading teams, identifying client needs, applying and obtaining capital for business ideas and plans, easy identification field of the new technologies and ideas etc.

In order to achieve this it is necessary to master the technical knowledge, quantitative financial methods and new management methodology based on scientific research. Special area, which would be necessary in the future to develop, is the knowledge necessary for a successful transfer of technology from concept to practical application.

4. Partnership of all three sides of Knowledge Triangle

One of the key problems of Serbia research and development is inadequate coordination among three basic components of partnership:

- the research and development (R&D) sector,
- the higher education sector, and
- the business enterprise sector.

This lack of coordination become responsible for:

- low efficiency of commercialization of R&D results;
- low demand for the potential capacity of the academic and higher education sectors of science;
- lack of special training of the personnel for particular areas of innovation activity;

Education is at the heart of business concerns. In other parts of the world, one meets students with a sense of urgency to finish their education in order to make a difference in their societies and to create value for themselves and for others. In Europe, and specially in Serbia, this spirit is seldom met and the educational programmes at European universities seldom help students to gain that spirit. European universities are focused on research as their main task. Higher education is viewed mostly as an individual project. High quality teaching for competencies rather than the mere acquisition of knowledge, and especially teaching from which students develop their competencies and attitudes in innovation and business, is scarce. Translating scientific discoveries into products is a unique talent and therefore demands new forms of teaching and learning.

The success and future position of the university, and the economy with it, depends on the creation and use of shared knowledge. In this sense it is said that one of the safest measures to strengthen economic development is to take care of knowledge transfer between universities and industry. The role is not new, nor is it genuine own, but it is necessary and it's no easy to achieve, as it should be developed not only for future needs but also for motives of knowledge transfer. The university should be always ready to promote the transfer of knowledge to the industry not only because of social obligations but also for financial implications.

However, it does not mean that only the finance is motive of existence of cooperation. There is certainly not only a legal but also a moral obligation. This collaboration certainly depends largely on the established traditions and needs. In some societies, it even has a status, in addition to teaching and scientific research, the third mission of universities, which indicates the importance and the need of it.

It turned out that just the obligation to cooperate is not enough, if there is not a real and genuine interest, which not only binds but also integrate partners. In this sense, transfer of academic knowledge should be understood as an activity with the aim of enabling and facilitating industry to adopt and effectively use it, so it is very important to create mechanisms that will assist with improving knowledge transfer.

The Universities shall, instead of emphasis to learning, the most urgently transform their orientation: connect learning to research and put it into a function of the economy.

Industrial organizations are both the generators of new knowledge through research and development implemented in the corporate sector and the subject of demand for developments created in the environment being external for organizations that are in the research and development sector.

In order to improve the partnership between universities and business it is necessary, as already noted, to define a methodology of development of knowledge and training of specialists in marketing and sales, management, finance, organization and project management, the transition from idea to innovation, the legal protection of innovations, preparation and patent protection and so on. Also, it is necessary to have the skills required for planning, management and organization of human resources. Training professionals with mentioned knowledge are need both in universities and in enterprises.

To increase the effect of the University contribution to regional development, it is necessary to take into account the ways to overcome barriers, capacity building, implementation of partnership and connecting partners in the regional innovation system. These methods should be developed systematically in the form of instructions, so that they can represent practical tool and methodological support to designers of national and regional policies responsible for creating and implementing innovative strategies, of which all regions should benefit particularly in the area of university mergers research experiences with growth of competitiveness of the regions.

These instructions seek to:

- provide an analysis of how universities can impact upon regions and how they can be mobilized for regional economic, social and cultural development,
- illustrate (by use of examples from around the EU) some of the potential delivery mechanisms that can be used to maximize the contribution of universities to regional growth,
- outlines the key success factors in building university-regional partnership, particularly the drivers and barriers on both sides behind such partnership is working, and how these barriers may be overcome.

In order to effectively engage universities, public authorities need to understand the principles underlying why universities can be important agents in regional development. There is also a range of mechanisms available to support engagement, many of which are already being deployed. However, it is the strategic coordination of these within a wider policy context that will produce the maximum impact.

It is important to recognize that there may well be a series of complex barriers and challenges to be overcome, both internal to the universities and in the wider enabling environment.

While these instructions should be focuses on what the region can 'get' from its universities, it should be recognized that this is a two way process and the university benefits from its presence in the region as well. Universities should appreciate and maximize the potential of the opportunity that their region presents and shows interest for their research.

In addition to this universities should serve regions to accurately present their capabilities for easier connection with the universities themselves and with relevant international institutions. Also, it is of crucial interest to link the main points of knowledge transfer, which are education, research and innovation, the so-called knowledge triangle.

It is necessary to analyse how universities can influence the development of the region, what mechanisms are needed to maximize the impact of universities on regional development, how to remove barriers to building partnerships on both sides, and how to mobilize the capacity of the university to have a positive effect on regional development. In order to achieve that, it is necessary to know the principles that emphasize the importance of universities in regional development and successful application of new achievements in technological development. It is also important to realize that this is a two-way process and that universities certainly have an interest in connecting with companies.

It is necessary to focus on developing the capabilities and skills in all education, research and business.

In education should focus on the transformation of existing education programs involving innovative and entrepreneurial skills and knowledge, related to knowledge triangle in the existing modules. It is recommended to organize summer schools, student and teacher mobility, and industrial projects and internships, to complement this.

Concerning research, technological development committee of the Ministry of Education and Science should, in the selection of future projects, more valorise innovative oriented projects which are oriented to development and experimental research. Also, it should be more encouraged the exchange of ideas and results, preparing joint initiatives, research networking and mobility.

Business should be focused on providing end-to-end tools for quick turning research results to successful innovation in an accessible, flexible, and agile manner. This set of measures will foster innovation on both the entrepreneurial and the industrial path. A key goal is to create an open market for problems and solutions by matching research results with potential entrepreneurs or industry partners.

All this involves the coordination of activities in education, technology and innovation and entrepreneurship. These activities should be designed, developed, and implemented by a very reasonable balance of top rank industries, research centres, universities and business schools, and actors of the knowledge triangle.

5. Innovation Culture at University

Advances in learning sciences, including cognitive science, neuroscience, education, and social sciences, give us greater understanding of the three connected types of human learning:

- factual knowledge („*that*" or *facts*),
- procedural knowledge („*how*" or *skills*), and
- motivational engagement („*why*" or *urgency*), corresponding to each of the three main areas of the human brain.

They should take advantage of research into brain activity and apply the appropriate behavioural science and technology to optimise individual learning, but also teaching methods.

Creativity and innovation on an individual basis occur all the time in everyday life when people adapt to their surroundings. Creativity and innovations that change society on a larger scale, in terms of new products or processes, can only occur in a system where different actors with diverse backgrounds and competencies are able to act together.

At universities should be introduced new features, which include basic knowledge of the vertices of the knowledge triangle with an emphasis on innovation.

6. Concluding Remarks

As a result of the project KNOWTS, at three universities in Serbia are established technology transfer offices, and at Belgrade University, it has contributed to the rapid development of already founded current office.

In this way, the at universities will foster a new generation of young specialists with an integrated view of research, education, innovation and business, combined with a spirit to transform ideas into business and to make a societal difference.

This involves close cooperation between researchers, students, innovators and entrepreneurs. This can be achieved if the company closely involved in education in order to participate in it and defining its need for highly trained and skilled labour force. It is also necessary to achieve a spatial and organizational mobility of students, researchers and entrepreneurs by promoting openness and creativity, to develop better methods of selection of outstanding researchers, students and entrepreneurs who promote scientific and creatively behaviour.

Acknowledgements

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2013 International Conference on Technology Transfer

Center of Excellence and Innovation Nis

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Abstract

Center of Excellence and Innovation supports development of IT industry sector and promotes implementation of IT solutions in other industry sectors in order to contribute to overall economic growth and competitiveness. The Center was established in 2012 with support of USAID's Regional Competitiveness Initiative and present one node in the network of similar centers of excellence, innovation, incubation and entrepreneurship in South-East Europe. Through provision of services and expertize of the whole network, transfer of best practices, development of workforce with optimal set of skills and establishment of management/operational standards competitiveness of the whole region will raise.

Selection and/or peer-review under responsibility of the organizers of the 2013 International Conference on Technology Transfer

Keywords: IT industry; training and standards

1. The present state IT industry sector in the region

A recent survey of the current state of the IT sector and opportunities for growth and development showed the following results:

Global turnover trends – in the past few years, turnover trends in software development and services are positive, and embedded systems and system integration have seen slow rises, however, the hardware segment has seen a drastic decrease and is now stagnating.

Presence in the international market – a small number of domestic companies are entering the global market through joint ventures with foreign IT companies. In these ventures, foreign partners bring market and domestic company recruiting programmers, as well as subsidies and head-hunters. In addition, there has been an increasing number of freelance workers in IT.

Development and management competencies – the interest in internationally standardized trainings and certificates is still low, talented programmers learn how to adopt new and agile methodologies online, project management is unstructured and hindered by frequent changes in project team members, and unbalanced task assignments and workloads.

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Competitiveness in development and management – talented individuals are making breakthroughs in software development, but unfortunately, project management is usually unstructured and disregards risk management. Top management is deeply involved in everyday tasks, which leaves no time for strategic planning, thus effective management methodologies are not put into practice.

2. Center of Excellence and Innovation Nis

Established in 2012 with the support of USAID's Regional Competitiveness Initiative and the Nis Cluster of Advanced Technologies and Regional Development Agency JUG, CEI is active member of the network of similar Centers in the South-East Europe, providing joint services and expertise.

According to studies on Serbian export potential, the following target groups have been selected:

- primary target group consists of IT/Communication companies,
- second group are companies in the food processing industry,
- third line of intervention will be application of IT solutions in other industry sectors in order to improve overall business results,
- fourth line of intervention will be support for e-Government applications, both from the side of Government institutions, and from the businesses that uses them.

Regarding the first target group, the most important is to build an internationally recognizable set of skills and expertise in the provision of IT products and services, as well as operational and strategic planning and management. This will increase the competitiveness of domestic companies as well as their ability to operate in the international market. Additionally, improving companies' networking capabilities and ability to join different consortia in the region of the South East Europe promotes the whole region as preferable business partners.

The most important reform is to adhere to structured and internationally recognized management methodologies to implement well planned and conducted business operations, and increase project management efficiency and effectiveness.

Trainings of innovators enables transformation of ideas to successful innovation and product/service and is the driving force of contemporary industry and an enabler of internationalization.

Close cooperation with the academic community will ensure students are equipped with the necessary knowledge and specific skills, and will enable the application of student knowledge to solve practical problems during internship programs.

3. Training and qualification activities

CEI Nis, in cooperation with other CEIs in the region, provides a rich portfolio of different awareness/capacity building/management improvement educational trainings. Courses provided by CEIs in the region are compatible, but not concurrent, which minimizes the effort for each CEI while maximizing customer benefits. Trainings are aimed at management improvement as well as innovation enabling. The portfolio includes but is not limited to:

- Leading a Development Team (TSP/PSP),
- Personal Software Process,
- Mind Maps & Creative Business Thinking,
- Strategy Development for IT Organizations,
- Introduction to CMMI for Development,
- Optimize Success/Kanban,
- Scrum & CMMI, Disciplined Agile
- Executive MBA.

- Creative Problem Solving,
- Leadership,
- Fund Raising, Innovation/Idea Funding Sources
- Virtual Rapid Prototyping for Idea Validation
- Women Entrepreneurship,
- And everything else you may be interested in.

During this operation period CEI Nish organized four trainings which improved knowledge and awareness of more than 50 experts from 40 companies in the region. At the same time few companies from this region sent their employees on trainings provided by Serbian Center of Innovation Excellence.

Fig. 1. Development of strategy for IT organizations

Fig. 2. Managing security and resilience

Fig. 3. Leading a Development Team

4. Networking, cooperation and competitiveness improvement in South East Europe region

ICT Forum & SPI Biz Conference, October 2012
120+ participants, 10 countries, 5 Centers—Serbia, FYR Macedonia, Bulgaria, Networking, promotion of Technology transfer centers

Regional IT & Entrepreneurship Conf., December 2012
80+ participants, 9 countries, 9 centers—BiH, Macedonia, Albania, Serbia, Bulgaria, Moldova, Networking, access to finance, business angels

Competences of graduate students, January 2013
50+ participants, Higher Professional school Nis, Higher school Krusevac, 3 high school representatives, 5 IT companies, Presenting educational programs, student's internship

RCI Regional Conf., April 2013
60+ participants, 13 countries, 11 centers, Networking, innovation, incubation, entrepreneurship

5. International Industry and Academic Councils

The primary purpose of the International Industry Council is to function as advisory body of the Center of Excellence and Innovation providing industrial expertise and suggestions. Expertise range from recommendations of industry development directions, over innovation and development consultancies to selection of potentially successful investment projects. Its advisory function is oriented both to the management of the Center and to companies/institutes/professionals seeking for expert opinion.

International Academy Council functions as advisory body of the Center of Excellence and Innovation guiding and suggesting in the area of education, teaching programs, competences definition, research and innovation in university environments. Close cooperation with International Industry Council will promote industry needs to the academic community and influence curricula updates. Advisory functions to universities/institutes/professors will also direct activities of the management of CEI Nis.

The International Councils consists of a minimum of 5 persons, including a Chairman. The members of the International Councils and their Chairmen are elected for a period of 3 years. The first composition of the International Councils and the Chairmen are proposed by the Founder.

6. Conclusion

The Center of Excellence and Innovation Nis is the center of IT knowledge and transfer of best practices. It is a playground for training IT specialists, center of education for top managers of all important companies in the South-East Serbia region, active partner with businesses and institutions in IT research and innovation projects, facilitator of international business/research/innovation opportunities, international forum where businessmen meet their customers, partner to educational institutions for curricula modernization and learning program innovations, and an active node in the network of centers of excellence and innovation.

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2013 International Conference on Technology Transfer

GADGET: A Cooperative Project Methodology to Developing University-industry Linkages via the Triple Helix Approach

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Abstract

The knowledge-based economy is widely acknowledged both in policy and practice as a 21st century reality. Rigid, traditional fact-based education no longer satisfies our changing economies and societies, nor does basic research satisfy the needs and demands of industry, and there is an evident mismatch of industry needs against the offerings of both teaching and research. There is a lack of communication and coherence from both sides, with government and policy actors additionally often playing the role of rule-maker, but not facilitator. To combat such a mismatch, it is fundamental to articulate a triple helix of actors within the knowledge triangle, bringing into line graduates' skills, industry demands, research offerings and innovation. The GADGET project, financed by the Lifelong Learning Programme of the European Commission, examines through an analytical, implementation and exploitation methodology these mismatches, proposing specific improvement schemes and policy influence. Due to the importance of energy and environment – also in line with current European policy – the action focuses on this specific sector and improving linkages between actors in this field. This pilot action is anticipated to be replicable across disciplines, industries and regions using a transferable methodology. This paper is intended to explain briefly the approach and methodology, as well as provide some preliminary results of the GADGET identification phase, currently in its final stages at the time of drafting.

Keywords: GADGET; triple helix; university-industry cooperation; research; innovation; supply; demand

1. The GADGET concept background and the triple helix

Enhancing linkages between academia and industry for more efficient and professional knowledge transfer, as well as the generation of growth and jobs, forms an integral part of current European Union policies and objectives. In a determined attempt to address the traditional low performance of European universities and PROs in terms of knowledge transfer and innovation [1] as well as produce a more adequately qualified labour force, these policies crystallize in a series of initiatives; in particular, Education and Training 2020, Europe 2020 Strategy and its Flagships initiatives for Smart Growth (Innovation Union and Youth on the Move) and Inclusive Growth (Agenda for New Skills and Jobs) which concerns itself with developing an economy based on knowledge and innovation, as well as improving the situation of youth and other vulnerable groups to

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achieve the goal of having 75% of persons between 20 and 64 employed by 2020 [2]. The document particularly underlines the importance of re-building Europe following recent economic crisis via job-creation and innovation, whilst also underlining the importance of the energy sector as a key target for 2020.

Against this evolving background, both undergraduate students and companies' staff need to acquire critical skills and knowledge for carrying out professional activities to fulfill the current demands of society. Transnational issues and aspects are increasingly important, as well as a business-oriented approach. Although much effort is dedicated by Member States and European Union institutions to tend bridges between education and business to stimulate training and competitiveness, there is still much left to be done for these initiatives to reach their potential.

Since the Commission Recommendation 2008/416/EC [3], EU universities still find difficulties in managing and transferring their knowledge and R&D results in an optimum way; turning research results into tangible outputs is still a challenge for most of them; the integration of business needs and perspectives, intellectual property and knowledge transfer matters in undergraduate studies is still insufficient, students' lack of training on skills and abilities which are needed for current employment demands; and finally, internal procedures at PROs and firms as knowledge management and innovation objectives are concerned can still be improved in many ways. While aspects for improvement are clear at the general level, the situation turns more challenging when innovative industries are targeted. Due to the increasing importance of energy efficiency for future societies at the medium term, GADGET (a Lifelong Learning Programme project funded by the European Commission) focuses on environment and energy solutions, a sector which needs specialised teams to understand technical and business concepts and implications in quickly evolving scenarios and legal frameworks.

The "Triple Helix" approach is a recognised and workable approach to generating linkages and cohesion between the worlds of university and industry. The Stanford University "Triple Helix Research Group" defines this thesis as "the potential for innovation and economic development in a Knowledge Society lies in a more prominent role for the university and the hybridisation of elements from University, industry and Government to generate new institutional and social formats for the production, transfer and application of knowledge" [4]. In lay terms, this means bringing together all relevant actors within the knowledge triangle in an attempt to bring research priorities in line with industry needs, as well as complying with national and supra-national objectives and policies. At the same time, teaching and learning must be adequate for industry needs in terms of skills, capacities and knowledge. The Triple Helix Approach by Stanford University and the Triple Helix Association [5] also proposes three steps:

- a more prominent and inclusive role for the University / research organisation, on equal terms as Government and Industry in the knowledge society;
- a movement towards cooperation and integrated relationships between the three actors including the expected result that innovation policy be as a direct result of such interaction, rather than dictated by policy-makers;
- and, all three actors must modify their traditional roles, participating actively in the functional roles of the other, so-called "innovation in innovation" [6].

Within this framework, GADGET is designed to stimulate linkages, in particular in university-provided training for updating employee skills, the skills of future graduates, and the participation of industry in research and teaching. It will provide a means for adapting university experience to the needs of the labour market to boost regional economic development and to enhance the employability of graduates. These distinct linkages clearly fall in line with the above-cited steps and concepts. However, in GADGET, the helix has been modified to include University-Industry-Intermediary, with a secondary focus on policy-makers. This was the case to be able to reach a larger target group of SMEs via the contacts of the intermediary (business associations, chambers of commerce, etc.). Such multipliers enhance the outreach of the action, as well as providing vital insight into their clients' needs.

GADGET will conduct a pilot action on good practice between industry needs, training and exploitation of results in the field of environment and energy solutions in three countries, Austria, United Kingdom and Spain. These countries have been selected in order to form a knowledge transfer axis covering regions of Europe which have a rich entrepreneurial tissue in the industrial sector addressed. To gain an insight into the real needs and possibilities between the academic and private actors in the different countries, GADGET gathers 9 partners of different nature, which are articulated as triple helixes of knowledge and practice in each country. There will be one triple helix per country, composed of one HEI, one business intermediary (Chamber of Commerce) and one SME. This multifaceted and complementary structure will help understand and integrate the necessities and expectations of local and regional companies with the expectations and capacities of their HEIs. Also of importance, experience gained will be easily translated to other public-private partnerships from geographical areas and countries of similar innovation profiles.

2. Methodology of the GADGET project

GADGET – "Good Practice Pilot Action for Innovative Industries: Education, Training and Exploitation", is a 2-year long pilot project running from October 2012 – September 2014 and funded under the European Commission's Lifelong Learning Programme under the Erasmus strand [7]. It focuses on an innovative industry sector critical for the sustainable development of future societies – that of "environment and energy solutions" - with a genuine pro-competitive approach in terms of structure and training. This pilot action will serve as a tentative model to be replicated by other higher education institutions (HEIs).

The general objective of the project is to **conduct a pilot action in three countries (Spain, Austria and the United Kingdom) for good practice for industry needs, training and exploitation of results in upcoming areas of environmental and energy industrie**s. Within this general objective, a series of specific objectives seek to provide concrete and attainable actions and solutions.

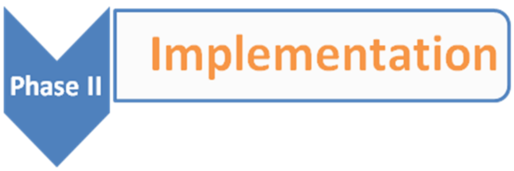
The composition of the consortium from different sectors (university – industry – business intermediary) enables GADGET to address three major identified challenges, which are:

i) mismatch of curriculum and the labour market,
ii) shortage of university-industry cooperation, and
iii) competence and skills enhancement of working adults in the environment and energy industries.

The project has been divided into three co-related phases as shown in the diagram below.
Phase 1: Identification - determining weaknesses, current processes, knowledge gaps and good practices;
Phase 2: Implementation - setting in motion specific collaboration schemes; and
Phase 3: Exploitation - transferring good practice to relevant stakeholders.

GADGET is intended as a pilot action. This means that it will test the hypothesis and, if successful, will serve as a tentative model to be replicated by other HEIs who can clearly follow the adopted methodology. GADGET has been constructed around a sound methodological base: **Analysis leads to conclusions, conclusions to action, and action to results.**

Phase 1: Benchmarking will be carried out through distributing surveys to HEIs, SMEs and intermediaries. The data collected from a minimum of 150 SMEs, 12 intermediaries and 12 HEIs will be analysed and compared among the participating countries. The questionnaires are to examine the existing linkage between university and industry and its cooperation mode, training needs for current working adults, desirable quality of future graduates, research and technical needs exist within industry and the focus of HEIs. Subsequently, three country reports and one comparison will be drawn and presented in both written and interactive means analysis supply vs. demand.



Phase 2: The identified results in phase I from both supply (university) and demand (industry) sides will be transformed into three schemes and implemented targeting the universities, students and working adults. (1) *Industry-orientated Lifelong Learning Training Scheme:* courses on identified topic (s) will be conducted for working adults according to the evaluation from the employers in Phase I. (2) *Interdepartmental Scheme:* dialogue and communications will be facilitated and as a result, new cooperation opportunities will be determined. (3) *Invited Professor Scheme:* industry representatives will be invited to deliver guest lectures to helps students to understand the real situation of the labour market in the field and state of the art, and at the same time, it will facilitate the communication between university professors and the business world.

Phase 3: In the final phase, the philosophy, methodology applied and results of GADGET will be widely disseminated to other HEIs in the three countries and further afield. Relevant stakeholders will be spotted and be informed with project information on a regular basis, including three-monthly newsletters. In addition, six "cafés" will be organised as an informal networking platform for researchers, SMEs and professors in each country. Student's involvement will not be ignored as they are also the primary target of GADGET. Finally, a conference will take place in Brussels with prominent speakers in the environment and energy sectors to share their successful stories on university-industry cooperation.

The working methodology and obtained results will be transformed to a handy and practical toolkit on the GADGET portal. Policy makers, top management, industry representatives or students can find the most relevant and appropriate information in this one-stop shop to enable the replication of GADGET. Moreover, courses conducted in the Phase III will be available on the portal for wider outreach and impact.

The target groups of the project can be identified as three-fold to echo the triple helix approach utilised:
1) European HEIS (institutions, students, researchers);
2) Industry actors (intermediaries and especially SMES - in this case in the energy and environmental sectors), and
3) To a lesser extent, policy makers.

The project will reach out to these target groups during the project life via the intended activities, which contain a high-expected participation, and also through the identification of other relevant stakeholders with multiplier effects, such as industry intermediaries (Chambers of Commerce, associations) and HEI actors (university associations, such as EUA). The use of intermediaries and multipliers will be vital to reach the project's intended stakeholders, and this will be promoted via a stakeholder identification exercise. The project's activities are clearly beneficial and geared towards the development strategies of the intended target groups, and this will be a key message when communicating with target groups. SMEs, intermediaries and HEIs form part of the consortium, and external entities form part of the activities via, for example, the analysis, collaboration schemes and as recipients of intended results. Policy-makers will be interested in the project results, in particular the supply vs. demand reports and results of the pilot schemes.

Again, echoing the proposed items by the Triple Helix Research Group, the results and expected impact for HEIs include a greater cohesion with the needs of innovative industries, and enhanced employability for graduates. By gaining such cohesion, HEIs can offer a better service to the community, which assists to accomplish one of the main objectives of an HEI. For the industry sector, the project will have a large-scale impact in that it will ensure the re-training of existing staff to meet specifically identified needs, the provision of better-prepared graduates and the opportunity to work with researchers to provide answers to their innovation needs. For all, enhanced dialogue and cohesion is the biggest impact. Policy makers will have specific results to influence future actions. In such a sense, in line with accepted theory, we promote:

a) equal roles for the three actors proposed (plus government) to determine cooperation schemes, findings on needs and requirements;
b) movement towards cooperation and integrated relationships via joint definition of priorities and dialogue, plus joint research into gaps of supply vs. demand, in an attempt to influence policy-making and generate good practice; and
c) the inclusion of all actors into the traditional roles of others (e.g. industry actors teaching guest lectures).

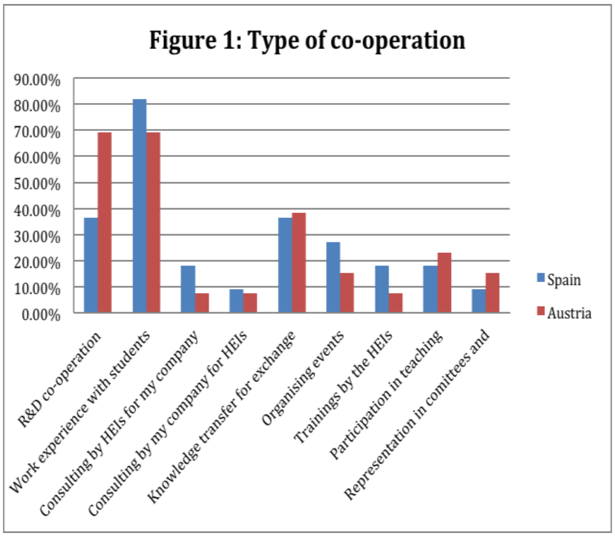
The intended change to be generated by GADGET is to provide a set of replicable activities, which will show the way to enhancing linkages between enterprise and education, in specific or generalised sectors. In the institutions targeted, the change will be tangible in that sustainable activities and linkages will be created assisting to bring together the worlds of education and work. On a European level, the project will provide an example of a three-tiered and cooperative approach to creating linkages, which is transferable in contexts and amongst sectors thanks to the national vs. European elements included and a methodology which is applicable in all contexts and industrial sectors.

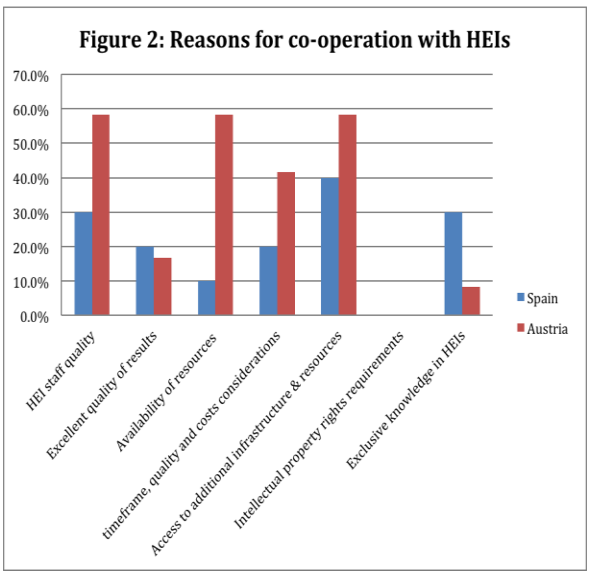
3. Preliminary Findings of the GADGET Identification Phase

The GADGET project is currently heading towards the end of phase 1 (Identification). In this section, we are going to introduce the preliminary data gathered from Spain and Austria. At the time of drafting, data from the third component (United Kingdom) was still being processed. Since GADGET is in its start-up stage, the findings discussed below do not represent the final results. However, the highlighted results suggested strengths and weaknesses of current curriculum, and university-industry cooperation modes in both countries.

As described earlier, the questionnaires are to examine the existing linkages between university and industry and its cooperation mode, training needs for current working adults, desirable quality of future graduates, research and technical needs exist within industry and the focus of HEIs. The target audience of this analysis is 50 SMEs, 4 universities and 4 intermediaries in each participated country. Questionnaires were sent out through targeted mailing to the environment and energy sectors, intermediaries and departments in universities.

The majority of the respondant SMEs have a similar scale in size and annual revenue. Amongst these two groups, they also share the same percentage, 60%, of cooperation history with HEIs. As shown in figure 1, the most common cooperation modes between SMEs and HEIs are student placement, R&D cooperation and knowledge transfer for exchange in both countries. Despite similarity in the cooperation type, the driving force for the linkage varies (see figure 2).





Both Spanish and Austrian enterprises believed that the staff quality, and access gained to additional infrastructure and resources in HEIs were top of the list when considering the bi-sector cooperation. However, the difference lays in the availability of resources and exclusive knowledge in HEIs. Almost 60% of Austrian SMEs were attracted by the availability of resources in HEIs, whereas, less than 10% Austrian SMEs indicated that knowledge exclusiveness attracted them to approach HEIs. On the contrary, only 10% of Spanish SMEs agreed attractiveness of resources availability whilst 30% of them revealed that exclusive knowledge in HEIs was an important factor. Coincidently, none of them approached HEIs for intellectual property rights' issues, showing a lack of information on the HEIs' role in this matter, or a lack of services at HEI level for industry.

Most of the collaboration was established through direct contacts, which means that companies approach HEIs or vice versa. Recommendations or response to tender were relatively rare. The satisfaction of university-industry cooperation varies a lot from Spain to Austria. In Austria, there was no negative data for degree of satisfaction, but not all HEIs in Austria would like to intensify the cooperation with companies in the energy or environment sector. In contrast, it showed that the university-industry cooperation left dissatisfaction to the Spanish HEIs only, especially when SMEs provided consultancy services.

In the survey, we also looked at how the current employers evaluate graduates' work performance and competence according to their observation. In our targeted sectors, Spanish SMEs were satisfied with graduates' competency in engineering and technological skills, which were rated very important by all respondents. Nevertheless, the Austrian counterparts, 64%, considered entrepreneurial competency was more important than the hard skills and the majority of them were happy with the performance of the graduates.

On the other hand, both countries agreed that communications skills were the second crucial element in workplace and that there was room for improvement. The data suggested that Spanish graduates were not very well prepared in entrepreneurship, innovation management and foreign language proficiency. Meanwhile, Austrians were not satisfied with graduates' leadership competency, project management and entrepreneurship.

According to the preliminary results, it showed that the enterprises in the two countries had a slightly different focus on graduate competencies. For instance, the driving force to establish collaborative relationships in Spain valued so-called "hard" skills, whilst in Austria, the emphasis was placed on entrepreneurial competence. The similarities and differences found in the survey will assist to largely improve the mismatch and lack of communication in the university-industry cooperation. The final results become a base for the second phase for implementation of GADGET [8].

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Standardization of Internationalization and Innovation Support for Serbian Companies

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Abstract

This paper explains the importance of providing constant support to the companies by the university staff. By introducing the example of standardized internationalization and innovation support provision given by the Enterprise Europe Network Consortium in Serbia (where three largest universities represent partners), the authors tend to highlight the necessity of mutual cooperation between higher education and research institutions with real life business operations. Based on the experience of more than four years in business support, the major obstacles that influence the service quality are highlighted, as well as improvement suggestions.

Selection and/or peer-review under responsibility of the organizers of the 2013 International Conference on Technology Transfer

Keywords: Internationalization; Innovation; European market; Companies; Support

1. Introduction

Today's business operations of all companies are generally based on timely and adequate response to market changes. In order to respond to the clients demands and to maintain its competitive position in the market, the modern company has to conduct numerous project based business operations. In addition, a company seeks for the internationalization and cooperation with foreign partners, since it very often has a need to go abroad (regardless of point in value chain). The fact that many companies perform constant innovation and technology transfer programs, especially ones belonging to broad engineering sectors, only imposes that well structured system of internationalization and innovation support for the most prosperous innovative companies is needed, where many stakeholders should be included.

In order to successfully proceed with the EU integration process, Republic of Serbia has to undertake major society and economic changes. In light of those changes, major innovation support reorganizations are indispensable. There are many EU' initiatives that aim to support innovation and technology transfer programs and where companies can become visible to numerous potential business partners. Companies often request support from universities, since they represent some kind of crossroads between qualitative theoretical

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approach and structured implementation of experimental results within industries. In addition, they are educating future companies' key players, both in terms of technology and management issues. Three largest state-owned universities in the Republic of Serbia (Belgrade, Novi Sad and Niš) have realized the need for standardization of their support to innovative companies. As they have joined, together with other Serbian business support flagship institutions (National Agency for Regional Development, Serbia Investment and Export Promotion Agency, Institute Mihajlo Pupin and Serbian Chamber of Commerce), the Enterprise Europe Network (EEN) Consortium in Serbia back in 2009, they have the access to various foreign institutions and help small and medium business (SME) to make the most of the European marketplace.

The Enterprise Europe Network is a key instrument in the EU's strategy to boost growth and jobs. Bringing together close to 600 business support organizations from more than 50 countries, the Network helps small and medium companies seize the unparalleled business opportunities in the EU Single Market. Its member organizations include chambers of commerce and industry, technology centers, universities and research institutes, as well as various development agencies. Most of them have been supporting local businesses for a long time. They know their clients' strengths and needs - and they know Europe. [1] European Commission, via its operational body Executive Agency for Competitiveness and Innovation (EACI), is responsible for Network activities, alongside with all the Network partners across Europe (and wider) that have joined.

2. Innovation importance and Networks' work

As previous studies have shown [2], innovation is one of the most important strategic factors in the company, and also the priority function which requires constant investments. The innovation drive level varies among various countries, as well as from one industrial sector to another. For a particular society as a whole, this level can be directly linked to the society's GDP. On the sector or national level, the innovation performance index measuring the overall national innovation performance has been proposed and measured systematically in the countries of the European Union and other countries. Generally, these reports associate the innovation with high technology industry (European Innovation Scoreboard), and tend to look at the low to medium technology sectors predominantly as users of a high technology innovation. [3]

Innovation very often goes hand in hand with technology transfer, where companies perform either technology offers or technology requests. However, most of the companies fail to notice the factors (size) that affect innovation and what is measuring tool of the quality of innovation activities and innovativeness within company. Only a few companies accurately measure and monitor their investments in innovation, although they are familiar with the importance of analysis and measurement of innovative activities. In fact, even in those companies which carry out such measurements, the employees who implement them are not quite sure they do it the right way. Wrong approach and methodology of measurement adopted in practice cause a number of different problems: incomplete information, unnecessary spending, and finally, not appreciable return on investment in innovation.

Based on previously mentioned, it is of crucial importance for companies to rely on distinguished institutions that are willing to enhance companies' operations indirectly by providing platforms for knowledge exchange. Three main focuses of EEN's support refer to:

- Technological brokerage services
- Commercial brokerage services
- Research brokerage services

Networks' clients (companies enlisted in profiles database or simply co-operation partners of EEN offices in 50 countries) receive different types of standardized, tailor-made services when it comes to internalization and innovation issues. Once they connect with business/research partners via EEN officers, they sign a Partnership

Agreements (PA). A PA is an acknowledgement by (usually) two EEN clients that they entered in a concrete, medium to long-term international cooperation with another SME, company, research institution, researcher or private person with EEN assistance [5]. A PA reported to the EACI shows that a Network partner successfully provided brokerage assistance to one of his/her clients. Therefore, EEN' services tend to provide practical, hand-on-work support to its clients, companies seeking for business partnership and/or technology transfer and innovation breakthrough.

3. Provision of internationalisation and innovation support - case of Serbian EEN consortium

The overall objective is to encourage Serbian companies to participate in a more active and productive way in EU economy and to increase their own competitiveness among EU SMEs by forcing their innovation capacities and by applying overall business services and know-how [4]. Specific objectives of this activity are:

- Providing information and support related to all aspects of Intellectual Property Rights (IPR) to network clients
- Identification of SMEs needs, procedures and technological capacity using the technology audits or business reviews, as the tool
- Providing the information related to available EU funds for Serbian enterprises and organizations
- Providing other types of intensive support related to internationalization and innovation
- Increasing competitiveness and innovation potential of SMEs on European level trough technology transfer and promotion of innovative solutions
- Disseminating public procurement opportunities (e.g. non-refundable state grants)

In order to achieve the above mentioned objectives, partners in Serbian EEN undertake the following actions: Providing support on all aspects related to IPR, Performing technology audits or business reviews, EU projects support, Support related to other types of services related to internationalization and innovation. Main beneficiaries are: Research and Technological Development (RTD) institutions, Start-ups, Sector organizations-clusters, EU project applicants, Innovative Companies (SMEs and Larger companies) with high potential for internationalization, Individuals - entrepreneurs and innovators, Professional and trade organizations.

For every activity a specific procedure was defined, as good as forms and patterns. By doing so, all the consortium partners are providing the same service type to Network's clients in the country. An example of such standardized procedure is given on Figure 1.

3.1. Support on all aspects related to IPR

Based on previous experiences, Serbian EEN partners have realized that SMEs need basic and specialized knowledge and set of services related to IPR. According to that, support is provided in: intellectual property audits, valorization of intellectual property assets, advisory services on IP enforcement and IP counterfeiting. All the partners perform intellectual property and innovation audits, by using IP audit form developed by partner organization University of Niš, to identify and recommend appropriate type of IP protection and level of protection (national, regional and international). The partners focus in helping SMEs in IPR application process and validation at national level and this process is documented in a form of unique reports at level of whole consortium. For regional and international protection available Networks tools are used and appropriate international partners who have more experiences are invited. There is a close work with specialist organizations that help small businesses to use intellectual property rights to protect and profit from their ideas and innovation.

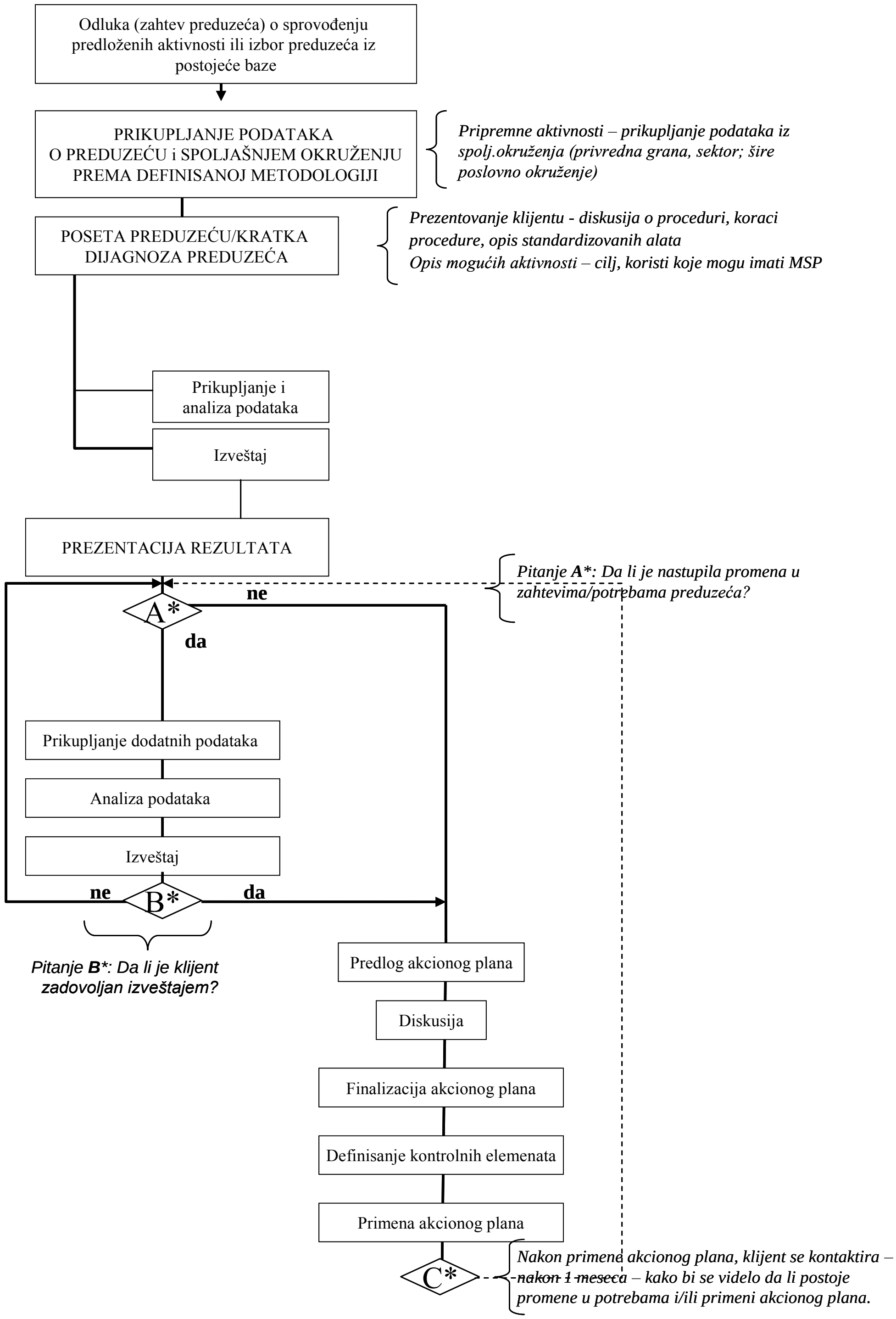

Fig. 1. An example of standardized service provision procedure within EEN

3.2. Technology audits or business reviews

By the end of 2010, the partners have provided for its clients very basic knowledge on technology audit and techniques required for its conducting. From 2011 on, institutions have continued to perform more sophisticated technology audits in order to identify RTD needs of SMEs and understand procedures and technological capacity of SMEs through fulfilling the basic questionnaire with necessary consultation with client's collaborators. The partners perform definition of specific needs of SMEs, main forces and creation of specific pool of skills, knowledge and tools needed for SMEs based on analyzed data in Technology Audits (TA). Also through TA the new product and innovative business ideas are identified and presented through Framework Programs (FP) projects, brokerage events, etc.

3.3. Support to finance in EU projects

Ever since they started their operations, EEN partners have been actively involved in dissemination of the information on EU available funds such are FP7 and CIP (Competitiveness and Innovation Program), but mainly on a group level. From 2011 on, they evaluate capabilities of each client for access to EU programs by using FP Check Tool and other recommended tools. Based on tool result reports (unique form for whole consortium) the partners know which local SME might be interested in specific kind of proposals and alert them. That also means that they analyze open calls for proposals, classify the existing EEN's database (of companies' profiles) and make matches. In case they assume that some EU calls (other than CIP and FP7) may be interesting for specific SME, the client is informed about that opportunity. If the client shows interest for participation in a specific call, EEN partners provide necessary support (assistance in how to apply for the call and best-practice sharing during the whole application process).

3.4. Other types of intensive support related to internationalization and innovation

These activities are also necessary in building of SMEs capacities. Therefore, the partners provide services such are tailored assistance related to standardization (e.g. CE Marking), legislation (e.g. REACH - Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals), taxes, foreign investments, innovation management, globalization of regional clusters, producing market and country reports.

Companies that have mostly been service users of those activities generally came from the manufacturing industry, the ICT sector and the traffic, and the analysis was performed for the research and development centers that have the innovative and feasibility potential for those activities.

4. Role of the university partners

EEN partners undertake provision of internationalization and innovation support based on their regular activities and capacities for internationalization and innovation support and previous experience gained from participation in the Network.

In this activity each partner is focused on actions in which they have more experiences. According to that, universities are focused on the support in all aspects of IPR and other partners in consortium are mainly signposting to them valorization of intellectual property assets, advisory services on IP enforcement and IP counterfeiting. In addition, universities are strongly supporting realization of technology issues, and help other partners in technology audits/business reviews. When it comes to EU projects applications and later implementation, universities are recognized as one of the most capable institutions in Serbia. Thus, universities are also focused on action connected with EU projects support and help other partners to realize this action, especially on assistance in how to apply for the call, and during the whole application process. Non-university EEN partners mainly operate with additional types of intensive support related to internationalization and innovation because of their experience in that section as a agencies whose daily actions are closely related to this action and because of their huge clients base. Still, universities have their active role in this field as well, especially taking into consideration the fact that many university spin-off companies have been established in the past two decades.

Still, there are many obstacles EEN partners are facing while providing abovementioned services. For example, the companies lack willingness to engage in innovation and technology transfer activities. Very often they express need for technology audits, but when it comes to realization they refuse to provide needed insight of data. It takes time and persistent explanations to companies' representatives that business support services do not tend to interfere in technology and business operations. The main idea is to lift up competitive advantage capacities.

5. Conclusion

The results achieved so far (for more than 2,000 Serbian companies profiles were created for seeking business partners / customers or technology transfer; through a network more than 45 Serbian enterprises have established business cooperation contracts signed with companies from abroad; at international business meetings and corporate missions 1,162 clients participated and held 3,697 meetings with foreign companies, etc.) evidence solid support to companies given the difficult circumstances of the external environment (transient period, etc.). Better functioning of the economy would lead to even better results. Policy makers should acknowledge the efforts of these institutions that seek to overcome the non-developed relations between colleges / universities and SMEs by using relatively modest means, and to support such efforts by introducing innovative approach and not intervene where there not necessary.

Acknowledgements

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Track 3: Quality Assurance in Education and Research

2013 International Conference on Technology Transfer

Effects of Quality Assurance in Serbian Higher Education After the First Round of Accreditation

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Abstract

After the constitution of Commission for Accreditation and Quality Assurance (CAQA) and adoption of the set of standards, procedures and guidelines for self-evaluation and external evaluation of higher education institutions (HEIs), CAQA has completed the first round of accreditation of all HEIs in Serbia (both, institutional and study programmes), conducted external quality control of HEIs and started the second accreditation round. It is important to note that by national legislation the external evaluation process in Serbia is dual: (accreditation and external quality control)–and, according to the report of ENQA review panel, is in compliance with the European Standards and Guidelines (ESG). On the basis of this report, as of April 25, 2013, CAQA has been granted full ENQA membership. These achievements mean that the quality assurance system in Serbian higher education is established according to the European best practice. This review will highlight some of the effects of the evaluation process carried out so far. It has 7 chapters: Introduction, Outcomes of the evaluation processes; Satisfaction of stakeholders; Effectiveness of CAQA; Impact of the evaluation process on HEIs; Conclusions and Future plans.

In the second part of this review we present the results of the evaluation processes carried out by CAQA. In brief these are: in the first round (2007-2011), 205 HEIs and 1553 study programmes were accredited, in the second round that has started in 2012, 51 higher schools of professional studies (polytechnics), accredited for the first time in 2007, and 210 study programmes were accredited and, finally, 78 reports on external quality control of HEIs have been adopted. In the third part CAQA has analysed the satisfaction of the stakeholders in the evaluation process by conducting a survey among them on the extent to which it fulfills its tasks and contributes to the overall improvements of HE in Serbia. Majority of feedback from various stakeholders on the accreditation process itself as well as on CAQA as its manager was positive. The fourth part explores the effectiveness of CAQA at carrying its remit by: a) comparing the time needed for preparing accreditation reports in the first and second accreditation round, b) analysing CAQA capacity to cooperate with stakeholders, c) analysing CAQA capacity to introduce changes in its work, d) analysing CAQA capacity for strategic planning and implementation and d) analysing CAQA capacity for international cooperation. The fiftth chapter tries to answer the crucial question: have our HEIs improved after the first round of both evaluation processes: accreditation and external quality control? To give some reliable answer to that question we have compared some aspects of the evaluation process and its outcomes of 52 higher schools of professional studies (polytechnics) that have been accredited first time in 2007 and second time in 2012. Data indicate increase in the capacity of schools to develop and manage their quality. In the concluding remarks we will try to reflect critically on our activities and to analyse possible improvements in the evaluation process as well as in CAQA organization.

Keywords: Quality assurance, Accreditation, Higher education

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1. Introduction

Dynamic adaptation of the higher education system towards European and international standards aimed towards transforming Serbian society into a knowledge based society, transformation towards the Bologna system of education and, finally, the Law of Higher Education (LoHE) from 2005, were the reasons for establishing the Commission for Accreditation and Quality Assurance (CAQA). To respond to the challenges mentioned above in the best possible manner, CAQA has intensively developed its expertise, learning from European and international best practice, as well as from its own experience in quality assurance procedures. In 2007 CAQA has published a set of standards, procedures and guidelines for self-evaluation and accreditation of HEIs and their study programmes [1]–that are fully compliant with the ESG. Since then intensive process of their implementation took place. This required accountability and focus towards constant and guided improvement of the academic community.

Since establishment, CAQA has been continuously raising awareness of the academic community regarding the quality culture in Serbian higher education. For CAQA it is of essential importance to recognize the needs of all stakeholders and to have them involved in structuring mechanisms for quality assurance in higher education. Nowadays, CAQA acts as a major stakeholder in the area of higher education in Serbia as well as a driving force fostering improvements. Such role is additionally strengthened by CAQA joining ENQA as a full member in April 2013.

The effects of these activities have been analysed partially [4-12] as well as in the form of system-wide analysis for the sector of higher professional education [13]. This paper reviews the major CAQA achievements as well as the impact of its evaluations on the Serbian higher education area.

2. Outcomes of the evaluation process

Legal framework of the evaluation processes nominates CAQA as an evaluation body for both accreditation of higher education institutions and their study programmes and external quality control. Accreditation cycles are regulated by the LoHE, where it says that accreditation has to be done every 5 years. Positive accreditation decision is a prerequisite for the operating licence of higher education institution. External quality control is also a periodic activity of CAQA, regulated by the LoHE.

The evaluation process is governed by a number of rules, regulations and several sets of standards for every type of evaluation, which can be found on CAQA’s website www.kapk.org. In this part of this review we present the results of both evaluation processes carried out by CAQA: accreditation and external quality control.

2.1. Outcomes of accreditation

The first round of accreditation of both institutions and study programmes in Serbian higher education was performed during the period 2007-2011. Accreditation was carried out according to the following plan:

- all polytechnics and their programmes were evaluated in 2007.
- evaluation of universities, faculties and colleges and their programmes was divided into 5 cycles: the first and the second cycle in 2008, the third, the forth and the fifth in 2009.
- additional evaluation of higher education institutions and study programmes was performed in the sixth and the seventh cycle in 2010, and in the eighth cycle in 2011.

In the first accreditation round in total 232 HEIs and 1947 programmes submitted accreditation request according to the following dynamics:

2007: 78 polytechnics+**515** programmes
2008: 81 faculties/coll./univ.+**928** programmes

2009: 60 faculties/coll./univ.+**308** programmes
2010: 13 faculties/coll./univ.+**51** programmes
2011: 145 programmes

Results of the first accreditation round (2007-2011) are:
• **65** (47 state, 18 private) accredited **polytechnics** with **331** study programmes for **22,773 s**tudents in the first year
• **16** accredited **universities** (8 state, 8 private)
• **118** accredited **faculties** with **1205** study programmes for **65,607** students in the first year
• **6** (2 state, 4 private) accredited **colleges** with **17** study programmes for **1,112** students in the first year
Total: **205** HEIs+**1553** programmes accredited (85% students enrol state, 15% private HEIs)

Results of the second accreditation round (2012-2016) are:
2012: 51 polytechnics+**210** programmes accredited
2013: 27 HEIs+**357** programmes in progress
Plan for the next period:
2014: 62 HEIs+400 programmes
2015: 55 HEIs+350 programmes
2016: 10 HEIs+200 programmes

2.2. Outcomes of the external quality control

In the first round of external quality control (2011-2015) **54** requests of HEIs supported by self-evaluation reports were submitted in 2011 and **44** requests of HEIs supported by self-evaluation reports were submitted in 2012. After the completion of the evaluation process CAQA accepted **78** reports on external quality control of HEIs and publicized the reports on its web-site.

Plan for the next period:
2013: 50 requests expected
2014: 50 requests expected
2015: 10 requests expected

3. Satisfaction of stakeholders

This section presents an analysis of the feedback provided by universities, faculties, higher schools of professional studies, as well as peers (university professors and students) and other stakeholders. The survey was sent electronically to the addresses of 1077 stakeholders who have directly cooperated with CAQA (members of the academic community - professors, students, university managers, CAQA reviewers, members of the labour market) with a total of 430 (40%) questionnaires returned.

We complied the answers received by 106 governing bodies members of higher education institutions (79 from state and 29 from private institutions), 55 directors of higher school of professional studies, 102 university professors peers, 62 students peers and 23 stakeholders. The questionnaire had 17 questions, in which the answers were ranked on the basis of four different options. The questionnaire for stakeholders had seven questions with three options for the answers.

None of the participants generally opposed the concept of accreditation and they also expressed understanding for different problems they have encountered due to the fact that it was the first exercise of this kind. The largest number of answers on all questions in all groups was very positive or positive, a very small percentage was negative. Detailed analysis of this survey, is presented in CAQA self-evaluation report [2].

The general conclusion could be that all participants had positive opinion about the accreditation process, CAQA criteria, recommendations and decisions, as well as about the CAQA members work. No participant was fundamentally opposing the idea of accreditation. The majority of criticisms related to problems of organisation and extensive workload for HEIs needed for implementing QA due to lot of documentation and various evidences needed for proving fulfilment of particular standards. On the other hand the process and the outcome were considered as very worthwhile the effort.

4. Effectiveness of CAQA

Effectiveness of CAQA was analysed by comparison of CAQA outcomes af the beginning of the first accreditation round (2007) and now (2013). Indicators of CAQA performance were:

- efficiency of delivering accreditation decisions
- capacity to cooperate with stakeholders
- capacity to improve procedures and documents
- capacity for strategic planning and implementation
- capacity for international cooperation

4.1. Efficiency of delivering accreditation decisions

This part explores the effectiveness of CAQA at carrying its remit by comparing the time needed for preparing accreditation reports in the first and second accreditation round and by comparing efficiency of CAQA in administering requests for accreditation in the first and second round. Table 1 presents the number of days needed for the accreditation decisions and Table 2 the number of decisions for 52 higher professional schools in the first and second accreditation round.

Table 1. Number of days from application to accreditation decisions without and with act of warning in 2 accreditation rounds of polytechnics (HSS – humanities and social sciences, TTS – technical and technological sciences, MS – medical sciences)

	Accreditation 2007					Accreditation 2012				
	HSS	MS	TTS	Art	Total	HSS	MS	TTS	Art	Total
Number of days from application to accreditation decision (without act of warning)										
Mean	103.1	97.3	101.1	131.0	101.5	99.5	93.6	96.9		97.3
SD	12.8	0.8	10.0		10.6	18.7	1.7	9.8		12.6
Number of days from application to accreditation decision after act of warning										
Mean	178.6	174.2	199.0	334.0	184.2	210.2	122.0	152.8	256.0	185.5
SD	71.5	48.2	59.6		70.1	56.8		49.9	9.9	61.1

Data presented in Table 1 show that time needed for accreditation decisions has slightly shortened in all fields and in both types of decisions (without and with act of warning). However number of decisions in two accreditation rounds differed – 158 decisions for study programmes in 2007 and 209 in 2012 (Table 2). Percentage of acts of warnings was similar 78% in 2007 and 75% in 2012. All this indicates maintenance of CAQA strictness in making decisions and even improvement of CAQA efficiency in 2 accreditation rounds.

Table 2. Number of accreditation decisions for 52 polytechnics and their study programmes in 2 accreditation rounds (HSS – humanities and social sciences, TTS – technical and technological sciences, MS – medical sciences)

	Accreditation 2007					Accreditation 2012				
	HSS	MS	TTS	Art	Total	HSS	MS	TTS	Art	Total
Number of all accreditation decisions (without and with act of warning)										
HEIs	23	4	26		53	22	4	26	0	52
Programmes	47	13	96	2	158	65	14	128	2	209
Total	70	17	122	2	211	87	18	154	2	261
Number of accreditation decisions without act of warning										
HEIs	12	3	25		40	14	4	22		40
Programmes	24	9	91	1	125	39	13	104		156
Total	36	12	116	1	165	53	17	126		196
Number of accreditation decisions after act of warning										
HEIs	11	1	1		13	8		4		12
Programmes	23	4	5	1	33	26	1	24	2	53
Total	34	5	6	1	46	34	1	28	2	65

4.2. Capacity to cooperate with stakeholders

Capacity to cooperate with stakeholders has improved since

- CAQA included students in the evaluation process since 2011
- CAQA included representatives of the labor market in the evaluation process since 2012 (2013)
- Number of reviewers increased from 650 in 2010 to 800 in 2013
- Programme of reviewer education continued (4 seminars in 2013)

Permanent contact with HEIs (consultations almost on every-day basis, seminars before the accreditation round – 1 in 2012, 1 in 2013) font size.

4.3. Capacity to improve procedures and documents

In the last few years CAQA has improved number of procedures and corresponding guidelines for both evaluation processes: accreditation and external quality control. For accreditation of study programmes at all levels and accreditation of institutional CAQA has improved instructions (guidelines) for reviewers and forms of reviewer reports. For external quality control CAQA has developed new procedures and instructions for both: institutions and reviewers:

- Procedure and form of application of HEI for external quality control
- Instructions for HEIs for preparing self-evaluation report and accompanying documents
- Instructions for reviewers
- Form of reviewers report
- Protocol of the site-visit
- Form of the sub-commission report on site-visit
- Form of the report on external quality control of HEI

All these documents are publicized on the web-site (www.kapk.org). CAQA has also improved its transparency since it publicizes all accreditation decisions and external evaluation reports on its web-site.

4.4. Capacity for strategic planning and implementation

CAQA has created a strategic document “CAQA strategy for 2013 -2017” [3] together with the Action plan for its implementation at the end of 2012. Both documents are on the web site (www. kapk.org). Since then CAQA has implemented several activities stated in the Action plan and actively works on implementation of the others. CAQA regularly updates the list Action plan progress on the web page. CAQA also monitors the tasks that are not yet implemented and plans the activities to complete their implementation. These will be specifically discussed in the last chapter.

4.5. Capacity for international cooperation

In the past few years CAQA has intensified its international cooperation by participating at meetings and conferences regarding QA, by cooperating with regional and European agencies and by active participation in ENQA events and activities. CAQA has also created an organizational unit for international cooperation. This unit successfully organised ENQA workshop in May 2012 and final Tempus CUBRIK Conference in July 2013. Due to its overall activities and results and its international role CAQA has become a leader in the region. The status of the full ENQA member has additional strengthened that position.

5. Impact of the evaluation process on HEIs

The data gathered during the first and the second accreditation round of higher schools of professional studies, as well as during external quality control gave CAQA a lot of information on progress in the sector of professional higher education. This analysis [13] monitors the progress of institutions and the higher professional studies sector as a whole as they strive to achieve a vision for higher education excellence, access, and dynamic adaptation towards European and international standards, and Bologna system of education.

This section presents the distribution of accredited polytechnics in Serbian regions (to illustrate the significance of this sector for Serbia), detailed analysis of outcomes of the accreditation process in both cycles of accreditation and, finally, comparative analysis of key indicators of the polytechnic quality after first and second accreditation cycle.

5.1. Geographical distribution of polytechnics

Fig 1. presents the distribution of accredited polytechnics (state and private) in Serbian regions, with the corresponding numbers of study programmes and students.

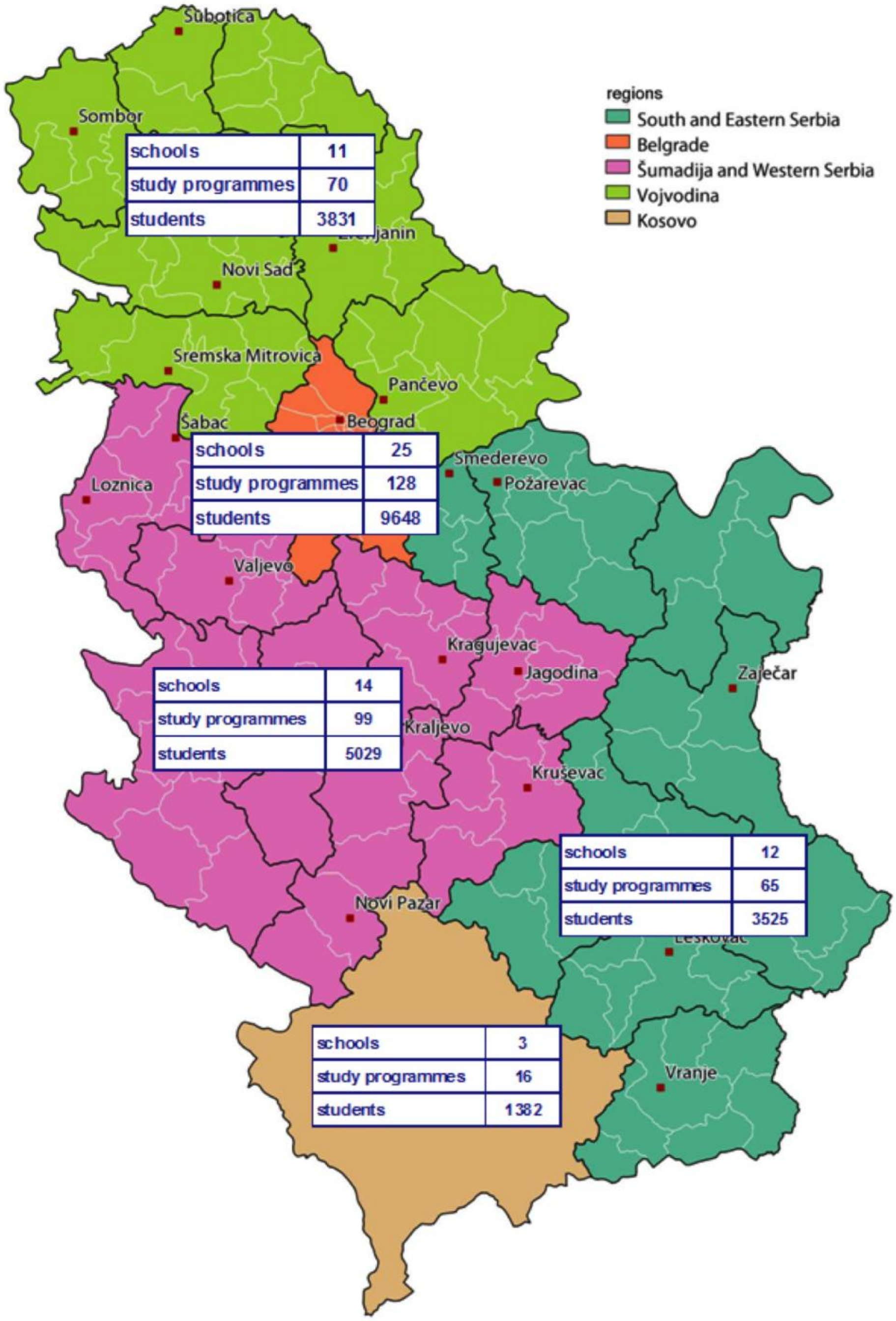

Fig. 1. Distribution of accredited higher schools of professional studies (state and private) in Serbian regions, with the corresponding numbers of study programms and students.

5.2. Analysis of the accreditation outcomes

This section presents detailed analysis of accreditation outcomes of the first and the second accreditation round for 50 polytechnics that were accredited in the first half of 2007 and 2012.

In 2007, 78 polytechnics entered the first accreditation round. According to the first accreditation decision, about 1/3 of schools and study programmes of basic professional studies were accredited, 1/3 had act of warning with suggestion for improvement and 1/3 was rejected. Decision on specialist study programmes was postponed for 2009. After corrections according to CAQA suggestions in the act of warning and after appeal procedures of rejected polytechnics, the number of accredited schools increased to 65, while 13 schools have been definitively rejected.

In 2012, 53 schools and 213 study programmes entered the second accreditation round, and the outcome of the first accreditation decision was considerably better: none of the schools was rejected, 13 obtained acts of warning and 40 was accredited. Accreditation outcome of study programmes was the following: 1 was rejected, 57 obtained acts of warning and 136 was accredited. After improvements according to suggestions in the acts of warning, additional 11 schools and 74 study programmes were accredited. At the time of writing this analysis, 2 schools and 2 programmes are still under acts. Accreditation outcomes of the second round, in comparison with the first, show that the system of quality assurance in the sector of higher professional education was successfully established.

5.3. Analysis of key indicators

Two key indicators: the number of students per professor and the number of square meters in higher education institution per student have been analyzed for the period od the first and the second accreditation round. The analysis shows that both indicators have improved.

The next table shows the mean value and the standard deviation of both key indicators.

Table 3. Statistical analysis of quality indicators of polytechnics from different fields (HSS – humanities and social sciences, TTS – technical and technological sciences, MS – medical sciences) in 2 periods.

Scientific field (n - number of schools)	2007-2011		2008-2012	
	number of students/number of teachers (mean±SD)	m^2/number of students {mean±SD}	number of students/number of teachers (mean±SD)	m^2/number of students {mean±SD}
HSS (n=20)	34.0±14.6	4.62±4.35	30.1±12.0	4.44±3.51
TTS (n=26)	26.1±11.1	3.23±2.88	23.6±9.4	3.25±1.23
MS (n=4)	17.6±15.1	6.08±3.32	13.0±1.9	6.89±2.87
Total	31.4±13.6	3.82±3.34	27.7±10.7	4.47±3.51

As can be seen from Table 3, in the period 2007-2011 the number of students/number of professors was on average 31.4, while in the period 2008-2012 this ratio has decreased to 27.7. The number of square meters per student has increased from 3.82 to 4.47. Both indicators show that polytechnics have improved conditions for studying. This improvement is partly due to a slight decrease of the total number of enrolled students, but also to the overall increase of the number of professors and the teaching premises. The table also shows the change of the indicators separately for 20 schools from the field of social sciences and humanities, 26 schools from technical and technological sciences, and 4 schools from medical sciences.

Tables 4 and 5 provide data for comparative analysis of number of the accredited study programmes and enrolled students for periods 2007-2011 and 2008-2012 and their distribution in different fields.

Table 4. Number of study programmes (BPS-basic professional studies and SPS-specialist professional studies) in polytechnics from different scientific fields (HSS – humanities and social sciences, TTS – technical and technological sciences, MS – medical sciences) in 2 periods.

Scientific field (n - number of schools)	2007-2011			2008-2012		
	BPS	SPS	Total	BPS	SPS	Total
HSS (n=20)	47	28	75	53	38	91
TTS (n=26)	147	64	211	135	79	214
MS (n=4)	11	3	14	13	4	17
Total	205	95	300	201	121	322

Table 5. Number of students studying basic professional studies (BPS) and specialist professional studies (SPS) in polytechnics from different scientific fields (HSS – humanities and social sciences, TTS – technical and technological sciences, MS – medical sciences) in 2 periods.

Scientific field (n - number of schools)	2007-2011			2008-2012		
	BPS	SPS	Total	BPS	SPS	Total
HSS (n=20)	19605	1208	20813	19704	1680	21384
TTS (n=26)	26292	1908	28200	23985	2358	26343
MS (n=4)	2028	85	2113	2157	104	2262
Total	47925	3201	51126	45846	4143	49989

As seen in Table 4, in the period 2007-2011 there were 300 accredited study programmes on the 50 polytechnics. In the period 2008-2012 this number has increased to 322. The increase was biggest in the field of humanities and social sciences (from 75 to 91). Regarding the level of studies, the total number of basic professional studies has slightly decreased from 205 to 201, whereas total number of specialist professional studies has increased from 95 to 121. The decrease of the number of basic professional studies was biggest in the field of technical and technological sciences (from 147 to 135), but this was compensated by the increase of the number of specialist study programmes (from 64 to 79).

On the other hand, total number of students attending accredited study programmes in the same periods (Table 5) has dropped from 51.126 to 49.989, due to the decrease of number of students enrolling basic professional studies in technical and technological sciences (from 26.292 to 23.985). All remaining fields of study show an increase in number of students. Regarding the level of studies, the total number of students enrolled in basic professional studies decreased from 47.025 to 45.846, whereas total number of students enrolled in specialist professional studies has increased from 3.201 to 4.143.

The analysis shows the satisfactory geographic distribution across Serbian regions and cities, with largest number of schools, study programmes and students in Belgrade region. It shows that the field of technical and technological sciences is still dominant, although there is an increase of student interest in social sciences and humanities. The new type of second level study programmes-specialist professional studies is successfully developing. Consequently, the increased number of graduates with higher competences potentially can contribute to development of the national economy.

In the period 2007-2012 polytechnics have fully implemented internal quality assurance processes and significantly increased the level of quality culture, which is documented by their self-evaluation reports, CAQA's reports on external quality control, as well as by results of the second accreditation round. Owing to this, in October 2012, the Conference of Academies for Professional Studies became a member of EURASHE (European Association of Institutions in Higher Education) and in this way officially became a part of the European higher education.

6. Conclusions

The main conclusion is that CAQA has successfully developed the system of quality assurance in higher education in Serbia. This is mainly due to the development of standards and guidelines compliant with ESG and their successful implementation. The result of both processes are: accreditation of 205 HEIs and 1553 study programmes in the first round, and in the second round, that started in 2012, 50 higher schools of professional studies (polytechnics) and 210 study programmes were re-accredited and, finally, 78 reports on external quality control of HEIs have been adopted.

By comparison of accreditation documentation given 5 years ago and now it is evident that schools have improved in both human and infrastructure resources what provides conditions for better studies. Overall improvement is also proved in the process of external quality control: almost all HEIs have successfully done their self-evaluation report, and 63 HEIs have got so far a positive report, published on CAQA web-site.

Increase in CAQA effectiveness is due to several factors: increased number of staff in last 2 years, increase in their expertise, engagement of assistants for technical help in preparing reports, increase in number and expertise of external reviewers, involvement of students and labour market representatives in the evaluation process, intensive international activities. It is also noticeable that the level of transparency of CAQA work has increased due to the correct web-site management and due to the increase of CAQA capacity to cooperate/communicate with stakeholders.

Results of the survey showed that stakeholders have a greater understanding of the evaluation process now in comparison with the period of the beginning of the evaluation process (year 2007) and, consequently, greater confidence in the necessity of the process and in CAQA as an evaluating agency. To conclude: majority of feedback from various stakeholders on the accreditation process itself as well as on CAQA as its manager was positive.

7. Future plans

- Harmonization of standards with changes in ESG
- Development of subject-specific standards
- Improvement of standards for doctoral studies
- Improvement of external quality control procedures to include follow-up
- Involvement of international experts
- Improvement of CAQA office organization
- Continual improvement of expertise of administrative officers
- Continual monitoring of the Action plan progress

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2013 International Conference on Technology Transfer

Accreditation of Doctoral Study Programs in Serbia

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Abstract

There is given an overview of standards for accreditation of doctoral study programs in Serbia. There is presented a method of measuring the workload of mentors at all higher education institutions in Serbia, which corresponds to the law of higher education.

Selection and/or peer-review under responsibility of the organizers of the 2013 International Conference on Technology Transfer

Keywords: Doctoral study program; accreditation; standard; mentor; CAQA.

1.Introduction

The procedure in Serbia to the accreditation of doctoral study programs are completely under responsibility of Commission for Accreditation and Quality Assurance (CAQA). Since doctoral study programs are fundamental for all study programs and future staffs of higher education CAQA took lot of efforts to manage corresponding standards and to realize them in the practice, see [1]. Surely that for successful doctoral study programs most important are teachers and mentors, and CAQA took lot of care on teaching staffs. For controlling this important part there are developed more sophisticated approaches, e.g., at Hungarian Accreditation Commission (HAC), see [2]. Namely, in Hungary the procedure involves two institutions: HAC and Hungarian Doctoral Council. The last one decide about lecturers who will be the basic lecturer for specific subjects, and made a pool of basic lecturers. Then each doctoral study program have to have some number of basic lecturers (the number depends on the number of students). After that HAC is taking the accreditation procedure of doctoral study programs.

In Serbia in the first accreditation round there were the following results. Number of accredited doctoral studies in Serbia (until June 2012) is 207 (176 state, private **3**1). A percentage of doctoral study programs related to all study programs was 13.3%, but the percentage related to the number of all students was only

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1.8%, see for more details [3].

The procedure of the accreditation were managed related to twelve standards, which will be presented in the next two sections. In the last section we present a method of measuring the workload of mentors in Serbia.

2. Standards

Special standard : Competency higher education institution for doctoral studies

Standard 1 Structure of the study program

Standard 2 Purpose of the study program

Standard 3 Objectives of the program

Standard 4 : Competences of graduated students

Standard 5 : Curriculum

Standard 6: Quality, modernity and international convergence of study programs

Standard 7: Admission of students

Standard 8: Grading and promotion of students

Standard 9: Teaching staff

Standard 10 : Organization and material resources

Standard 11: Quality control

We shall examine only some of the most important standards.

Special standard : Competence of higher education institution to carry out the doctor studies The higher education institution shall have a short term and long term work program, and shall be accredited as science research institution in keeping with the law. Capacities of a higher education institutions shall be measured according to the following criteria:

- number of doctoral dissertation and master thesis that were granted in the higher education institution in the area of accreditation of the study program, taking into account the ratio between the number of doctoral and master dissertations to the graduated students and the number of teachers;
- ratio of the number of teachers and the teachers involved in the science research projects;
- ratio of the number of publications and international magazines namely the number of articles in the international magazines of the ministry competent for science in the last 10 years and the number of teachers;
- cooperation achieved with the institutions in the country and abroad. The higher education institution has the teachers under permanent employment contracts who were the mentors for doctoral thesis.

Standard 4: Competences of graduated students

The student who completed the study program of the doctoral studies acquires general and specific capacities second to the quality of performance of the professional, scientific and artistic activity. The program of doctoral studies should enable the students, after the completion of the study, to have knowledge, skills, developed abilities and competences for:

- independent solution of practical and theoretical problems in the area they covered and organize and carry out R&D;
- integration into the international scientific projects;
- carrying out the development of new technologies and procedures within their professions and to understand and use the latest knowledge in the given scientific area;
- thinking critically and acting creatively and independently;
- observing the principles of the code of ethics of goods scientific practice;

- communicate at the professional level in presenting their science research results, are trained to present the results at the scientific conferences, publish them in the scientific magazines, via patens and new technical solutions;
- contributing to the development of a scientific discipline and science in general. Having completed the study program the student acquires the subject-specific competences, as follows:
- fundamental knowledge and understanding of the discipline of the corresponding occupation;
- capacity of solving the problems by using scientific methods and procedures;
- compilation of the basic knowledge from different areas and their application;
- capacity to follow up contemporary achievements in the profession;
- develop skills and agility to use knowledge in the respective field;
- use the ICT in mastering the knowledge in the relevant area.

Standard 5: Curriculum

Curriculum contains a list and structure of obligatory and optional subjects and models with description and doctoral dissertation as a final part of the study program of the doctoral studies, except the doctors of art, which is an artistic program. and capacities they acquire during the studies. Curriculum contains the defined fundamentals for independent research work of the students. Curriculum defines the subjects and modules by volume and contents and the manner of realization. The description of the contents contains the name, type of the subject, year and semester of studies, number of ECTS credits, name of the professor, the objective of the subject with the expected outcomes (knowledge and capacities), pre conditions for attendance, contents of the subject, recommended literature, methods of delivery of teaching, assessment of knowledge and grading and other appropriate data. The number of credits corresponding to the optional subjects is minimum 50% of the total number of credits that correspond to all the subjects of the study program. Curriculum more closely defines the requirements concerning the preparation of doctoral dissertation, specific for every educational scientific namely educational artistic field within the area. The doctoral dissertation is an independent scientific or artistic work of the students at the doctoral studies.

The procedure for application, elaboration and defense of the doctoral dissertation is specified in the general bylaw of the independent higher education institution. The number of credits for doctoral dissertation enters the total number of credits needed for finalization of doctoral studies. At least a half of ECTS credits foreseen for the realization of doctoral studies goes to

the doctoral dissertation and subjects which are connected with the topic of the doctoral dissertation.

Standard 9: Teaching staff

For the realization of the study program of doctoral dissertation there is teaching staff with the necessary scientific capacities. The higher-education institution which delivers the doctoral dissertation should have:
- defined selection criteria for teachers under permanent employment contract who have full time contract in a higher education institution and developed system of selection of teachers from other scientific institutions who take prart in the delivery of doctoral studies;
- teachers capable of teaching at the doctoral studies proven by the list of works (10 major works) and the data on the participation in the national and international scientific research projects;
- minimum half of the teaching staff involved in science research projects.

Mentor has at least five scientific works published or accepted for publication in scientific magazines of the related area of the study program from the list of the ministry in charge of science in the last 10 years. Mentor may attend to maximum five candidates for a doctor at the same time. The minimum number of teachers who take part in the study program of the doctoral studies with the permanent employment contrast is five. Of the total number of teachers 50% are under permanent employment contact with the higher education institution.

3.Supplementary accreditation standards of doctoral studies within the educational scientific namely educational artistic field

3.1. Mathematics sciences

Standard 8: Grading and promotion of students

At least one work of the student is published or accepted for publication in a magazine on SCI list.

Standard 9: Teaching staff

The competence of the teachers is determined on the basis of: scientific works published in the international magazines (at least one work published or accepted for publication in a magazine on SCI list), local magazines, science work published in the proceeds of international scientific gatherings, monographs, patents, text books, new products or essentially improved existing products. Mentor has minimum three works on SCI list (criterion applicable as of 01.01.2009) and five works from SCI list (criterion applicable as of 01.01.2010).

3.2. Social- humanistic sciences

Standard 8: Grading and advancement of students

At least one work of the student published or accepted for publication in a national magazine figuring on the list of the Ministry in charge of science.

Standard 9: Teaching staff

Old rules: The competence of teachers is determined on the basis of scientific works published in the international magazines, national magazines, works published in the proceedings of the international scientific gatherings, monographs, patents and textbooks. The teacher who delivers the teaching at the doctoral studies has at least one work published or accepted for publication in a magazine on SSCI list (criterion applicable as of 01.01.2010). Mentor shall have at least three works published or accepted for publication in the magazine on SSCI list (criterion applicable as of 01.01.2010).

New rules (01.06.2013): The competence of teachers is determined on the basis of scientific works published in the international magazines, national magazines, works published in the proceedings of the international scientific gatherings, monographs, patents and textbooks. The teacher who delivers the teaching at the doctoral studies has at least 12 points (corresponding points by rules of Ministry of education and science) for papers in categories: M11, M12, M13, M14 (monographs and chapters in monographs); M21, M22, M23, M24 (international scientific journals); M31, M32, M33, M34 (international conferences); M51 (domestic scientific journal). Mentor has at least 24 points in the following way: at least two works published or accepted for publication in the magazine on SSCI list or in journal of category M24, and at least 20 points from categories: M11, M12, M13, M14, M21, M22, M23, M24, M31, M32, M33, M34, M51. Papers from categories M31, M32, M33, M34, can be maximaly involved with 20% points in the prescribed minimal 24 points.

3.3. Medical sciences

Standard 8: Grading and advancement of students

At least one work of the student is published or accepted for publication in a magazine on SCI list.

Standard 9: Teaching staff

The competence of the teachers is established on the basis of scientific works published in the international magazines (at least one work published or accepted for acceptance in the magazine on SCI list), scientific works published in national magazines, the works published in the proceedings from the international scientific gatherings, monographs, patents, new products or essentially improved existing product. Mentor has at least three works from SCI list (criterion valid as of 01.01.2009) and five works from SCI list (criterion applicable as of 01.01.2010).

3.4. Technical-technological sciences

Standard 8: Grading and advancement of students

At least one work of the student published or accepted for publication from SCI list.

Standard 9: Teaching staff

The competence of teachers is determined on the basis pf scientific works published in the international magazines (at least one work published or accepted for publication in a magazine on SCI list), scientific works published in national magazines, works published in proceedings from the international scientific conferences, monographs, patents, textbooks, new product or significantly improved existing product, new plant species, new livestock an new technologies. Mentor has at least three works from SCI list (criterion applicable as of 01.01.2009) and five works from SCI list (criterion applicable as of 01.01.2010).

3.5. Arts

Instructions for use of Standard 9: 9.1. The higher education institution implementing doctoral studies should have defined criteria and a developed system for the selection of teachers from the system as well as other educational , cultural and scientific institutions involved in the implementation of doctoral studies. 9.2. A mentor can be a doctor or a professor of art in the relevant field of art. 9.3. Mentor can take up to five PhD students at the same time. 9.4. Minimum number of teachers participating in the study program of doctoral studies is five .

4. Workload of mentors

CAQA managed a pool of mentors at the level of whole higher education institutions in Serbia. Then CAQA is measuring the workload of mentors at whole Serbia in the following way.

The workload of mentor at one doctoral study program is given as quotient of the minimum number of mentors in a program of study (three times the number of students at doctoral study program divided by five) divided by the actual number of mentors at this study program, and all multiplied by 100 This means that one teacher for all doctoral studies at the level of Serbia, as a mentor, must not exceed 100%. Example: At study program 1, there are 6 mentors, and entered 5 students. Workload of mentor is then 50%. At study program 2, there are 15 mentors and 10 students involved. Workload of mentor is 40 %. Then, e.g., Charles Brown who was a mentor to both study programs have 90% of the workload .

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Accelerating pedagogical reform

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Abstract

Higher education in the Republic of Serbia is currently undergoing deep transformation and adaptation to the European and international standards, with the ultimate goal to transform the Serbian society into a knowledge-based society. This paper analyzes the possibilities how to accelerate the pedagogical reform and proposes some recommendations to Serbian decision making bodies.

Keywords: Education; Research; Quality Assurance;

1. Main text

Higher education in the Republic of Serbia is currently undergoing deep transformation and adaptation to the European and international standards, with the ultimate goal to transform the Serbian society into a knowledge-based society. In harmony with the recommendations of the European Union and European Standards and Guidelines (ESG) for quality assurance (QA), onto which the policy of quality of the CAQA (as a full ENQA member) is based, educated workforce is more and more seen as an essential resource of the economic and development of our society in general. The Republic of Serbia has adopted the Strategy of Development of Education (up to 2020) and Strategy of Scientific and Technologic Development (up to 2015), elaborating the issues of relevance for the areas of education and research, but the strategies are insufficiently related one to another, with incomplete and unclear guidelines for the roads to be taken in the process of internationalization of higher education and the development of transversal teacher competences for a sustainable, democratic society.

The assessment and surveillance within the Bologna process, after signing the Declaration back in 1999, took place every two years at the ministerial conferences in order to measure the advances in the implementation of guidelines and recommendations for the establishment of the common European Area of Higher Education. In recent years, lifelong learning has been one of the principal tasks of institutions of higher learning. At the same

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time, National Reports at the regular ministerial conferences held up to 2012 (the last one being in Bucarest, Romania) demonstrated that the issues of flexible learning and recognition of prior learning, especially informal and non-institutional learning, became the practice in only a small number of countries. The aim of the Platform for Synergy of Education, Research, and Innovation in the domain related to the acceleration of pedagogical reforms is to help, via a series of public discussions, in the exchange of experience, both nationally and internationally, stimulating the actions of the academic community, CAQA above all, as well as the National Council for Higher Education, National Council for Science, and Ministry of Education and Science, in the fulfillment of the ESG requirements related to the introduction of common recommendations for the acquisition of appropriate teacher competences and establishment of common standards in the procedure of assessment of pedagogical work in all institutions of higher education in Serbia. A part of the activity within the above Platform will be specifically directed to strengthening of the role of employers in continual re-defining of learning outcomes and student and teacher competences.

Naturally, in the realization of planned objectives, internationalization of higher education is gaining significance not only because of the global dimension of the Bologna process, but also because of the development of transversal teacher competences, that largely determine the contribution of teachers to a knowledge-based society. In this way, QA and strengthening of the process of internationalization of higher education institutions become an essential component of the overall QA.

Most institutions of higher education in Europe find that internationalization begins with a relatively traditional focus on the admission of foreign (international) students. Many institutions are making efforts to expand the definition of internationalization to involve the activities of cooperation and partnership in research, teaching, and learning, in foreign language courses, deeper involvement of graduates from foreign universities, and partnerships with non-academic international organizations. The significance of culture and infrastructure that could support a broader definition of “internationalization” is also an important question that has been increasingly addressed.

It is a widely accepted maxim that, similarly to economy in general, higher education is being globalized too. For many countries, higher education is an essential export sector, with many of the university campuses trying to attract international students from every part of the world. With the advancements of information and communication technologies and growing hegemony of English language, higher education in general follows the classic pattern of globalization in economy (1,2). In addition to this orthodox viewpoint, an alternative explanation of development has been offered as well, leading to a different vision of global “industry” of higher education in 2020.

The terms internationalization and globalization have commonly been used interchangeably in academic communities, but they have been often confused in practice. These are different, although related terms, used to denote the phenomena with different backgrounds, aims, and effects. Globalization, in its broadest sense, describes social processes that extend over national borders. While the concept of globalization involves individual, overlapping areas, it is fundamentally a process of economic integration that negates traditional national borders, and ultimately, has an impact on the flow of knowledge, people, values, and ideas. Globalization has introduced marked competition into universities worldwide, radically changing the appearance of university as an institution. The approach “To do more with less” in the context of economic globalization would represent a threat to quality, including universities as well. The need to differentiate internationalization from globalization has been more and more urgent in view of the scenario of evergrowing globalization, which is narrowing the institutional options in the domain of internationalization. All this is even more conspicuous in the context of development of long-term collaboration programs, designed to mutual benefit (to both international partners) (3).

The key elements of the Conclusions Draft were adopted at the Conference “Internationalization of Higher Education: A Foresight Exercise for 2020 and Beyond“, held in Madrid, Spain, in 2010, with participation of 120 experts from Europe, Africa, North America, Latin America, and Asia (4). The principal conclusion was that international cooperation in higher education should be strengthened, that it deserved full EU support, contributing to the development of competences for work in an international, open environment, and with a constructive interaction of people of different races, religions, ideas, and attitudes.

The formation of the „European model“ in the area of higher education and research has both a normative and structural dimension. The normative dimension stresses the significance of values such as: cooperation, dialog, differences, mobility, and solidarity. The structural dimension contains the elements of the Bologna process „architecture“, especially the structural tiers (three cycles of study), European qualification framework, European credit transfer and accumulation system, quality assurance system, and diploma supplement.

In the situation of absence of the governmental initiative in the Republic of Serbia to impose the strategy of internationalization, and to provide resources for its sustainable implementation and development, institutions of higher education would have to incorporate individually their international activity in their strategies (at the university level, as the best solution), giving priority to the resources and actions in the areas of research and innovation strategies, as well as the areas of teaching and learning.

An appropriately defined strategy and action plan would have to contribute to the student motivation by the environment in which research activity is given abundant attention, encouraging them to gain experience, knowledge, and skills in other countries as well.

Various studies undertaken throughout the world have pointed out some huge changes of the socio-economic context in the 21st century, in which higher education has to re-define its role and contribution to the society. The key aspects of the above context are the acceleration of pedagogical reforms and development of teacher competences, which could further support the acquisition and development of transversal competences of students as well, provided that the teachers themselves acquired them first. Regarding teachers, transversal competences involve the following abilities:

1. Ability to adopt the patterns in their work, family life, and relationships with the general community, in order to prepare their students to be the citizens of Europe and contribute to the development of a socially inclusive society.
2. Ability to support individual learning and skills of group or team learning in their students.
3. Ability to use and continually update their knowledge of modern information and communication technologies (digital competence) (5), in order to have open access to knowledge resources, to develop critical approach to knowledge, and to support their students in the acquisition of knowledge and adequate use of knowledge
4. Ability to adopt the imperative of lifelong learning, in order to transfer their knowledge to students more efficiently.
5. Ability to adopt the requirement to create the professionals with creative knowledge and abilities to use the knowledge for the purpose of innovation.

The acquisition of transversal competences by the teachers is expected to occur in the context of lifelong learning and continuing professional education. Acceleration of pedagogical reforms in this direction would incite a great interest in the interface of societal and economic principles in the search for holistic strategies which could resolve many problems the government and its institutions are faced with.

In the document of the Republic of Serbia “The Strategy of Development of Education” (2020), the need for harmonization of the education system with the labour market has been stressed. However, a huge problem in this regard is the fact that nobody is really engaged in the systematic surveillance and anticipation of future labour market changes. There is no clear, comprehensive, and long-term policy which could effectively link the system of education with the state sector.

The Council of Europe has stressed the twofold role, societal and economic, of the system of education and innovation. Education is a decisive, key factor in the potential of any country to compete with others in the areas of quality, innovation, and ability. At the same time, it is an integral part of the social dimension of Europe, since it transfers the values of solidarity, equal opportunities, and social participation, creating simultaneously a positive effect upon health, reduction of crime rates, environmental protection, democratization, and quality of life in general.

Any individual should continually gain and update one's knowledge, skills, and competences through lifelong learning. Specific needs of those at risk of social exclusion have to be always accounted for. This could help to increase the overall workforce of a society and enhance economic growth rates, simultaneously ensuring social cohesion.

The needs of labour markets in the context of knowledge-based economy and Lisbon objectives, as assessed by the CEDEFOP in the Report on Principles, are such that "up to 2020, almost half of additional jobs will require higher education, and slightly below 40% will require vocational education, while only 15% of jobs will require elementary education" (6).

Investments in education and training cost a lot, but a huge personal, economic, and social "profit", both mid-term and long-term, largely exceeds the initial costs. The reforms should thus continue to merge economic with social and political objectives, making them in fact more steadfast than before. These considerations are very relevant for the vision of the European Union, concerning future development of the European society model. That goes for Serbia as well, especially in the context of joining the EU. Europe is faced with huge social, economic, and demographic challenges, related to population ageing, large numbers of adults with low qualification levels, high unemployment rates, and so on. At the same time, the needs of labour markets for improved and diverse competences and qualifications is continually growing. It is necessary to respond to these challenges adequately, in order to improve long-term sustainability of the European social system.

In order to develop a knowledge-based society, the citizens of Serbia have to acquire and use new knowledge and skills in all their activities and in all segments of the society. We need a multilingual, completely literate society, confident in its own identity, results, and place in the world.

We have to make efforts to provide for ourselves the access to international knowledge circles. However, we have to work hard ourselves on the acquisition of new knowledge in the areas in which we, as a relatively young country, are able to contribute to the world as a whole, strengthening our abilities and place within the international system of education and training, and research community as well.

People with special skills, who are adaptable, as well as institutions ready and willing to cooperate, are the key factor in this process of social transformation.

In an educational system such as ours in Serbia, with adopted strategies of education but without long-term strategy of economic development, some of the prerequisites and objectives of internationalization, planned to be achieved by the Serbian universities and/or institutions of higher education via the decision-making rights concerning international cooperation (within their autonomy rights), could be as follows:

- Stronger bonds between the curriculum, teaching and learning, and the profession;
- Focusing on teacher competences;
- Essential, and not formal, acquisition of international and intercultural competences;
- Activities undertaken, which would not be self-sufficient, but instead the instrument which would promote international and intercultural competences of both students and teachers;
- Quality and internationalization: measurement of not only the inputs and outputs (results), but also the learning outcomes;
- Adequate collaboration with the sector of economy and employers;
- Adequate collaboration with the alumni (ex-students of an institution of higher education) in order to improve the study programs and advance the area of education and keep pace with the national and worldwide trends;
- Finally, our successful development as a prosperous and reliable society based on knowledge will depend on the personal attitudes of our people.

Teaching quality throughout the world is also influenced by contextual shifts within the highereducation environment. Current factors influencing the quality of teaching include:

- the internationalisation of higher education
- the increasingly broadening scope of education and greater diversity of student profiles
- the rapid changes in technology, which can quickly make programme content and pedagogies obsolete
- the demand for greater civic engagement of graduates and regional development of higher education
- the increased pressures of global competition, economic efficiency
- the need to produce a skilled workforce to meet the challenges of the 21st century

With this view of learning, the role of higher education teachers is therefore changing. In addition to being, first and foremost, a subject expert acquainted with ways to transmit knowledge, higher education teachers are now required to have effective pedagogical skills for delivering student learning outcomes. They also need to co-operate with students, colleagues from other departments, and with external stakeholders as members of a dynamic learning community.

The new teaching and learning paradigms in higher education actually imply:

- New relationships regarding access to teachers, and a wider range of communication and collaborative working through learning platforms
- Re-designing of curricula
- Bridging teaching and research more intensively
- Re-thinking of student workload and teaching load
- Continuous upgrading in pedagogy, use of technologies, assessment models aligned with student-centred learning
- Creating of innovative learning platforms
- Providing guidance and tutoring to students with new means and methods
- Assessing impacts and documenting effectiveness of the teaching delivered

"Quality in Teaching and Learning", in Higher education will help the Higher education Institutions to:

- link Higher education system to the labour market;
- increase the key qualifications and competencies; encourage practical transfer of knowledge; and
- create awareness of changes in pedagogical approaches in teaching.

One of the goals of the Platform for Synergy of Education, Research, and Innovation is to incite the creation of a strategic document for accelerated development of pedagogical reforms and enable the development of transversal competences of teachers in higher education in Serbia.

It would be necessary to introduce the changes in three different domains:

Policy. Changes in the national qualification framework, which would involve transversal competences, with appropriate forms of assessment, formal recognition, and awards.

Teacher education. Structural reform of teacher education, demonstrating the transversal and interdisciplinary approaches, as well as mobility; provision of students with teachers who have good command of IT skills, have the capacity to adapt to new situations and make correct decisions, have interpersonal skills and ability to interact with other people, those who can be easily involved in team work; communication competences of teachers should involve both oral and written communication, and good command of at least one of the leading European languages; teachers should have good knowledge of and abide by the ethical principles.

Institution of higher education. Institutions of higher education should be the places where teachers gain their experience and practice teaching. In the programs of lifelong learning and continuing professional education of teachers, the bonds have to be created between the discipline (as a traditional focus of interest) and pedagogy, in the broader context of practice of education.

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2013 International Conference on Technology Transfer

University of Alicante's International Project Experience in the Quality Assurance field

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Abstract

This paper underlines the importance of the Quality Assurance aspects at Higher Education Institutions and presents one of the best practices of the University of Alicante in the frameworks of the CUBRIK project, a Tempus initiative coordinated by the University of Alicante in the Western Balkans Region. We describe the project objectives, main results and discuss about the challenges encountered and how we solved each one of them always taking into account the benefit of the Partner Countries institutions involved in the action: Higher Education institutions and Quality Assurance Agencies.

Keywords: International Cooperation, Tempus Programme, Quality Assurance, Accreditation, Self Evaluation of Study Programmes, Western Balkans, Bologna Process, European Higher Education Area, European Standards and Guidelines.

1. Introduction

There is no doubt about the fact that Higher Education Institutions (HEIs) play a key role in the present society and are the main channel for ensuring knowledge generation, exploitation. Thus HEIs have a crucial responsibility for the development of the modern society [1]. Prove of this is that the last years debate on their role and main responsibilities was strictly focused on the relationship between on the one hand the HEIs aims and objectives and on the other the priorities of the European Commission concerning the contribution which HEIs can bring to the social and economic development of the European Area.

Equally important is the role of European HEIs toward the rest of the world, especially face to the less developed neighbouring areas. In this context, EU HEIs have the responsibility of bringing their experience, good practices, lessons learnt, example and knowledge to other HEIs for their benefit; and this is possible by means of implementing international initiatives for widely disseminating the EU HEIs best practices across the world.

At present EU HEIs are integrated in the Bologna process (started in 1999 with the Bologna declaration) and even if at different progress stages they all share the main common pillars. The Bologna process main idea consists in shaping common education framework upon the different EU contexts for the convergence of the EU HE systems towards from their heterogeneity without loosing national features and always taking into account the different local contexts and needs. Thus, the main distinguishing features of being in line and integrated in the Bologna process are [2]:

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- Implementation of Quality Higher Education system
- Adoption of a two/three-cycle system of study (BA, MA, PhD)
- Promotion of the mobility of students and academic and administrative staff
- Introduction of the ECTS credit system for the assessment of study performance
- Levels recognition levels: adopting a system of easily identifiable and comparable levels
- Involve actively HEIs, teachers and students in the Bologna Process and student participation in the management of higher education
- Promotion of a European dimension in higher education
- Focus on the attractiveness of the European Higher education area
- Emphasis on Lifelong learning

These priorities are translated in a range of EC initiatives implemented through programmes, which are being deployed in various ways towards Higher Education affecting directly or indirectly the formulation of universities' European policy for the next years.

As we can see in the list above, one of the main aspects and focus is ensuring the high quality of education and services provided by European HEIs. In order for all HEIs to translate this concept into reality, the European Association for Quality Assurance in Higher Education created the Standards and Guidelines for Quality Assurance in the European Higher Education Area, reference point for all national Quality Assurance Agencies and HEIs.

Nowadays Quality Assurance at HEIs is not only a European concern. In fact, all over the world there is an increasing interest in this topic as response to the rapid growth of HE and its cost to the public and the private sectors. Thus, if Europe focus is to be the most dynamic and knowledge-based economy in the world (Lisbon Strategy), then European HE will need to demonstrate that it takes the quality of its programmes and awards seriously and is willing to put into place the means of assuring and demonstrating such quality.

Taking into account the present context, this paper is focused on the work the University of Alicante is carrying out by means of the Tempus Programme initiative in the framework of the HEIs Quality Assurance. The remaining of this paper is organised as follows: Section 2 describes the focus of the University of Alicante and the International Project Management Office. Section 3 is about the main features of the CUBRIK project. Section 4 presents the most relevant results achieved under this Tempus project.

2. The University of Alicante, The International Project Management Office

The University of Alicante (UA)1 was created in October 1979. It was formed on the basis of the Centre for University Studies, which had come into being in 1968. In this way, Alicante recuperated university studies which had disappeared in 1834 when its predecessor, the University of Orihuela, closed after two centuries of education. The University of Orihuela was created by Papal Bull in 1545 and kept its doors open during two centuries (1610-1808).

[1] www.ua.es

After almost thirty years of experience, the UA presents high potential regarding socioeconomic development; in fact it is the fourth province of Spain in Gross Domestic Product. About 39 degrees, 62 master degrees, 59 University Departments and 36 research unities and 199 groups in Social and Legal Sciences, Experimental Sciences, Technological Sciences, Human Sciences, Education and Health Sciences, 15 Research University Centres (Sciences, Law, Education, Philosophy, Polytechnics, Nursery) cover the expectations of more than 30.000 students and develop one of the country's most reputable research activity. Our University is the first institution with more than 2.000 workers (both teaching, research and administrative staff) and an annual budget around 200 million Euros. Moreover, the institution is considered a point of reference for numerous firms with which the UA keeps technical assistance contracts, technology transfer, student training programmes, post-graduate studies and continuous training. It is also an appreciated reference point for international relations: agreements, head offices, mobility and exchange, cooperation among different and very innovative projects all over the world. In addition to all this mentioned above, for which the University of Alicante is considered to be one of the best campuses in Europe.

In this framework, it is worth underlying that the International Project Management Office (OGPI) of the UA particular field of interest lays within the context of international cooperation within different topics and particularly Quality Assurance at HEIs to support the integration of countries willing to join the Bologna process and gain international reputation, develop their international status and networks. OGPI has a broad experience (over 20 years) in managing international projects on quality assurance as ALTAIR[2] and AFRIQUNITS[3], CUBRIK[4], FOCUS[5] and as been involved in a number of Tempus Project in the Balkans: CONTINUED Project (Serbia) and CREDIT Project. OGPI worked in over 100 countries worldwide: from Europe to Africa, Asia to Latin America, the Middle East to the Caribbean. To carry out our collaborative work OGPI has built up an extensive and highly diverse contact network across Europe and the globe. OGPI contacts include individual experts as well as national authorities, universities, etc.

3. The CUBRIK project

The project (funded under the Tempus Programme[6]) aims to contribute to Strengthen Quality Assurance System within West Balkans HEIs in support of National and Regional Planning.

More specifically the project specific objectives are:

- Creation of a quality assurance framework through the development of common QA practices and network at national and regional level
- Consolidation of capacity building through targeted training programme and pilot assessment activities for the external institutional assessment of Universities and Quality Assurance Agencies in Western Balkans

To address these specific objectives the following outcomes are being achieved:

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[2] www.altair-project.org
[3] www.afriqunits.org
[4] www.cubrik.eu
[5] www.focusquality.eu
[6] http://eacea.ec.europa.eu/tempus/

- Creation of a functional framework for the QA implementation: Increase inter-institutional liaison, networking and sharing of best-practices by the creation of a network of expert, development of an information system and drafting of study trend analysis
- Set up a Western Balkans Quality Assurance Observatory in order to agree on common practices, track the last development and foster benchmarking initiatives
- Defining common guidelines and methodologies for QA at National and regional level that foster the creation of integral strategies supported by data evidence and based on the constitution of common values
- Strengthen capacity building through targeted training programme
- Improve technical capacity by the conducting External Institutional Assessment within HEIs
- Widely disseminate project results within Western Balkans institutions and contribute to the Bologna process by creating attractiveness of the European higher education

3.1. The CUBRIK consortium

The CUBRIK consortium is composed by different kind of institutions: Higher Education Institutions, Quality Assurance Agencies and Higher Education authorities.

The countries that compose the team are: Austria, Belgium, Bosnia and Herzegovina, Germany, Ireland, Republic of Serbia, Republic of Macedonia and Spain.

More concretely, the project partners are:

- Spain:
    - University of Alicante
    - Spanish Ministry for Education, Culture and Sport
- Germany:
    - ASIIN[7]
- Belgium:
    - Erasmushogeschool Brussel[8]
- Ireland:
    - University College Cork[9]
- Austria:
    - Austrian Agency for Quality Assurance[10]
- Republic of Serbia (universities of):
    - Kragujevac[11]
    - Novi Sad[12]
    - Nis[13]

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[7] www.asiin-ev.de/pages/en/asiin-e.-v.php
[8] www.erasmushogeschool.be
[9] www.ucc.ie/en/
[10] www.aqa.ac.at
[11] www.kg.ac.rs/indexeng.php
[12] www.uns.ac.rs/en/o_univerzitetu.htm

  - Ministry of Education
  - Commission for Accreditation and Quality Assurance[14]
- Bosnia and Herzegovina (universities of):
  - Banja Luka[15]
  - Mostar[16]
  - Tuzla[17]
  - Zenica [18]
  - Ministry of Science and Technology
  - Federal Ministry of Education and Science
  - Agency for Development of Higher Education and Quality Assurance[19]
- Republic of Macedonia (universities of):
  - St. Kliment Ohridski[20]
  - Tetova[21]
  - Macedonian Board for Accreditation and Evaluation
  - Ministry of Education and Science

3.2. The reform Content

The reform content of the project is based at four level of implementation that flows towards the achievement of the specific objectives. At national and university level external quality assurance practices in line with the European experience of the EFQM Excellence Model and TRIS have been piloted. A common methodology for the institutional assessment has been introduced and benchmarked. At regional level the project foresees the creation of the *Western Balkans Regional Observatory for Quality Assurance*[22] to foster regional initiatives and as an excellent starting point to encourage regional cooperation.

The experience of the National Round Tables (one per country) followed by the regional ones on the same topic served to create a precedent in making the national issues a regional concern. Also the review and adaptation of legislation will conduce to the adoption of new legislation that integrated within the SEE HE reform. The accreditation of SEE HEIs and assessment of SEE Quality Assurance Agencies is introducing a culture of public accountability and managerial behaviour.

3.3. The project methodology

The project methodology has been developed according to the experience of the EU partners concerning the implementation of similar actions. The consortium believes that the creation of sustainable Quality Assurance structures through the creation of a Network of Experts and the setting up of the QA Observatory followed by the revision of existing quality assurance set up the basis for regional cooperation and lays down the

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13 www.ni.ac.rs/en/
14 www.kapk.org
15 http://unibl.org/en/
16 http://sve-mo.ba/university-of-mostar/
17 www.untz.ba/index_en.htm
18 www.unze.ba/
19 http://hea.gov.ba/
20 www.uklo.edu.mk/categories/view/25
21 www.unite.edu.mk/ANGLISHT/index.html
22 www.qa-observatory.eu

foundations for the project activities.

Additionally, the core project methodology consists in building capacity through targeted trainings and strengthening of physical infrastructure followed by practical implementation of assessment activities. Indeed the trainings have been designed according to the needs identified during the preparation of the project proposal and cover the full spectrum necessary for the implementation of the external quality assurance culture within the partner Universities and QAA including the practical observation session within the European Partners institutions.

In order to obtain reliable information system will be integrated within the Quality Assurance Units and equipment has been purchased. At the end of the first year the network of experts has been created as well as the QA Observatory and data has been collected and analysed within the Study trend analysis of SEE HEIs and EES-QAA. Stakeholders expectations have be assessed and possible path of collaboration identified.

At the end of the year one, after having implemented the set of activities foreseen, the consortium defined common methodologies and guidelines for QA at national and regional level. Years two and three have been dedicated to the external assessment of Universities and QAA. Concerning the SEE HEIs, training has been first provided by EU partners on the Institutional Assessment Model and EFQM Excellence Model or TRIS (depending on their preference), then self-assessment methodologies and external review and accreditation followed by the pilot process of assessing the university at the institutional level.

As the involvement of stakeholders has been identified as critical for the successful implementation of quality culture within an institution, the assessments will include identification of methods and practical implementation of processes for the inclusion of different stakeholders and in particular the inclusion of students. Furthermore, Ministries and QAA have been invited to participate in the process, together with international experts from the consortium in order to foster cooperation and strong links across the Western Balkan Region. Year three has been be devoted to the training of the external assessment of QAA following the European Standards and Guidelines for the evaluation of European Higher Education Institutions. The pilot process provided a unique opportunity for capacity building through training workshop and the acquirement of practical knowledge in the external assessment of QAA for real and useful purposes. Finally a final project meeting (3^{rd} July 2013) will take place in order to have a complete overview on the project results and the benefit achieved by our Partner Countries.

3.4. Main project outcomes

- Creation of a functional framework for the QA implementation: Increase inter-institutional liaison, networking and sharing of best-practices by the creation of a network of expert, development of an information system and drafting of study trend analysis
- Set up a Western Balkans Quality Assurance Observatory in order to agree on common practices, track the last development and foster benchmarking initiatives
- Definition of common guidelines and methodologies for QA at National and regional level that foster the creation of integral strategies supported by data evidence and based on the constitution of common values
- Strengthening of capacity building through targeted training programme
- Improvement of technical capacity by the conducting External Institutional Assessment within HEIs
- Wide dissemination of project results within Western Balkans institutions and contribute to the Bologna process by creating attractiveness of the European higher education

4. CUBRIK main achievements

Being actor of an international project is an enriching experience even if not always a simple task. This can be due to different factors, but in general working within a consortium with different cultures, ways of working and also depending on the topic which is treated could be complex but at the same time extremely enriching both at personal as well as professional level.

In this case the University of Alicante is the CUBRIK project coordinator. Despite the huge size of the consortium the project is on the right track and all foreseen objectives are being achieved.

Different have been the challenges to overcome. One of the most important was the fact that we are working with 3 different countries that are Serbia, Bosnia and Herzegovina and Macedonia, that despite being part of the same Region, the Western Balkans Area, they have different regulations in terms of Quality Assurance Procedures for HEIs and regulation for the Quality Assurance Agencies. Thus in order to satisfy the needs of an heterogeneous scenario, different adjustments of the original planning have been proposed and adopted always taking into account the final project objective: raising awareness and make significant advances in the field of Quality Assurance at internal (HEIs) and external (QAA) levels.

Here we take the opportunity to underline that given the abovementioned context, this Tempus project has been a very satisfactory, effective and dynamic example of good practices sharing and dialogue between Partner and EU countries, where he most experienced shared their know-how for the benefit of the others and the less mature countries shared their questions and worries asking (and obtaining) for support.

CUBRIK is also being a good example of EU partners' collaboration and cooperation in which the tasks and in general the workflow is distributed among the EU partners according to their expertise, thus the potential of each EU institution has been underlined and exploited. Their response has been excellent, active and extremely professional, thus ensuring the quality of the output produced at all levels. Some of the best examples of such results are: The ENQA membership achieved by the Serbian CAQA, the pilot assessment carried out by the Bosnian QA Agency, the pilot assessment of Self Evaluation of a study programme at each PC HEI.

Last but not least, the CUBRIK project established a strong and solid network of experts at different levels all of them in the field of Quality Assurance. The component are the very key actors in the sectors, from HEIs, to QA Agencies or authorities, with the support of our external project experts.

Acknowledgements

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Experiences and Results of TEMPUS Project "International Accreditation of Engineering Studies"

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Abstract

The project 144856-TEMPUS-2008-RS-JPGR (15/01/2009-14/01/2013) was dedicated to the introduction and implementation of the procedures needed for international accreditation of engineering studies. These procedures comprised quality assurance fulfilments in all aspects, not just at the level of studies, but also at the level of institution. Engineering studies are specific in a sense that very close up connection to technology is needed and a feedback from industry plays an important role in quality of studies. Also, practical and soft skills are to be transferred to future engineers, so they can work in technology transfer and innovation demanding environment. Learning know-how and getting experience in these fields was very important to all the participants in the project, and results are obvious in several ways: formally the accreditation seal of the studies from ASIIN is going to be gained for some partners, as well as the EUR-ACE label, but in essence all the partners improved the quality of studies, as well as the connection to industry and innovation. Qualitative engineering education represents a compulsory presumption for technology transfer. The paper presents some results of the project.

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Keywords: Accreditation of Engineering Studies; ASIIN; EUR-ACE; Technology transfer; Knowledge triangle

1. Introduction

University of Belgrade, Faculty of Mechanical Engineering (UB-FME), was the Grantholder of the EC funded project 144856-TEMPUS-2008-RS-JPGR – International Accreditation of Engineering Studies (IAES) [1], with Prof. Dr. Milos Nedeljkovic as responsible Project leader. Partner institutions in this project were: TU Munich (as EU partner in charge for coordination of activities, with Prof. Dr. Hans-Joachim Bungartz as responsible person), Uni-Karlsruhe, ASIIN (Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik e.V.) Germany, Imperial College London, Polytechnic University of Catalonia - Barcelona, German University in Cairo, Uni-

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Belgrade, Uni-Kragujevac (with Prof. Dr. Milan Matijevic as coordinator), Uni-Nis (with Prof. Dr. Zarko Cojbasic as co ordinator), Serbian Ministry of Education, Robotina-Slovenia, Institute “Mihajlo Pupin”, Informatika, IvDam Process Control, all Belgrade. The proposal for the project has been submitted in April 2008 and was selected to be granted in October 2008. The project started in mid-January 2009 and was planned to last until mid-January 2012 [1]. For several reasons, it has been approved to be extended for one year, and to finally end in mid-January 2013. The intermediate report was submitted in mid-July 2010, and the final report in mid-March 2013 [2]. Considering the role of ASIIN [3], its double activity must be noted – as a consultant-participant in the project from one side, and as an agency to which accreditation application was planned to be submitted on the other side. GUC used accreditation agency ACQUIN (Akkreditierungs-, Certifizierungs- und Qualitätssicherungs-Instituts) [4] since that one was used even before the Project. UB-FME used also RINA [5] for accreditation of its Department for naval architecture.

2. Activities

The essential part of the project was the necessary improvement at beneficiary universities concerning all relevant faculty/university processes and relevant engineering study programs with all of their characteristics, in order to reach a new and relevant quality in engineering education verified by international accreditation of these study programs. **Planned activities** were: Quality assurance and enhancement system for engineering education (Review of existing national and international quality assurance and enhancement systems for engineering education; Establishment of Committee for quality of engineering education; Proposal of quality assurance and enhancement system for engineering education; Promotion of necessity of quality assurance and enhancement system based on the best international practice; Implementation of quality assurance and enhancement system at beneficiary faculties), New flexible study program models in order to reach interdisciplinarity and new qualifications frameworks (Review of current standards in engineering education and contemporary qualifications frameworks; Creation of new flexible study program models in order to reach interdisciplinarity and new qualifications frameworks), New laboratory, library, learning and teaching facilities as well as administrative/student services improvement (Selection, procurement and installation of laboratory software and equipment; Library facilities and administrative/student services improvement; Developing of partnership with enterprises through student practice organization), Pilot project of international accreditation of engineering studies (Accreditation of at least two selected study programs with ASIIN).

Some of **activities done** were: At GUC a review of current standards in engineering education and contemporary qualifications frameworks has been processed by the Quality Management and Accreditation Committee (QMAC), as shown in the National Academic Reference Standards (NARS) publications of January and August 2009 with active participation of GUC. Also, GUC thoroughly studied the European Qualification Framework (EQF) & the German Qualification Framework (GQF). The QMAC held several meetings with EMS curriculum committee staff members to discuss NARS, EQF & GQF. Comparison of Mechatronics study programs of 5 different degree awarding institutions was prepared by GUC. Modernization of the Mechatronics Bachelor & Master programs, together with Design & Production Engineering Bachelor & Master programs, was made and the learning outcomes were modified in compliance with Bologna process with verification of the allocated student workload and the courses' syllabi catalogues preparation. Two study programs at both BSc and MSc study level were under modification to confirm to the accreditation requirements, taking into consideration the modular structure and flexibility. Finally, GUC has submitted applications for international accreditation to ACQUIN for two study programs. After accreditation of international Mechatronics study programs by ACQUIN, GUC and University of Ulm will establish joint degree programmes in Mechatronics (at Bachelor and Master level). ACQUIN accreditation will make necessary compatibility with quality assurance and education system at University of Ulm. In essential sense there aren't differences between ASIIN and ACQUIN approach in international accreditation.

At the Faculty of Mechanical Engineering, University of Belgrade (UB-FME), establishing of a new system curricula design was done as a part of quality assurance mechanisms. This solution was accredited by CAQA. It is a unique accredited solution in Serbia at BSc study level with inherent flexibility for students to collect elective subjects from different areas of engineering, science and soft skills. Professors can offer new elective courses in each year and propose new modules with defined line of courses (within different old modules, with both new and old courses). Students have opportunity to expand their qualification framework related to elected subjects within one or more modules.

In this manner, at Faculty of Engineering (Faculty of Mechanical Engineering up to 28th July 2011) at University of Kragujevac (UKg-FE) new study programs were also formed from the old courses within different study modules of Mechanical Engineering study program at both BSc and MSc study levels. At this faculty the dominant opinion was that "new" study programs like Automotive Engineering and Military-Industrial Engineering are more useful for attracting enrolment of new students than proposed elective path within Mechanical Engineering study program, which was the solution of Faculty of Mechanical Engineering at University of Belgrade.

3. Equipment

At all the beneficiary faculties, laboratory equipment is planned to support education in Mechatronics as an interdisciplinary engineering field which is a part Mechanical Engineering education too. New laboratory facilities are showed at http://cpa.fin.kg.ac.rs:30/Home/EquipmentUniversity. At the Faculty of Mechanical Engineering University of Belgrade a new laboratory for 25 students is formed, and procured laboratory equipment for individual student's work. At the Faculty of Engineering (former Faculty of Mechanical Engineering) at University of Kragujevac, two laboratories with 8 and 20 student places are improved. Additional donation resources from industry were used in order to improve some laboratory aspects (furniture, and so on). At the Faculty of Mechanical Engineering at University of Nis, existing Mechatronics educational laboratory is improved. Laboratory equipment at RS beneficiary faculties is available for teachers and students in accordance with adopted quality assurance system. Note that equipment is a part of teaching laboratories. The Mechatronics Department at GUC purchased two new educational equipment sets that are used in the Mechatronics Lab. Full details on equipment with photos are given at: http://tempus.mas.bg.ac.rs/equip.html.

4. Some experiences and results

All the beneficiary institutions gained very valuable experience through participation in the project. Cooperation among the partners was well established and intensive. Although principles and procedures of QA and accreditation were already known (for instance all Serbian universities were already accredited by national accreditation agency CAQA [6]), a lot of new details were learned in intercommunication, and were applied by all the partners.

Achieved results related to national/regional priorities: The essential part of the project was the necessary improvements at beneficiary universities concerning all relevant faculty/university processes and relevant engineering study programs with all of their characteristics, in order to reach a new and relevant quality in engineering education verified by international accreditation of these study programs. Study of European Qualification Framework (EQF) & the German Qualification Framework (GQF) as well as study of EU engineering programs were necessary for relevant modernization of partner country engineering study programs, taking into consideration modular structure and flexibility. Interdisciplinary study programs were more focused by this project. Also, implementation of relevant quality assurance system is necessary in order to reach international accreditation.

According to the project application, in the final phase of this project, at faculties with similar structural characteristics, the implemented activities will be tested and verified through the international accreditation at least on two study programs. This pilot international accreditation encompasses updating of laboratories and libraries, student counselling practices, organization of student mobility and industrial practice, as well as informational facilities, administrative & student services, etc.

Up to now, Faculty of Mechanical Engineering, University of Belgrade has got international accreditation for the study program in Naval Architecture Engineering (MSc level), and German University in Cairo for the study programs in Material Science (BSc and MSc levels).

Also, GUC has submitted applications for international accreditation for two interdisciplinary study programs: Mechatronics Engineering International Bachelor of Science Program (in English), and Mechatronics Engineering International Master of Science Program (in English). These international study programs were targeted focus of GUC in this project during the overall project realization. Development of international relations as a priority will be obviously reached by accreditation of international study programs. As a logical extension of this project, GUC has started with establishing joint degree programmes in Mechatronics (at Bachelor and Master level) with University of Ulm.

Faculty of Mechanical Engineering at University of Belgrade has submitted applications for international accreditation to ASIIN for two study programs: Mechanical Engineering - Bachelor of Science Program (in Serbian/ English), and Mechanical Engineering – Master of Science Program (in Serbian/ English) with all teaching modules (elective line of courses in order to reach foreseen specialization in engineering including interdisciplinary engineering specialization like Automatic Control or Mechatronics, and so on).

Faculty of Engineering at University of Kragujevac prepared itself for international accreditation in the same manner as the Faculty of Mechanical Engineering at University of Belgrade, as well as the Faculty of Mechanical Engineering at University of Nis did, but no formal applications were made yet.

All beneficiary faculties had enhanced the quality and relevance of higher education in engineering field and achieved following objectives during the project: 1) Adoption of quality assurance and enhancement system (related to criteria of national and international accreditation agencies), 2) Improvement of laboratory, library, learning and teaching facilities.

Also, during the project different forms of partnership with enterprises were developed: 1) Quality assurance procedure for student practice organization was established and adopted, 2) Partnership based on infrastructure development for better education (different donations of enterprises have been implemented), 3) Partnership based on employment of students & graduates in accordance with defined of enterprises needs (for example, Center for Applied Automatic Control at FE UNI KG has selected 10 students & graduates for Muehlbauer Technologies doo, and at the same time has got donation from Muehlbauer (for infrastructure needs)).

Achieved results related to set of the project proposal objectives: The project has achieved its set objective which matches the needs identified in the original application in accordance to the available project budget and to planned activities.

The overall objective of this project was to enhance the quality and relevance of higher education in engineering area in partner countries, in order to reach the integration of partner country universities into the European higher education system, with obvious result manifested by international accreditation of engineering studies.

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Track 4: The Role of Technology Transfer Offices

Technology Transfer in an Academic Context: The Spanish TT Network (Red OTRI)

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Abstract

Technology transfer is the transfer of skills, technologies, knowledge and other innovation aspects between research organisation and third party, normally industry. The purpose of such transfer for universities is to exploit their knowledge, not least as a means of income generation. However, as with all research, the issue of ownership often comes into play making it necessary to set up specific specialist structures and regulation. This paper explains briefly the challenges in an educational context for technology transfer, and explains the Spanish model of TT offices in a network, based within the educational framework and structure, and controlled by concrete regulation.

Keywords: technology transfer; Spain; innovation management; academia; research; ownership; commercialisation

1. Introduction to the Technology Transfer Office

1.1 What is Technology Transfer?

Technology Transfer (TT) is the process of transferring skills, knowledge, research results and other technologies and processes between different actors of the knowledge - innovation - triangle. This refers to, for example, the process of interaction between an industry actor and a research partner (e.g. university). Within such a context, a dedicated technology transfer structure is both ideal and desirable.

In an educational context, technology transfer commonly refers to the practice of commercialising research results, transferring the results and / or their ownership or exploitation rights to third parties, or even undertaking specific research activities at the request of such third parties. Many educational institutions now comprehend and have internalised the activities of TT as a core pillar of activity, alongside teaching and research. To face up to the challenges and tasks required to carry out such activities, many European universities now turn their attention to the creation of a research and innovation structure, of which the dedicated technology transfer office is an important and essential element.

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1.2 Technology Transfer in an Academic Context

Most international organisations and authorities such as WIPO[1], OECD[2], European Commission and even the World Bank recognise and have a clear posture that TT is a fundamental part of productivity and economic development, in particular, the practice of transferring research results successfully to industry.[3]

In modern economies, higher education institutions and research organisations are considered not only as "seats of learning" as in the past, but also as drivers of innovation and development. The universities themselves have adopted this very definition and are creating and promoting the necessary structures to take on board this new role. In the past, such a role was not a traditional function of a higher education institution. To undertake this innovative activity, the European Commission underlines the importance of the university and other HEIs within the knowledge transfer process, going as far as producing recommendations to the Member States the adoption of a common policy and methodology for both technology transfer and intellectual property management in an educational context. Within these recommendations and outlines, the EC particularly emphasizes that:

- HEIs and research organisations should define TT and knowledge transfer as part of the strategic mission of the organisation;
- HEIs should support developing capacity and techniques for TT in public research organisations:
- HEIs in Europe (and beyond, Europe's neighbours and partners) should cooperate and take action to reach coherency in the treatment and application of intellectual property rights, and knowledge transfer activities to facilitate transnational collaborative activity and research and development projects.

It is important to note, that the European Commission not only speaks about "technology" but "knowledge". This all-encompassing term refers not only to the results of research, but also for example know-how of research teams, publications, staff and student transfer and exchange, benchmarking, and other collaborative ventures[4]. Intangible items such as know-how are not necessarily patentable, but can be well taken advantage of and transferable.

Within an academic context there are a number of challenges to bear in mind when discussing the set up and carrying out of activities of knowledge transfer. Some of these principal challenges include the "publish or perish" conundrum, the ownership of research and results, distribution of benefits, and the knowledge / skills of all involved staff in relation to IP and TT. Specifically:

1) Publish or perish / Know-how Conflict

One of the main activities an active and renowned researcher must undertake is that of publishing. It ensures the visibility of his / her work and name on an international stage. However, to adequately protect the interests of not only the researcher but the university's potential application of research results, a regulatory framework must be set up to control the divulgation of research results. This involves both the consideration of protection of know-how, and novelty of an invention / patent or research results. If divulged, this may be compromised. Whereby an idea has potential commercial application or transfer possibilities, a HEI must set clear guidelines and oversee the publication process so it is entirely compatible with the commercialisation.

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1 www.wipo.int/portal/index.html.en
2 www.oecd.org
3 PILA Project Publication: “TT desde una perspectiva jurídica” (“TT from a legal perspective”)
4 Commission Recommendation: 10th April 2008

2) Ownership of results

Who owns the research results generated using HEI resources and working time? This is a clear source of potential conflict. Without the researcher's knowledge, the results would not exist. However, without the university's resources (budget, laboratories, other resources both physical and intellectual) the research would be impossible to carry out. It is ideal and oftentimes necessary set the rule that the university is the owner of results (and all benefits resulting hereof) of investigation carried on its premises and on its working time. In the research process, many actors within the university community intervene, not only bearing in the mind the utilisation of the university's resources and structures. There are a number of agreement typologies which can regulate this ownership: the employment contract, material transfer agreements, etc. These agreements should be carefully drawn up by professionals, and all sides should be adequately informed and understand them fully.

In the specific case of Spain and Spanish institutions, the ownership of research results resides in the university, even though the authors and creators of such know-how and research are the researchers themselves. This is not a decision at institutional level, but is reflected in Spanish legislation. This ownership of results on the part of the institution allows them the capacity and means to exploit such results adequately, and also try to make some profit out of the investments given to research, as well as generate funds for further research.

This 'trend' towards universities being the owner commenced in the USA by the Bayh-Dole Act (or Patent and Trademark Amendments Act, 1980), which deals with intellectual property arising from public-funded research. Following this act, many countries included similar acts or provisions to existing legal frameworks. For the development of a university, it is extremely important that support from the relevant legislation on a national level exists. It is also true and evident that a lack of support in this sense can lead to the situation in which a TT office cannot properly develop its functions as research results are not obliged to be handled through this means, or even be declared. In Spain, such a legislative framework does exist through the "Ley de la Ciencia, la Tecnologií y la Innovación (Ley 14/2011)[5]. which is the latest addition and revision to the "Ley 13/1988 de Fomento y Coordinación General de la Investigación, Ciencia y Técnica" and Article 20 of the Patent Law (Ley 11/1986).

3) Distribution of Benefits

Very closely linked to the above, there must also be a clear policy and framework on the distribution of any benefits and profits received as a result of the commercialisation and transfer of research results. This agreement should be reached and concluded between the researcher and the organisation or entity, as well as any other involved institutions (e.g. sponsor, project partners, etc).

4) Knowledge / Skills of Staff

It should be the HEI's responsibility to ensure that human resources working in and around the field of TT and related issues like IP are adequately trained and know how to deal with the underlying issues, potential conflicts and the use of instruments such as agreements. Training is also necessary not only for the staff who work in TT, but also awareness-raising actions and other elements of diffusion for the research staff and even students. This

5 www.boe.es/boe/dias/2011/06/02/pdfs/BOE-A-2011-9617.pdf

makes sure that all of the university community is aware of the regulations, purpose and services available to them in terms of TT and knowledge.
For all the above, HEIs must seek to create and properly staff and regulate specific and dedicated offices within their structures and strategic missions for the purpose of technology transfer.

1.3 What is the purpose of a Technology Transfer Office?

As the name suggests, a Technology Transfer Office is a specialised unit taking charge of the activities of transfer - in this case within a higher education institution context - from the idea stage to the finalisation of transfer, be it research results, a process, documentation, or other item. There are differing structures, but many are involved in a very limited and similar set of activities. A common mission set for the TT office could be defined as follows[6]**:**

- facilitate the commercialisation of the university's research results and inventions for public good;
- reward university community for the commercialisation of findings;
- forge and maintain industry linkages;
- generate income for the university and its activities;
- promote and disseminate the research activity of the university (research marketing);
- generate funds for research specifically from private sources / public sources both nationally and internationally (e.g. Project financing, EC).

Some of the ways in which a Technology Transfer Office can do the above is through[7], for example,

- Licensing the use of technologies to third parties (e.g. industry);
- Setting up and maintaining joint ventures to develop technologies;
- investing and setting up spin-off companies which retain close links with the parent organisation.

As already mentioned, the Commission recommends to higher education institutions some degree of homogeneity in dealing with transfer issues. For that purpose, within the Spanish innovation system, the government wanted to create a nationwide network acting inside and for the interests of academia to bridge the gap between research and industry.

2. Spanish Network of Technology Transfer Offices - "Red OTRI"

Within the Spanish innovation management system, there exists a network of technology transfer offices, particularly concerned with TT in a research and education context, called Red OTRI "Oficinas de Transferencias de Resultados de la Investigación" (Research Results Transfer Offices). According to the dossier of the OTRI 2005, the OTRIs are created with a view to "promote relations between the worlds of university research and business" to increase the transfer and use of results of research in industry. OTRI was conceived and in 1988 in line with the National Research and Development Plan, to be the physical and mobilising structure within the educational institutions that the National Plan so desperately needed.

The official objectives of the network of offices are the following:

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6 Source: http://worldeventsforum.com/addf/presentations/Zawad,%20John.pdf
7 Source: http://www.nottingham.ac.uk/servicesforbusiness/services/technology-transfer/index.aspx

- To boost the development of the OTRI member offices and the training and professionalization of their staff members;
- To promote the networking of the offices and network functions through the development of common actions, instruments ad services;
- To promote the participation of universities in European Union programmes and activities;
- To collaborate with the government and other social and economic actors to promote university industry linkages;
- To contribute to the development and creation of a positive image of the university as a key contributor to socio-economic development and in the modernisation process of industry.

Bearing in mind the above, the OTRI network offices have 7 principal instruments at their disposal to undertake this role:

1) Research contracts and support services for the use and exploitation of research results;
2) Research and development projects, including public sources of finance towards potential commercialisation of research results:
3) Strategic alliances with other organisations dedicated to the exploitation of research results;
4) Protection of research results via patenting and other forms of IPRs (Intellectual property rights);
5) Patent licensing;
6) Creation and development of spin-offs and companies based on university and research-based knowledge;
7) Promotional and linkage actions with companies and other industrial actors.

3. RED OTRI - Structure and Actions

RED OTRI[8] is structured similar to an association, with a Board of Directors and OTRI managers, in which all of the university members are present. This forms the main basis for decision-making and debate within the network. For management and co-ordination purposes, the Board has a Permanent Commission made up of a coordinator and four spokespersons which are elected every two years. This Commission is in charge of driving the work of the network, as well as the Sectoral Commission for Research and Development. Lastly, since 2003 the network has a Technical Secretariat in the CRUE, the Spanish National Rectors' Conference.

The work within the OTRI Network is structured around Working Groups. The network has the following Working Groups associated to it:

- Working Group on OTRI-School: This group is dedicated to the training and professionalization of the staff members which make up the RED OTRI members. It organises training activities, which are tailored to specific needs and specialised for OTRI staff. It is the executing body for the Red OTRI Training Plan. One of the main actions of this plan is the OTRI Technician's Course, which gives training to newly appointed OTRI staff members.
- Working Group on Technological Evaluation: The group's remit is to analyse and devise methodologies for identifying the potential commercial application and capacity for different technologies and research results. As a result of this working group, REDValor[9] was created, a secondary network dedicated to this purpose.

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8 www.redotriuniversidades.net/portal/index.php
9 http://redvalor.com/

- Working Group on Indicators: Responsible for the correct measurement and notification of the reach and results of the work of the OTRI offices. One of the main actions is the design and undertaking of the Encuesta OTRI (OTRI questionnaire), which exists to monitor the TT and knowledge transfer activity of the individual offices and the network as a whole.
- Working Group on Spin-Offs: Designed to promote and boost the participation of the Spanish universities in the creation and start-up of spin-offs. This is done principally via the programme "UNIEMPRENDIA"[10] which is a competition-based programme taking place annually.
- Working Group on European Projects: This group works towards increasing the participation of the Spanish research and universities in European Projects, via the creation of project managers and other professionals in the OTRI offices in this specialist field.

Alongside the different Working Groups, the RED OTRI also undertakes other activities. These include an annual conference, and an IT based platform. The RED OTRI annual conference is an opportunity for the exchange of experiences between OTRI staff, as well as the planning of future actions. In such annual events, the work of the past year is also presented. The IT tool, PlataOTRI is a management platform in which members of the OTRI network can access services such as the virtual library, mailing lists, fora, calendar, and working group spaces.

4. OTRI Offices: Day-to-day activities

The OTRIs' day-to-day functions are regulated by this network, but are also concerned with their immediate context. The activity in one of these offices may mirror the activity in another, but is also adapted to needs and context. OTRIs within Spanish universities tend to be structured differently, according to the size of the institution and the potential or actual volume of work. There are two typical structures: 1) an integrated structure within the official units of the institution, most commonly depending from the Vice-Chancellorship for research (or similar). 2) An independent structure from any university organ, generally as a Foundation.

However, in both cases although the autonomy and structure changes, the OTRIS in general terms have the following workflow:

- Área de Transferencia (Transfer Area). This area has the following activities:
    - <u>Cataloguing the technology portfolio of the University:</u>

So that the transfer function is possible, the OTRIs must have a clear idea and identification process of the "product" to transfer. As is obvious, in a university context this "product" can be a patent, results, software method, knowledge, etc. This is why it is important to talk about "results" (transferable item as a result of research) and Capacities (knowledge and know-how from a research group, more intangible). To be able to identify Results and Capacities, the OTRIs create a catalogue or Portfolio which encompasses all of the material capable of being transferred to companies if desired. OTRIs therefore usually have all of the research offer of the institution catalogued in diverse formats (technology offers, capacity offers, search engines for research, etc.). These tools must be constantly updated and revised on an almost daily basis with the advances in the state of the art and research activity, as new results are reached, patents applied for, new systems, new methods, etc. As a part of this cataloguing process, OTRIs must undertake internal activities within the institution. This includes, for example, visiting research groups and creating strong relationships with them.

10 http://arnor.unirioja.es/textos/view/uniemprendia

- Promoting and disseminating results and capacities to the business sector:

Once results and capacities are catalogued, OTRIs must make an appropriate dissemination of these results to the outside, towards the socio-economic actors and other potential actors who might have an interest in such results. For this purpose, OTRIs must use systems of effective communication and work daily carrying out research marketing activities. These activities could be classified as Active Dissemination and Passive Dissemination. Active Dissemination includes actions directed towards the target group with an interest in the institution's technologies. These are normally companies. These activities can be, for example, info-days, participation in trade fairs to showcase university technologies, trade missions and visits to companies, technology diagnosis, participation in transfer networks, activities as a multiplier organisation with development agencies, chambers of commerce and business networks, etc. New technologies are a useful new resource for the OTRIs' promotional activities, and are being applied more frequently; social networks, blogs and other internet-based tools are useful for client and partner search. Passive Dissemination includes identifying marketplaces or database where technology offers are posted, and usually again takes place via Internet. In Spain, it is worth noting that in the last few years there has been an appearance and increase of companies which are including technology brokerage into their activities, similar to those already existing in countries like USA and UK. Management of dissemination systems, an active participation in this subject and the maintenance of the portfolio of technologies is a typical line of work for members of the OTRI network. The objective of these activities is to transfer know-how to civil society, as well as create value for the business sector and economic actors. Lastly, as already mentioned, a key aim is to exploit and make some profit from the investments made in research and development. Another key activity is to act as a point of entry for the actors who wish to collaborate with the university. OTRIs are capable of re-directing queries from different actors (companies, other public entities, individuals) to the corresponding and appropriate research groups.

- Assessment and negotiation for potential projects:

Once a company or other organisation demonstrates an interests in a specific technology or RD project, the OTRI can provide advice and assessment to the researchers to establish the best method of cooperation, in a manner that benefits both parties mutually and producing a satisfactory result. In this sense, the OTRIs establish a multitude of different project typologies. RD projects can be public, private, individual or with other entities. For this, OTRIs manage the participation of research groups in these projects, taking on board a coordination role (proposal assessment, partner search, coordination with other universities, budget control, etc.).

- Management of Intellectual Property:

All OTRIs have an Intellectual Property Rights management area. The protection of results via IPRs is of crucial importance, to assure a correct dissemination (publishing, for example) as well as exploiting and generating income and benefits from their usage. Normally, in the day-to-day work of the OTRI, it is necessary to manage the paperwork for patent applications, as well as the registration of other results such as software, publications, etc. Management of intellectual property must be carefully carried out via experts in the OTRI and in conjunction with the research group. As previously pointed out, for example, publication of results before their adequate protection via, e.g. patenting, may jeopardise the patent application.

- Creation of Spin-Off Companies:

Many OTRIs have a specific area dedicated to assisting researchers to set up a Spin-off company. Given that the majority of research results used as a base to create such Spin-offs are the property of the university, there must be an agreement in place between the spin-off and university to use such results. For this purpose, a common approach is for the university to receive a percentage of shares (become a shareholder) in the company and also a specific agreement to receive royalties for the exploitation of the technology or know-how. The spin-off creation area of an OTRI generally has to be directly in contact with any potential entrepreneurial research groups to assure that the university's interest in creating such a company is taken into account. The OTRI therefore takes care of the business model and plans of the company, assists in the necessary registration and set-up paperwork, etc.

- Contract Management:

The majority of the daily activities of an OTRI have as their main objective to establish connections and cooperation frameworks requiring a legal support or basis, in the form of contracts and agreements For this, the OTRI usually has a dedicated contract area which is charged with creating this legal support to the different collaborative typologies (RD agreements, confidentiality agreements, licensing, etc.). This is an extremely important area of the OTRI's workflow, as all potential cooperation must be in line with corresponding legislation.

- Research Management Area:

As is logical, an OTRI must have a research management specialist and area. Once a cooperation project or activity is agreed with a third party, within the university there are a number of internal steps to complete. This area has to be able to deal with internal challenges and items such as the financial management of research. When funds are received to develop certain activities, the university must manage them efficiently and make them readily available to the research group (to pay contracted researchers, acquire new materials and equipment, consumables, attend conferences, publish, etc.). Depending on the type of project, these funds can come from public or private organisms, as well as national, regional or international. In the majority of cases, such funds and their utilisation must be justified to the financing body, alongside the results obtained with such funds. These cost justifications in many cases are centralised via the OTRI, separate from the university's central financial management system.

- International Project Management Area:

In the majority of OTRIs, an international project management area is separate from the main activity, being a specialised area of activity. Activities undertaken in this area include the dissemination of national and international calls for proposals. This dissemination usually takes place towards researchers of the university community, for which purpose the catalogue of results and capacities is of fundamental importance to be able to tailor this information. If a researcher is interested in a particular call, his / her participation is assessed against all criteria. This advice includes budget for participating, checking that all assessment criteria are complied with, viability checks of the project, partner search, etc. If a project is approved, the OTRI intervenes coordinating with the research management area to appropriately manage the financial and administrative aspects of the project, leaving the researcher free to undertake the important scientific aspects.

2013 International Conference on Technology Transfer

Serbian National Technology Brokers Network: Structure, Opportunities and Challenges

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Abstract

In order to increase competitiveness and economic growth in the Republic of Serbia, through strengthening of innovation in Small and Medium-Sized Enterprises (SMEs), the European Union (EU) has funded the project called Integrated Innovation Support Programme (IISP). The main beneficiary and project partner is the Ministry of Finance and Economy (MoFE). The other project partners are the National Agency for Regional Development (NARD) and the Ministry of Education, Science and Technological Development (MoESTD). One of the project key objectives is to develop a new Government mechanism for direct support to innovative SMEs such as a national technology brokers network. For that purpose the preparation of a feasibility plan and an operational manual for the network has been done following the training of selected Technology Brokers (TBs) who will be members of the Serbian National Technology Brokers Network (SNTBN) which is still under development and further described in this paper.

Keywords: Technology Transfer, Knowledge Transfer, Innovation, Network, Small and Medium-Sized Enterprises

1. Introduction

There are numerous definitions of technology brokerage available, however in terms of the SNTBN it can best be described as the successful application and/or adaptation of an innovative technology or knowledge developed in one organisation to the meet the needs of one or more other organisations [1]. The brokerage in its wider sense can be split broadly into two categories: Technology Transfer (TT) and Knowledge Transfer (KT) as shown in Fig. 1.

TT generally involves high technology solutions producing revolutionary new products and services, many of which subsequently fail during development due to the high level of risk involved in the process. They often involve extensive patent discussions and complex licensing arrangements. As a result, it is a relatively small but headline grabbing component in terms of workload for the technology brokers.

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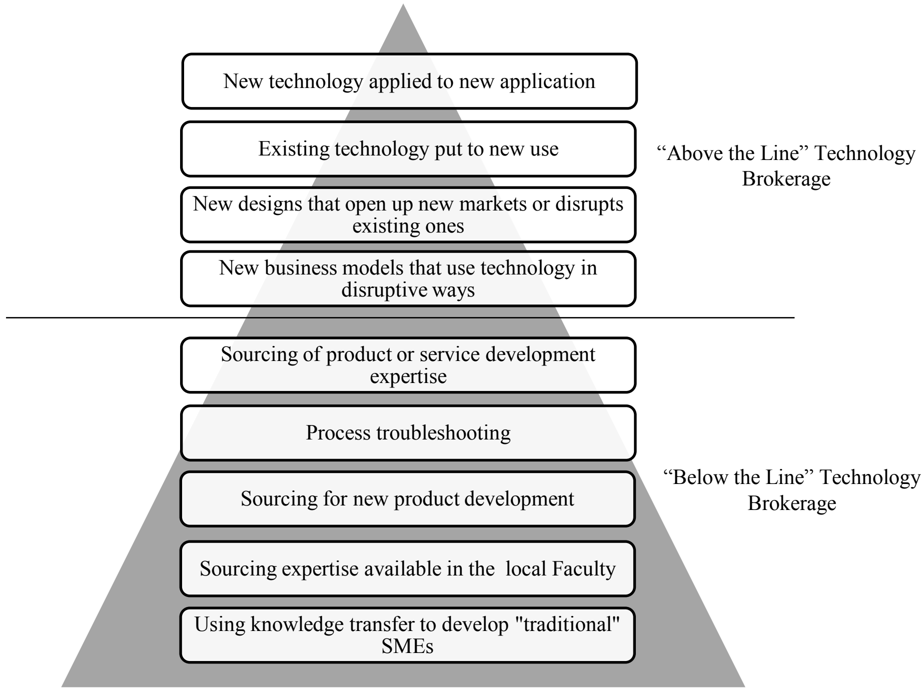

Fig. 1. The technology brokerage pyramid detailing typical brokerage activity and volume

The vast majority of technology brokerage is in Industrial Liaison (ILO) or KT in the sense that it involves the adoption of existing expertise, technologies and processes that in many cases is tactical rather than strategic and an SME has not been able to identify the source of help. It is often referred to within the academic community as either an ILO or KT role to indicate the more varied and general nature of the enquiries handled. This can be in the form of finding academic expertise, sourcing innovative items for product development or manufacturing processes and finding existing solutions that solve the businesses' current problems, participate in knowledge transfer or help the SME plot a clearer roadmap for its future development. In most cases the likely source of assistance will come from expertise with brokers own faculty or another member within the SNTBN. Whilst below the line work generally does not generate such a large volume of media interest and public relations stories, it is the bread and butter of most TB's working day, and provides the ideal platform to build trust between the businesses and the TBs, allowing the TBs to provide much better support to business as the businesses evolve up the pyramid into more complex product and process development issues.

2. Structure

2.1. Host institutions and technology brokers

Host institutions directly employ TBs, who have been drawn from staff with a technical background already working in SME facing roles. Host institutions will need to be able to support the resource implications of either employing new staff or managing the workloads of staff employed on this and other roles simultaneously. Host institutions will also need to be able to support an active program of contacting local SMEs either directly via one-to-one contact or by using workshops seminars and other one-to-many events. Significant initial work will also be required to sell the SNTBN internally within host institutions, assess the willingness of other parts of host institutions to cooperate in delivery of consultancy contracts and build up a "skills and assets" register that TBs can use whilst recruiting SMEs. Buy in from academics and a good knowledge of faculty expertise is particularly important for servicing the "Below the Line" brokerage activity, which is anticipated to be the biggest volume of work for TBs. TBs can then share this information within the SNTBN to promote "cross-selling" of opportunities.

Until now 25 TBs were drawn from existing staff with a technical background at 12 institutions which are part of four biggest Serbian universities in Belgrade, Nis, Novi Sad and Kragujevac and selected to be part of the SNTBN as well as to attend the 7-day technology brokers training held in Belgrade during the spring 2013. The following institutions have been selected so far to host the TBs:

- Faculty of Agriculture, University of Belgrade
- Innovation Centre, Faculty of Technology and Metallurgy, University of Belgrade
- Science and Technology Policy Research Centre, "Mihajlo Pupin" Institute, University of Belgrade
- Faculty of Engineering, University of Kragujevac
- Faculty of Mechanical Engineering, University of Nis
- Faculty of Technology Leskovac, University of Nis
- Faculty of Civil Engineering Subotica, University of Novi Sad
- Technical Faculty Bor, University of Belgrade
- Technical Faculty "Mihajlo Pupin" Zrenjanin, University of Novi Sad
- Faculty of Technical Sciences, University of Novi Sad
- Technology Transfer Centre, University of Belgrade
- Technology Transfer Centre, University of Nis

During the selection and assessment process of the host institutions the ministries have taken into account their sector specialism, alignment with the national priorities as well as geographical coverage. Most of the host institutions have already signed the Memorandum of Understanding with the ministries about their participation in the SNTBN and thus accepted to support their TBs, provide sufficient resources and promote the SNTBN both regionally and nationally. Some of them are partners of the Enterprise Europe Network (EEN) in Serbia which will help internationalization of the SNTBN activities. Moreover, the Code of Conduct has been established and will be signed between the TBs and their host institutions [2]. The document considers how to improve the commitment of companies to the SNTBN processes as well as how to increase the professionalism of the TBs.

The technology brokers training has enabled the TBs to operate within the SNTBN and to balance existing host institution commitments with a range of TT tasks. Such brokers are supposed to be able to communicate on a regular basis with both SMEs and academics to explain the SNTBN benefits, recruit and create technology profiles as well as handle TT negotiation set-up and tracking of results. Furthermore, TBs must be able to suggest to clients a proper form of TT, such as: licensing, franchising, joint venture, inter-firm linkages, acquisition of new products or processes, sub-contracting, collaborative R&D, recruitment of expertise, etc.

Empirically, it has been acknowledged that technology and knowledge generators, e.g. universities and Research Technology Organisations (RTOs), research-intensive SMEs, are often unaware or unable to identify opportunities with their work and when they do, they can find it hard to locate potential end users [3]. Conversely, businesses of all sizes are often searching for new approaches and technologies that would help them bring new products and processes to market but struggle to find where suitable solution might be located and how to access them. This arises for a variety of reasons, such as: lack of knowledge/awareness, fear of change/ the unknown, conflicting priorities, lack of time, lack of balanced leadership, geography or too much choice. It is clear that the SNTBN will face many challenges within further development of Serbian entrepreneurial culture. The SNTBN ought to be able to support the country to make best use of its current and future knowledge base and the expansion of that knowledge base into the Serbian SME ecosystem.

2.2. Clearing house

The IISP project team has proposed establishment of a national clearing house which should add value to the SNTBN in key areas, i.e. provide

- A shop window for Serbian technology and business opportunities,
- A neutral space for technologies from “competing” faculties/institutes to be presented, and
- An opportunity for academics, the host institutions and public laboratories to display their expertise, which in turn allows TBs to find support for Serbian SMEs within the country, before internationalizing requests for support via the EEN as shown in Fig. 2.

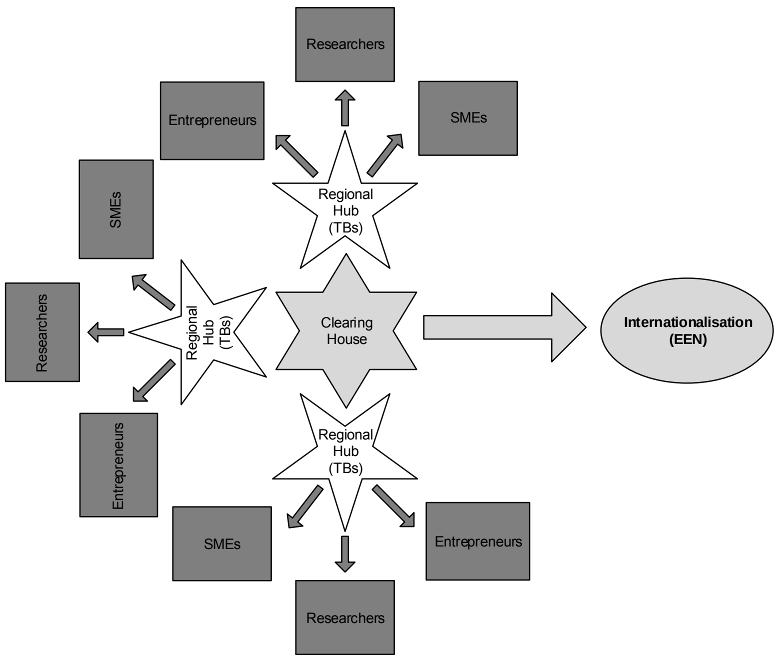

Fig. 3. Hub and spoke model proposed for the SNTBN.

The clearing house will be effectively a database of business and technology offers and requests, skills and expertise, known as technology profiles. It will require basic web hosting support and administration of users. Key procedures can be built into the operation of the clearing house to ensure compatibility of data and that relevant confidentiality clauses are respected. Brokers would be able to directly enter profile data, a decision would then need to be made as to requirements for reviewing of profiles before publication. Potential data sources are outlined in Fig. 3. To avoid duplication profiles should be designed to be similar to EEN in format, so that those profiles with likely international interest can be transposed onto the EEN and other systems with minimal effort.

The technology transfer web database recently designed and developed at the Faculty of Electronic Engineering, University of Nis and within an another project funded by EU, the National Platform for Knowledge Triangle in Serbia (KNOWTS), has been seen as one of the most promising potential solutions for the clearing house [4]. The web database has been already presented to all TBs together with its great capabilities related to advanced user registration and automatic technology profiles matching. Apart from the TT web database the IISP and the KNOWTS have established a quite good cooperation in order to support and help each other while trying to achieve a common goal that is to further facilitate TT process in Serbia.

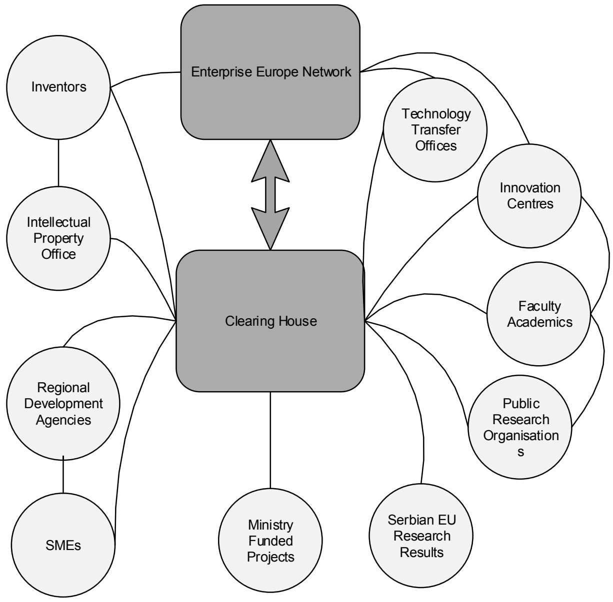

Fig. 3. Potential source and their interrelationships to form the clearing house for the SNTBN.

2.3. The steering committee

To develop a strong and cooperative national network where all hosts and brokers work together for the benefit of increasing competitiveness and innovation of SMEs in Serbia, it is important that the hosts ensure the brokers to maintain open and regular communication with each other and other intermediaries. For that purpose, a steering committee will be set up consisting of the representatives of the ministries, the NARD (as the EEN coordinator in Serbia), the Serbian Chamber of Commerce, representatives of the host institutions as well as the Intellectual Property Office of Serbia (IPOS). They are supposed to meet for reviewing the SNTBN progress bi-annually and managing any open issues.

3. Key Tasks

The SNTBN will concentrate on SMEs as the principal target group, but other organisations will be included, such as universities, research centers and, where appropriate, larger companies, as well as professional and trade associations and development agencies. The main tasks of the SNTBN will be to:

- Stimulate the capacity of firms to adopt new technologies and knowledge by establishing their needs and ability for co-operation and partnerships
- Promote the transfer of technologies and knowledge, whatever their origin is, in accordance with the needs of the local industrial, economic and social fabric both regionally and nationally
- Promote the dissemination and exploitation of the results of research, notably those results identified as suitable for third party exploitation
- Provide other key services which help promote or facilitate innovative technology and knowledge transfer
- Pursue possible synergies between the host institutions and the internationalisation activities via the EEN.

The role of the SNTBN can simply described as the promotion of innovative solutions by bringing together organisations and companies that have technology needs or technology to offer. Through the matching of these needs and offers the chances of successful TT can be increased and SME profitability increased as well as an improved return of investments (ROI) for publicly funded R&D.

4. Performance Indicators

The aim of performance measurement is to contribute to the professionalism of the SNTBN and improve both client facing and internal network activities. The purpose is to foster the understanding by each host institution of its performance and on their regional client base. The implementation of Performance Indicators (PIs) is expected to stimulate a process of continuous network improvement.

The SNTBN criteria have been defined taking into account the characteristics of each host institution and the geographical area covered, as illustrated below:

Table 1. SNTBN performance and efficiency measures (# = Number of)

Indicator	Definition
Size of the host institution	# Full-Tim Employees (FTE) engaged in the SNTBN activities
Density of SMEs	# SMEs in geographical area covered / Surface area of the host institution region (km^2)
Wealth of a region	Gross Domestic Product (GDP) per capita of the SNTBN region (€)
# Profiles published	Profiles published on the clearing house, per annum
# Expression Of Interest (EOI) managed	EOIs in profiles published (as above), per annum
# Serious negotiations started	Where two parties are engaged in discussions that involve material transfer of knowledge and/or the likelihood of an agreement being reached is high, per annum.
# Agreements declared	Based on completed forms submitted to the steering committee, per annum
Impact	Jobs created or safeguarded, turnover increased, contracts won, etc. per annum.

The chosen criteria have the advantage that they are simple to implement, as the host institutions would only need to communicate the number of FTE, the number of SMEs in the geographical area covered, the surface of this area, and the GDP per capita of the hosts region and simple management data which is required by each TB to monitor their own TT activity at an operational level.

At this stage of planning the SNTBN is envisioned to consist of sufficient TBs to be able to cover an arbitrary target of developing 25 SME/academic profiles per host per year, and to elicit 75 EOIs per year, split between outward EOIs in response needs posted elsewhere and inward EOIs trying to connect with the 25 profiles produced from a given region. When scaled up across the 10 hosts, this implies national targets of 250 profiles a year, leading to 750 EOI “leads” and 10-25 new technology inspired partnerships per year (once established, which can take up to two years) creating wealth and employment benefits for Serbia.

5. SWOT Analysis

SWOT analysis is well-known structured planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture and related to both internal and external factors. We have carried out such an analysis for the SNTBN and the results are presented in Table 2.

There is no any doubt that the SNTBN possess the strengths which will definitely make it different from other business support organizations available in the SME marketplace. Also most of the weaknesses could be turned into additional strengths in close future by appropriate actions taken by both TBs and their host institutions. In order to fully exploit the presented opportunities and at the same time successfully mitigate all the threats a set of coordinated actions will be needed which will involve all above mentioned stakeholders.

Table 2. SNTBN SWOT analysis

Strengths	Weaknesses
Knowledge, resources and long tradition in the host institutions	New in the SME marketplace
Multidisciplinary in the host institutions involved in network	Lack of trust between SMEs and the host institutions
Willingness of TBs	Huge gap between SMEs and the academia
Trainings, certificates and support from the ministries	Traditional SME business models
TBs are close to technology sources	Hard to achieve fast and measurable results
Intellectual property management	No knowledge base
The university TT centres support	Weak links between the host institutions
The NARD and the EEN support	Low awareness of innovative entrepreneurship
	Hard to locate potential users
	Hard to achieve fast national recognition
Opportunities	**Threats**
Developing new entrepreneurial culture	Inactivity of university staff
Creating a national TT database	Inactivity of SMEs
Resources in numerous young researchers involved in national science project cycle 2011-2015	There is no widely known good practice There are no strong guarantees of success
Applying domestic innovations for creating goods with higher market value	Economic situation in SEE region Lack of financing possibilities
Raising SMEs competitiveness	Many choices in TT
Huge space for improvements in SMEs	Lack of TBs time
SNTB activities are in accordance with most of national and European strategies for economic and industrial development	Regional differences Inactivity of R&D sector in SMEs
Successful TBs can facilitate TT regardless the systems they work in	Size and complexity of brokerage tasks Hard to develop strong and wide connections shortly

6. Conclusion

There is clearly a range of forms by which knowledge and technology transfer can take place. However, equally there are many challenges within the process to overcome. Irresponsive of this, there remains a clear need to encourage technology transfer as a means of regional and national wealth creation and ensuring that the maximum possible returns are gained from publically funded research. A successful technology brokerage network depends upon getting its nodes connected in an effective and efficient manner to each other, and access to opportunities within and beyond the network. In this instance, the SNTBN nodes are the TBs themselves and their performance will be intimately linked with the host organisation that employ them. Leaving aside political, legal and societal issues beyond the scope of this activity, key feasibility challenges revolve around:

- Funding - The lack of core funding leading to, at best, mixed mode funding and the concomitant split objectives that brokers will inherit.
- Closeness to Knowledge Users (SMEs) - The ability of host organisation to penetrate their local SME communities and engender support for technology transfer.
- Closeness to Knowledge Producers - The ability of TBs to work with their academic staff, innovation centres and technology transfer offices to facilitate technology commercialisation and SME problem solving.
- Cooperation - The ability of host organisation to work with each other to ensure the best possible opportunities are presented to network clients regardless of who benefits.
- Centralisation - The setting up of a central clearing house where data can be easily stored, accessed and swapped with other external networks.

The SNTB as structured above and when finally established with all the challenges successfully addressed is going to play an important role in TT both nationally and internationally as well as bridge the existing gap between the academia and the SME sector in Serbia.

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Technology Transfer In Higher Education: The Case Of University Of Belgrade

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Abstract

Long-term sustainability of a system is determined by it's capability to adapt to changes in the environment. Due to the fact that consumer society has been shaped by acceleration in technological development and hyper production of versatile goods and services, constant innovations and their commercialization became an imperative for further economical growth. Knowledge based institutions, as epicenters of intellectual potential are taking a big part in a solution for overcoming the challenges associated with this process.
Present study shows needs, mechanisms, obstacles and motivations regarding technology transfer between university research and industry in the case of University of Belgrade.

Keyword: Technology Transfer; Commercialization; University of Belgrade; Research; Innovation

1. Introduction

Universities as engines of economic growth, via the commercialization of university generated intellectual property (IP) have captured the attention of University administrators and policymakers all over the world. Accordingly, the generation and exploitation of IP has become a central issue not only for the universities but it is also a major driver for government policy, due to a fact that the successful creation and commercialization of university originated technology can lead to gains that stretch beyond the immediate financial gains for the university. Also, the emergence of the knowledge based economy, in which production, use and distribution of information and knowledge have become central to economic development, has given the additional importance to involvement of universities, since they are not longer just a creators of knowledge, a trainer of young minds and a transmitter of culture, but also a major agent for economic growth: the knowledge factory, as it were at the center of knowledge economy [1].

The management of the exploitation of IP is generally performed by the Technology Transfer Office (TTO). Based on the OECD definition, a TTO, as it is commonly referred to by technology transfer professionals, is *"this organization or parts of an organisation which help the staff at public research institutions to identify and manage the organisation's intellectual assets, including protecting intellectual property and transferring or licensing rights to other parties to enhance prospects for further development."* According to recent European Commission studies on technology transfer from science to enterprises, a

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Technology Transfer Office is *"a dedicated entity which provides, continuously and systematically, services to publicly funded or co-funded research organisations in order to commercialise their research results and capacities"*[2,3].

A number of academic studies have recognised that TTOs play an intermediary role between three major stakeholders, industry, academia and state, and that collaboration between this three institutional spheres is critical to improving regional and national systems of innovation. This tri-spherical co-operation is also known Triple Helix model [4-6]. Thus, TTOs can be seen as the bridge between a technology "push" process aiming to improve the uptake of technology coming from the science base and a technology "pull" process related to the promotion of the demand for new technology in the business sector.

This paper aims to present the mechanisms of the technology transfer system, the motivations of technology transfer between university research and industry and the obstacles to technology transfer at Serbia's biggest university, University of Belgrade (UB), from the view point of Center for Technology Transfer.

2. Centre for Technology Transfer University of Belgrade – real needs

The Ministry of Education, Science and Technological Development of the Republic of Serbia is setting up a legal framework to facilitate the creation of technology transfer offices. On 25 February 2010, the government adopted the "Scientific and Technological Development Strategy of the Republic of Serbia", together with draft amendments to the relevant laws. Under the strategy, a knowledge transfer program was envisaged as one of the measures to be implemented. The strategy also underlines the significance of technology transfer offices in speeding up the transfer of technology to industry and helping to boost the development, and exploit the innovative potential, of Serbian companies [7].

Besides being an educational institution with a long tradition that annually produces several thousand professionals of all professions, the University of Belgrade is a huge and widely structured scientific capacity. About seven thousand teachers, researchers and collaborators and about ninety thousand undergraduate, graduate and doctoral students from different professions have been the scientific support to the economy and development of the country for decades. In addition to educational and scientific work, the University had been solving problems, not only of adopting and developing new technologies in industry, construction, agriculture, but also of the harmonization of socio-economic relations, culture, education or anything else that required the engagement of the highest creative and scientific potential. In other words, the University was fully involved in some kind of spontaneous transfer of technology. The University has achieved a multitude of innovations and patents, the results of which the majority went to entities with whom the university had been cooperating or to collaborators who had been involved, but the University had no share in ownership or in their exploitation [8]. Bearing all this in mind and recognizing the need to institutionalize and regulate the protection and commercialization of intellectual property and research results generated at the University and to enhance the transfer of knowledge and technology, the University of Belgrade was founded the Center for Technology Transfer by a decision of the University Council on October 26th, 2010. The task of the Center is to popularize, to initiate, to facilitate and to carry out the protection of intellectual property of the University, to keep the portfolio and to commercialize the realized patents and research results, to place expert knowledge and research capacities and to establish or to improve the links between the University and industry.

3. Technology transfer

Technology is information that is put into use in order to accomplish some task. Transfer is the movement of technology via some communication channel from one individual or organization to another.

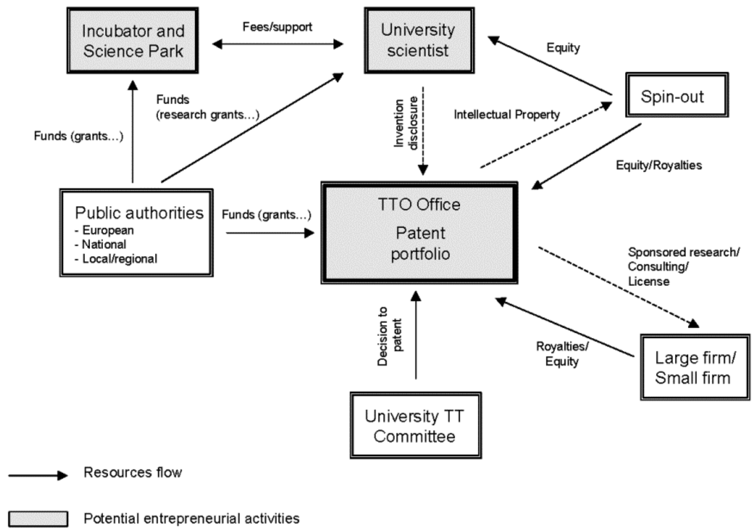

Fig. 1. A model of TT resources flow [9].

A technological innovation is an idea, practice or object that is perceived as new by an individual or some other unit. Therefore, technology transfer is the application of information (a technological innovation) into use. The technology transfer process usually involves moving a technological innovation from an R&D organization to a receptor organization (such as a private company). A technological innovation is fully transferred when it is commercialized into a product that is sold in the marketplace. So technology transfer is a special type of communication process, Figure 1 [10].

The core tasks within the CTT UB technology transfer process include securing invention disclosures from researchers, filing patent applications, negotiating licences, and creating spin-out companies, Figure 2.

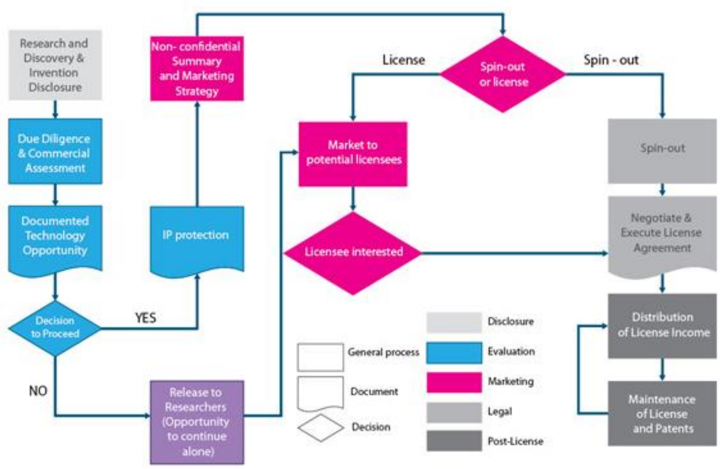

Fig. 2. Technology transfer process map at the University of Belgrade.

There are other related activities that are needed to make the entire process work, such as managing research and consulting grants and contracts, training students and entrepreneurs, and managing business incubation and science park programs.

4. Technology transfer mechanisms

Different mechanisms could be applied in technology transfer between University and industry depending on their motivation and available resources. Relating to previous five main mechanisms of technology transfer are planned to be conducted through the Center for Technology Transfer University of Belgrade (CTT UB). The plan for commercialization through following these mechanisms should ensure the recognition of University of Belgrade as one of the key players in innovation activity in Serbia, and would allow an efficient implementation of research results and knowledge transfer with industry.

i. Joint venture of R&D

A contract would be drawn between the university research center and a contractor, containing detailed specification of respective costs and their division between parties involved. Also, degree of cooperation from the stage of R&D to commercialization would be specified, taking into account the best interest of them all. It provides some assurance that the best brain in the business will be brought together to bear on the problem, and that there will be a balance between long term, high risk research and short-term work which can be promptly commercialized.

ii. Cooperative Research and Development Agreements (CRADAs)

A CRADA is basically a written agreement between a private sector organization and a government agency to work together on a project. The agreement involves no transfer of funds from the Government and is not considered a procurement action. Through a CRADA, all parties may agree to keep research results emerging from the CRADA activity confidential to the extent permitted by the law or until they are published in scientific literature or presented at a public forum. The partners can agree to share patent and intellectual property rights in any manner agreeable to both parties. This is an agreement between one or more university research laboratories and one or more firms under which the university side provides personnel, facilities, or other resources with or without reimbursement. The industrial parties provide funds, personnel, services, facilities, equipment, and other resources to conduct specific research or development efforts that are consistent with the laboratory's mission.

iii. Contract research

It is a contract between a research center and a firm for contract R&D to be performed by the research center. Industry usually provides funds, while the university provides brains with the time frame ranging from a few months to several years. Through contract research, industry wants to utilize the unique capability of the research centers that works for commercial benefit.

iv. Licensing

Licensing is the granting of permission or rights to make, use and/or sell a certain product, design or process, or to perform certain other actions, by a party that has the right to give such permission. It can be exclusive or non-exclusive and is preferred by small business. A licensing fee is usually paid in exchange for acquiring a technology license. Licensing royalties may earn considerable income for a university, faculties or institutes. Increasing emphasis on technology licensing royalties by universities could be a way for transforming these institutions into "entrepreneurial universities".

v. Spin-off

A University spin-off is a business founded by researchers to enhance the results of their own research activity and scientific knowledge, in which the University of Belgrade may be a partner. Researchers, as partners, share the profits. From the legal viewpoint, a spin-off is no different from an ordinary business enterprise. The particularity of spin-offs lies in the fact that they are promoted, created and developed by one or more people who have a close relationship with the research world and use the know-how developed within research organizations in their business activity. A high rate of establishing spin-off companies is characteristic of technopolises like Silicon Valley, Austin, Route 128, Cambridge, Tsukuba Science City. In fact, spin-offs are the main mechanism for the rapid growth of each of these technopolises.

The CTT UB has assisted in the formation of three spin-out companies and in the licensing of more than ten technologies. The CTT UB is working on matchmaking between the University and industry through software support for the technology transfer. The Portal for Technology Transfer was developed within the frame of the project 158881-TEMPUS-1-2009-1-RS-TEMPUSJPHES „National Platform for Knowledge Triangle in Serbia“ [11]. The system should support the acquisition of data related to the technologies developed at the academic institutions, as well as commercial potentials of the companies. The main goal of the system is the quick and efficient forming of a unique technology database and linking and cooperation between academic institutions and companies.

5. Motivations of technology transfer between University and Industry

Fast growing technology, an ever-changing economy and rapid changes in innovation have triggered companies to face the challenge of competitive advantages. Academia-industry collaborations have been encouraged in many countries by policy-makers [12,13]. Cooperation with universities should be especially important for industrial firms to access new knowledge, ideas and technologies, as well as skilled labour, especially qualified engineers, whose capabilities can be tested during the collaborative project. In particular, firms seem to engage in collaborative projects with universities to access and develop interdisciplinary scientific capabilities for solving complex problems and for supporting product development. Indeed, collaborative projects with university often focus on research related to existing product lines, exploratory research in search of new products, instrumentation and technical problem solving, and the design of prototypes. Additionally, firms may collaborate with universities to maintain or to establish direct personal links with top professors.

The CTT UB identified four main industry motivations for firms to propose or engage in collaboration with university: (i) support for product development (the most important motivation), followed by (ii) the desire to access public research sponsoring, (iii) to get support in solving technological problems, and (iv) the motivation to explore a good research opportunity.

Benefits for industry from collaboration with universities tend to be in line with their objectives to participate. Benefits could be:

- a supply of better qualified graduates having more relevant training because industry’s needs have been identified
- a supply of better qualified graduates having more relevant training because industry’s needs have been identified;
- access to the university’s physical facilities and the expertise of its staff;
- access to research, consulting and data collection of the university;
- an improved public image in the society in which it operates, which means that more talented students will be attracted to the industrial sector;
- gained technical knowledge;
- gained technology services not available before;
- cost savings;
- new markets;
- manufacturing and lead time reduction

University researchers are found to participate in collaboration with firms for accessing production technologies and getting prototypes manufactured, as well as for obtaining additional research funds. University benefits from collaboration with industry were found to be strongly correlated with the early reasons for collaboration as well as with the length of the project.

There are many reasons why researchers would like to participate in the process of technology transfer. Only some of the most important identified by the CTT UB are: (i) obtaining insights into the industrial applicability of previous research, (ii) maintaining collaborative industrial contacts, (iii) access to additional funding, and (iv) increasing future (collaborative) research opportunities.

The advantages to University and its members could be listed as follows:

- the opportunity to access the needs of the economy and to develop its activities accordingly through income from the sales of technology;

- the opportunity to place students in industry so that classroom learning can be related to practical experience;
- access to industry for both fundamental and applied research;
- access to the protected markets;
- business stature enhancement;
- improvement in new technology implementation;
- creation of goodwill;
- new product development and spin-offs;
- cost savings (lower production cost);
- patenting.

6. Obstacles to technology transfer

Nowadays commercialization of university research and R&D innovations is considered as a significant factor in the economic stability of the countries. Although the process of commercialization seems to be simple and conventional, it has its own obstacles [14]. Evidently, it could be noted that technology transfer is a high-risk process since there is no guarantee that a technology development project will result in successful product launch or that the investment will generate sufficient return. This characteristic would lead to resistance to technology transfer [15]. Various technology transfer barriers can be identified in practice. According to Parker (1999), there are natural obstacles to technology transfer, such as: academic tradition and values (teaching, publications, long horizon of research, etc.); and industrial priorities and culture (profit, risk taking, short horizon of activities, etc.) [16]. Kirkland (1999) describes five groups of the barriers: legal barriers, mainly intellectual property rights, financial barriers, mainly lack of financial resources, manpower constraints (skills), barriers to communication between universities and industry, technological barriers/difficulties [17]. Corsten (1987) has found the following obstacles to technology transfer from an academic perspective: (1) attitude of many professors, (2) inclination towards perfectionism, (3) lack of practicality, (4) lack of realism and hostility to compromise prompted by the search for scientific truth, (5) lack of regard for deadlines and profitability, (6) communication difficulties, and (7) confidentiality problems [18].

The main obstacles identified by the CTT UB at the national level are as follows:

- Research and technologies are not completely based on customer needs

Many research ideas and results generated in university research centers often fail to align with industry business strategies or the timing is inopportune in relation to product launch.

- Inadequate relationship with the regional and global market

According to the limitations posed to researchers and innovators in the country and obstacles in registering and protecting their achievements, the relationships with global markets would encounter some problems.

- Lack of adequate venture capital for investment in new technologies

Although there are some institutions which have been established, especially after 2010, to provide venture capital and entrepreneurial funds for researchers and innovators, still there is a gap to be filled.

- Tendencies towards risk-avoidance and/or indecisiveness,
- There are particular problems for small and medium-sized enterprises, where technology transfer is much more frequently problem-solution-oriented rather strategic in nature, and based less on conceptual or “pure” research.
- Lack of effective communication industry with universities,
- R&D units not fully open and prepared to cooperate with firms,
- Inefficient system supporting industry innovation and R&D activity,
- Difficulties in getting financial resources from outside the industry,
- Lack of industrial financial resources,

- Lack of innovative culture and mentality,
- Cost of patenting discoveries;
- Lack of industry interest;
- Lack of researcher or faculty interest;
- Industry reluctance to accept non-exclusive licenses;
- Industry reluctance to meet royalty demands;
- Unproven state of academic technology.

As may be seen, there are similarities between the major obstacles that have been identified at the national level and those given in the literature.

7. Conclusion

The Center for Technology Transfer University of Belgrade was created in order to induce better exploitation of the intellectual and technical potential of the University and to help scientists to commercialize potentially valuable inventions. The CTT UB activities are mainly focused on securing invention disclosures from researchers, filing patent applications, negotiating licenses, and creating spin-out companies as well as managing research and consulting grants and contracts, training students and entrepreneurs, and managing business incubation and science park programs. The joint venture of R&D, cooperative research and development agreements, contract research, licensing and spin-off have been identified as the five main mechanisms of technology transfer at the University of Belgrade.The CTT UB has assisted in the formation of three spin-out companies and in licensing more than ten technologies. The CTT UB is working on matchmaking between the University and industry through software support for the technology transfer. The Center for Technology Transfer will strive to substantially contribute to the development of a national innovation system and the creation of an economy and society based on knowledge and to ensure that the University of Belgrade be recognized as one of the key players in innovation activities in Serbia.

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Software Architecture for Information Gathering in Technology Transfer Offices

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Abstract

University-industry relationships are multifaceted, complex, and diverse. The role of Technology Transfer Offices is to push this cooperation further by actively seeking for the opportunities to straighten the collaboration, and find and exploit new possibilities. In order to actively push the technology transfer further, Technology Transfer Offices need to constantly seek for novelties and potentials at both sides. Having a clear picture of developed technologies and industry potentials is crucial for Technology Transfer Offices to operate successfully. The goal of this paper is a development of strategies and techniques for information gathering for Technology Transfer Offices. The scenarios for registration of potential actors in technology transfer will be developed and implemented in the form of web application. The web application architecture will be presented. The implementation will be illustrated on the example of the Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš.

Keywords: Technology Transfer; Software Support; Web-based systems;

1. Introduction

Universities have potentially a pivotal role to play in the social and economic development of their regions. They are a critical asset of the region; even more so in less favoured regions where the private sector may be weak or relatively small, with low levels of research and development activity. Successful mobilization of the resources of the university can have a disproportionately positive effect on their regional economies and achievement of comprehensive regional strategies [1].

There is a growing body of theory and practice about the role of universities in regional development [2]. This has identified why regional authorities are seeking to mobilize universities in support of their regional development strategies and why, for their part, many universities are engaging with the development of their regions (the drivers). A key message in [2] is that successful partnerships depend on understanding each others drivers. Too often partnerships fail because university managers do not understand the challenges of regional development and regional authorities do not understand the core mission of universities and the constraints within which they work. However, once mutual understanding is reached it is possible to put in place structures and procedures which overcome the barriers to collaboration.

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University-industry relationships are multifaceted, complex, and diverse. Technology Transfer, also called Technology Commercialisation, is the process of transferring skills, knowledge, technologies, methods of manufacturing, samples of manufacturing and facilities among governments or universities and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services.

In the knowledge society, one of the most important flows in technology transfer is the flow from university to the industry. While universities have long served as a source of technological advances for industry, university-industry collaboration has intensified in recent years due to four interrelated factors: the development of new, high-opportunity technology platforms such as computer science, molecular biology and material science; the more general growing scientific and technical content of all types of industrial production; the need for new sources of academic research funding created by budgetary stringency; and the prominence of government policies aimed at raising the economic returns of publicly funded research by stimulating university technology-transfer [3], [4].

Many companies, universities and governmental organizations have a Technology Transfer Office (TTO, also known as "Tech Transfer" or "TechXfer") dedicated to identifying research which has potential commercial interest and strategies for how to exploit it. For instance, a research result may be of scientific and commercial interest, but patents are normally only issued for practical processes, and so someone, not necessarily the researchers, must come up with a specific practical process. Another consideration is commercial value; for example, while there are many ways to accomplish nuclear fusion, the ones of commercial value are those that generate more energy than they require to operate.

The role of Technology Transfer Offices is to push the university–industry cooperation further by actively seeking for the opportunities to straighten the collaboration, and find and exploit new possibilities. There are software support systems that are build around large databases which contain technologies information. One example of such systems is Enterprise Europe Network (EEN) [5]. The mission of EEN is to make the most of the business opportunities in the European Union by promoting the technologies to the wide audience [5].

A way before a technology is ready to pass to the phase of promotion and seek for a business opportunity, TTOs need to have a clear picture of a potentials in their own regions, and select the technologies with a commercial value. In order to push the technology transfer further, TTOs need to constantly seek for novelties and potentials at both sides. Having a clear picture of developed technologies and industry potentials is crucial for TTOs to operate successfully. In this paper are proposing the techniques for user registration and information gathering for Technology Transfer Offices, developed under the framework of project 158881-TEMPUS-1-2009-1-RS-TEMPUSJPHES "National Platform for Knowledge Triangle in Serbia - KNOWTS". The goal of this paper is a development of strategies and techniques for information gathering for Technology Transfer Offices. The scenarios for registration of potential actors in technology transfer will be developed and implemented in the form of web application. Implemented software will be illustrated on the example of the Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš. As one of the KNOWTS project results, the software is installed at four TTO centers in Serbia: University of Belgrade, University of Niš, University of Novi Sad and University of Kragujevac.

The paper is organized as follows: Section 2 gives a brief overview of a conceptual model in which technology transfer operates, Section 3 is the main section and it is devoted to the information registration processes, Section 4 discusses the proposed software architecture, implementation and customization features, while in Section 5 the concluding remarks are given.

2. Conceptual model

The commercialization of university research, at its simplest, is a dyad involving transactions between the university and a commercial firm. Commercializing a technology may encompass many different types of transactions between a university and the company and different types of transactions may occur sequentially to reinforce commercialization. Ultimately, a relationship may develop that furthers the interests and goals of each party. Universities themselves are complex bureaucracies with their own rules, rewards and incentive structures. Moreover, in contrast to commercial firms with a relatively simple profit motive, universities have complex objective functions that involve a variety of educational and societal objectives as well as the interests of faculty members and the larger scientific community [6].

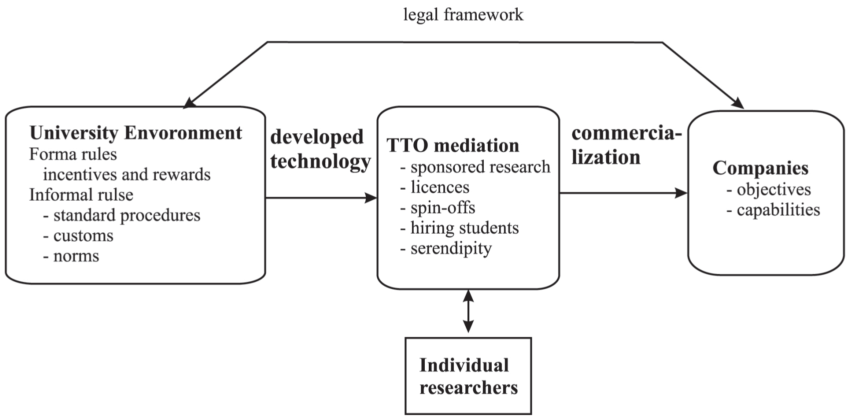

Fig. 1. Universityindustry relationship evolutionary schema.

Fig. 1 provides the conceptual framework in which TTOs operate [6]. Universities relationships with industry are formed through a series of sequential transactions such as sponsored research, licenses spin-off firms, and the hiring of students. Scholars have tended to analyze formal mechanisms such as sponsored research agreements, licenses, or equity swaps when investigating technology transfer (Fig. 1) [6], [7], [8], [9]. While enlightening, this focus is narrow as firmindustry interactions combine formal and informal interactions and are influenced by firm strategy and industry characteristics, university policies as well as the structure of the technology transfer operations and the parameters defined by government policy.

The core elements in university-industry relationships are transactions that occur through the mechanisms of sponsored research support (including participation and sponsorship of research centers), agreements to license university intellectual property, the hiring of research students, and new start-up firms (Fig. 1). To be inclusive, serendipity is also included as an informal mechanism that might be used to initiate a relationship, which subsequently develops through other mechanisms.

The TTO plays a significant role in this mission by protecting and promoting university research discoveries and intellectual property, working with and guiding industry partners, and promoting the acceleration of startups. In the environment in which they operate, TTOs need a software support, especially on the Internet, which should extend the a range of TTO's presence. There are two aspects in which especially web applications can support and improve technology transfer activities:

1. *Support in technology promotion* - These are usually a web systems that are build around large databases which contain technologies information. One example of such systems is Enterprise Europe Network (EEN) [5]. The mission of EEN is to make the most of the business opportunities in the European Union by promoting the technologies to the wide audience [5].
2. *Support in information gathering* - Before TTO can take further steps, it must take a snapshot of a potentials available in the region, on which an assessment of a commercialization value will be performed.

In this paper we are proposing a novel approach for gathering of initial information about technology potentials, which can be implemented as a web application. The roles of web based software system for supporting TTOs in information gathering proposed in this paper are:

- registration of academic users and companies
- registration of the data related to the developed technologies,
- registration of the data related to the market potential and needs,

3. User registration and information gathering technique

In order to gather the information about the regional potentials regarding the technologies and commercialization potentials, the actors on the both university and industry sides should be registered. A dedicated method for the registration of the subjects relevant for technology-transfer, which will be embedded into the architecture of the system for supporting TTOs in the information gathering, is proposed in this section. We'll reference the software for supporting TTOs in the Information Gathering in the following text as IGsw.

The functional requirement set for the IGsw is to register a large number of users, which can be generally grouped into two types: academic institutions and companies. In order to register a large number of users, registration imposes a non-functional requirement of an automatization of the user accounts creation. Automatic registration implies that the users should be permitted to register themselves and create an account with IGsw without, or with a minimum interference of the systems administrator. The fact that the academic institutions are generally interconnected and have an internal hierarchy, with universities as central points, should be exploited during the registration.

In order to reduce the system administrator activity in the process of academic institutions registration, it is necessary to identify the characteristics of the domain. The main feature are the relations that exist between academic institutions. There are two types of relations: horizontal and vertical. The vertical relations include university → faculty → department → laboratory → individual researchers connections. Horizontal relations make mutual cooperation between institutions. Vertical links directed from higher to lower entity can be referred as ”requests”, and the ones in the opposite direction can be referred as ”initiatives”.

All three mentioned relation types (request, initiatives and cooperation) can be used for validating user data, and the type of ”request” may be used to further speed up the registration process exploiting the authority of the particular entity. The technique for user registration proposed in this paper is shown as UML sequence diagram in Fig. 2, and it is based on invitations, where existing user can invite the other potential users to register.

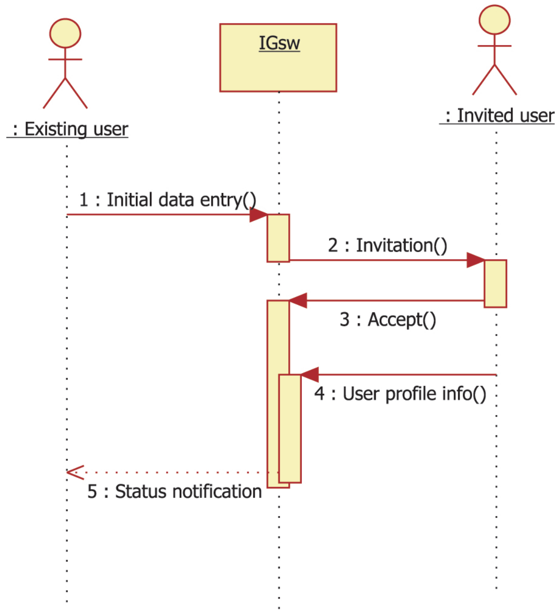

Fig. 2. UML sequence diagram of academic institutions registration technique

The process shown in Fig. 2 begins with the registration of one academic user by the administrator. The first registered user should be the highest authority in the described relations chain, namely university. It should be noted that the proposed strategy is based on recursion, which is not explicitly emphasized in Fig. 2, as the existing user that sends the invitation for the registration and new academic institutions (in terms of new users) are shown as a separate actors in the figure.

After initial data entry of the invited parity by the existing user, Fig. 2, the IGsw generates and sends a registration request message with a security information that describes how to access the system and register. Upon a successful registration the user who sent the request will be notified about the status of the registration process, which serves as an additional driver that exploits ”authority” relation, and can accelerate the registration process (Fig. 2). This model implicitly includes data validation, so that the administrator does not play significant role in the process, further then to monitor the activities.

Automation of registration of users from industry is more complex then a registration of academic institutions, because of the diversity that exists within the industry, and lack of ”central point” that exists in the form of universities with academic institutions. This implies that the registration for companies should be given as publicly available service. In order to ensure the accuracy and validity of data, it is necessary to provide appropriate mechanism. The proposed process of companies registration is shown in Fig. 3. A company finds the IGsw registration form *ad-hoc*, and sends the request for registration by filling the registration request form (Fig. 3). The validity of the data for the local companies is possible to check using the web site of the Agency for Business Registers of Republic of Serbia (APR). APR has a register of legal entities, which are grouped into categories. The potential problem is that APR does not provide a proper interface for connecting external third parity software, thus it is a challenging task to verify the company’s data automatically. The verification process can be done by the administrator, as it is shown in Fig. 3. It should be noted that the data verification of foreign companies is the issue that should be dealt with the registry of the country in which the company is registered.

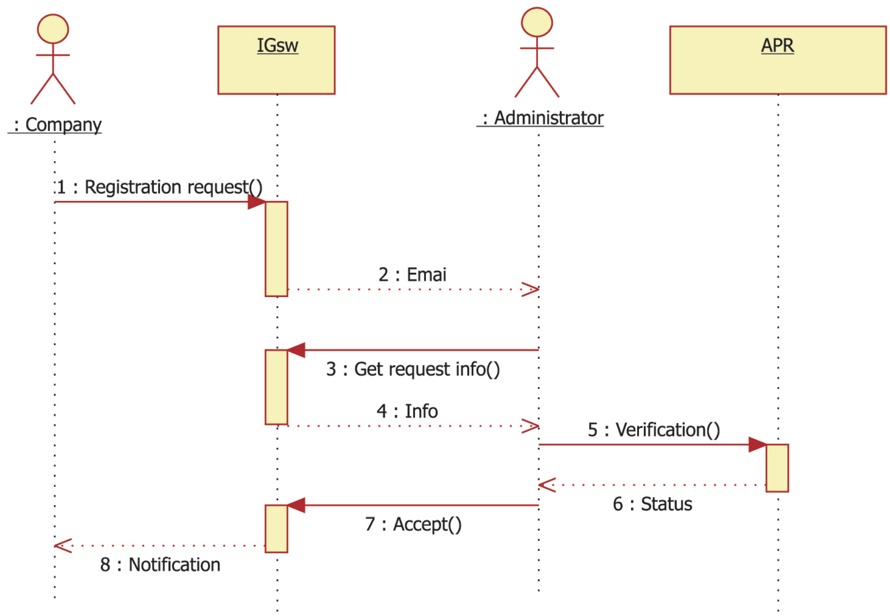

Fig. 3. USM sequence diagram of companies registration process

The proposed model for academic user registration (Fig. 2), and mode for registration of companies (Fig. 3) is suitable for the implementation within web-based software. The architecture of the software for supporting TTOs in information gathering, which encompasses proposed methods will be presented in the next section.

4. TTO Support Software Architecture and Implementation

4.1. The architecture of the software

Fig. 4 shows the architecture of the proposed IGsw. The central part of IGsw architecture is user interface display package. This package offers display of an interface related to user registration, technology info submission and database search (Fig. 4). The user registration package is implemented using the proposed model for user registration shown in Figs. 2 and 3. The IGsw architecture model offers an interface for technologies info through which academic institutions can post the relevant information about the developed technology, and through which

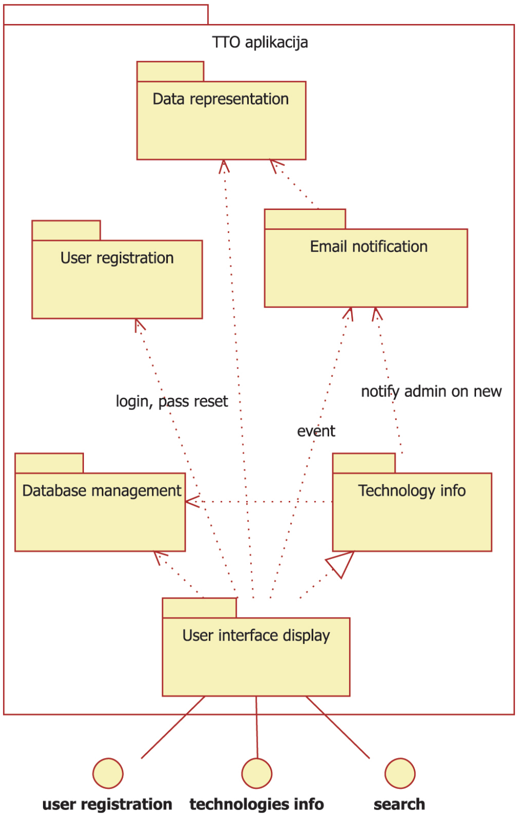

Fig. 4. Architecture of IGsw

companies can post requests for particular technology. The database search, shown as an interface in Fig. 4, is implemented in a form of database queries, with appropriate data presentation.

4.2. Software Implementation

The IGsw is implemented using open source software technologies. The software is implemented using PHP, HTML and JavaScript. User registration and database search are implemented using AJAX technology. For an underlying web server a well-known Apache server was used, and for the email notifications standard Linux sendmail component was employed. Used technologies ensures relatively low implementation cost.

There are about 50 web forms implemented within IGsw which offers both user interface and administrative panel. The User Guide document, as well as the Installation and Administration Manual are available for download at both Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš [10]. One of the IGsw forms is shown in Fig. 5. Fig. 5 shows the web form for sending invitations for the registration of an academic institution.

The form contains a minimum required information about the invited parity, such as an email and the type of the institution. The invitation letter text is also included in the form. After sending the invitation letter, the user that sent the invitation gets a new row in the table ”invited users”, which is available in the user’s profile. The table contains a list of all invited users, with status ”accepted” or ”pending” next to each one of them. While the status is ”pending” the user can abort the invitation. After the invitation is accepted, the abort action is not available, and the user can see all the details that the invited user entered into his profile.

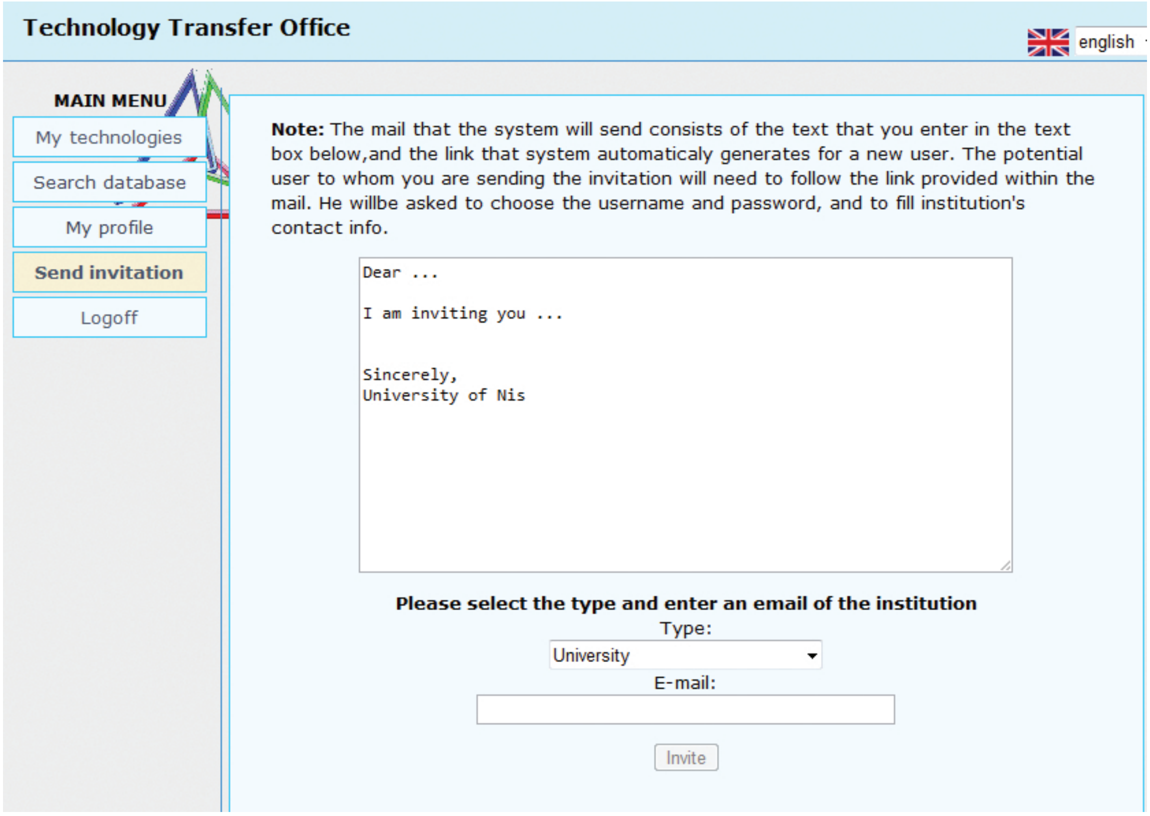

Fig. 5. Web form for user invitation

4.3. Customization options

The IGsw is designed to be highly customizable, with special concern devoted in allowing the software to be embedded into an existing Content Management Systems (CMS). This is implemented by employing CSS style sheets, which is well-known tool for offloading design related attributes out of HTML/PHP programm code.

The software is installed on the servers of both Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš [10]. At University of Belgrade the IGsw is embedded into Word-Press CMS system, while at the University of Niš the IGsw is embedded into Joomla CMS. This two CMSs are the most widely used CMS systems, and as such, the IGsw is specially equipped with JavaScript functions which solves the problems that might appear while displaying a long text and tables from third parity software within them. The example of IGsw login form, embedded into CMSs of Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš is shown in Fig. 6.

5. Concluding Remarks

The role of Technology Transfer Offices is to push the cooperation of universities and industry further by actively seeking for the opportunities to straighten the collaboration. In order to actively push the technology transfer further, Technology Transfer Offices need to constantly seek for novelties and potentials at both sides. Having a clear picture of developed technologies and industry potentials is crucial for Technology Transfer Offices to operate successfully. Before TTO can take further steps, it must take a snapshot of a potentials available in the region, on which an assessment of a commercialization value will be performed. In this paper we proposed the techniques for information gathering for Technology Transfer Offices, developed under the framework of project 158881-TEMPUS-1-2009-1-RS-TEMPUSJPHES "National Platform for Knowledge Triangle in Serbia". The

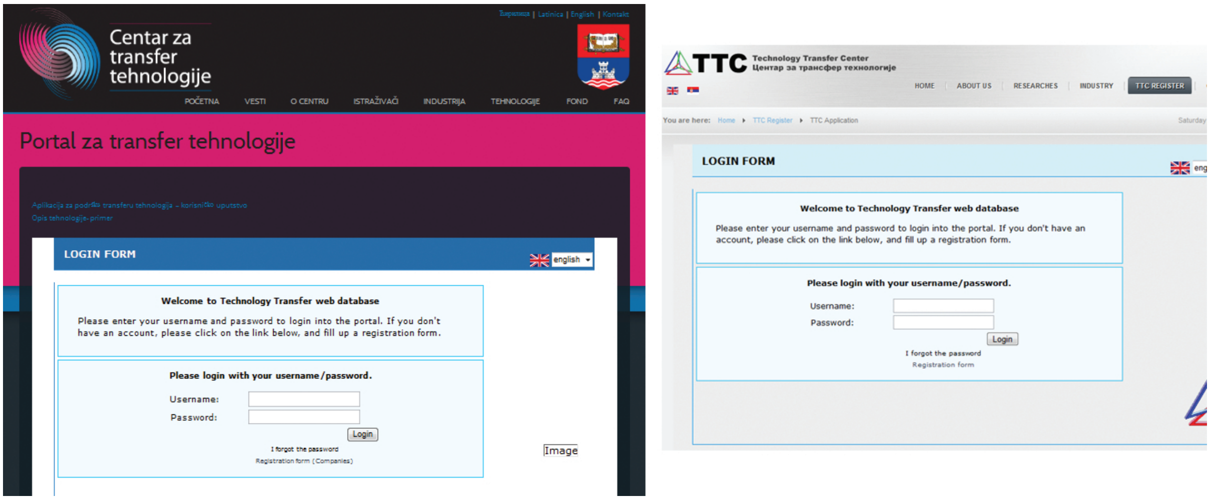

Fig. 6. The example of IGsw login form embedded in CMS: left side - WordPress at Center for Technology Transfer, University of Belgrade; right side - Joomla CMS at Technology Transfer Center, University of Niš

scenarios for registration of potential actors in technology transfer are developed and implemented in the form of web application. Implemented software was illustrated on the example of the Center for Technology Transfer, University of Belgrade, and Technology Transfer Center, University of Niš. As one of the project results, the software is installed at 4 TTO centers in Serbia: University of Belgrade, University of Niš, University of Novi Sad and University of Kragujevac.

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Track 5: Students in Technology Transfer and Research

2013 International Conference on Technology Transfer

The Possibilities of the Vocational Education in the Process of Technology Transfer

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Abstract

The development of vocational higher education in Serbia, demands the openness of institutions to market and innovation in all aspects of their activities. The problems that these institutions face from recognition problems on the labour market, ambiguities in the law on higher education, poor international cooperation and etc., require serious activities and measures for their effective overcome. Openness to new technologies and their readiness for rapid deployment in the contents of the study programs is one of the solutions of above mentioned problems. The experience of VTS Nis in this field, seen through the work of students in Samsung Apps laboratory presents a good model of openness institutions to market and new technologies. On the other hand, the results of two years work of laboratory, confirmed that defining the competencies of graduate's long-term process that requires a greater role subjects from the labour market than is the case now.

Key words: The higher education of vocational orientation, ICT sector, transfer technology, competences, students, study programs, smart technologies

1. Introduction

The system of higher education in the Republic of Serbia has been faced with serious challenges in the previous period. The actual law of higher education presents a good base and support for global processes of unification such as the Bologna process [1]. Implementation of standards, preparation of self-evaluation reports, CAQA external quality control, process of reaccreditation etc., gave a clear directions and reviews, where higher education in Serbia was in that moment, either that it was a vocational or academic level. The general opinion is that HE in Serbia made a good first step [2]. The most commonly used terms in the field of higher education in the previous period were notions of quality assurance, self-assessment, SWOT analysis, surveys, standards, etc. Their different interpretations, applications, proposed corrective methods and analytical apparatus which followed them, have led to increased awareness and improvements in different sectors in higher education with a clearly defined directions to provide sustainable objectives of development with reflection on the whole society.

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On the other side, the triangle education, research and innovation presents an excellent area for creation a pre-conditions for progress and development in the future in the all area of our life especially in HE sector. Innovation is the successful development and implementation of ideas and knowledge that contribute to significantly improved product or service offerings market (innovation products) or when a new and significantly improved production or delivery method commercial uses (process innovation). The innovations also demands the changes in knowledge, skills, routines, competences, equipment or engineering practice to develop or create a new product or introduce a new process [2].

In this paper we have presented our experience in improving the learning process through the results of the Samsung Apps laboratory in our institution. The results achieved by Apps team of students and teachers VTS Nis, clearly indicate the directions of development of the curriculum and the objectives and outcomes that are driven by innovative trends and market needs in the ICT sector [3].

2. The model of cooperation HE Institution with work filed

Starting from the clearly defined form of contemporary society, that treat the science and education as factors that governed its dynamic, continuous work and innovations, it is logical that HE governed economic trends. The application of results of scientific researches, transfer of knowledge and technology from research and development sector in the field of manufacturing and service sectors, present key factors of technological develop of modern society. Checking and periodic analysis of the results of these activities, their optimization and improvement is the final step in the observed chain of technological development of society.

Opting for the knowledge economy and the development of technological and scientific capacity of the country Samsung electronics LTD., in cooperation with VTS Nis, established a Samsung Apps laboratory at 2011. The aim of this laboratory is to contribute to creation of the knowledge society, through the improvement a student education. This improvement is reflected in the creation of opportunities for students to develop skills, to acquire a new knowledge and to be involved in practical projects. Also, the aim of this project is to promote the values of higher education, the importance of lifelong learning and the possibilities offered by applied studies and etc.

The enthusiasm of teachers, students and employees in higher education is a basic requirement for the development and faster recovery and global economic crisis. State of art of Serbian economy, especially in the industrial sector is the subject of numerous analyzes of the previous two decades. Strong industrial centres have simply disappeared from the map of technological development. Numerous attempts for some changes in this area have given only partial results. But, some positive and encouraging trends are noticed in the previous time.

Samsung Apps laboratory in Nis is part of a long-term project between Samsung and VTS Nis. Samsung electronics LTD has created ideal conditions for improvement of student's knowledge to be able to independently develop advanced applications for mobile phones, and to be ready for the demand of the work field. Samsung Apps laboratories, among other things, contains 10 workstations for students, 2 workstations for teachers, multi-functional area for the presentation of Samsung products, projector, TV and whiteboard for effective presentations and lectures. All this is supported by professional persons from Samsung Electronics LTD, which in Nis coming every 6 to 8 weeks. Their task is to solve current problems of programming and implementation of new software solutions Samsung through the work with teaching staff of VTS Nis involved in the project and team members

Laboratory is managed by the VTS Nis, and the role of Samsung that students always provide the latest models of phones, tablets, Smart TV`s, testing applications in its laboratory and give all other necessary support. The laboratory is regularly in contact with Samsung research team in Poland. The applications are develop in Bada and Android platforms. It is important to emphasis the study programs Modern computer technology in VTS Nis, covers partially some elements of these platforms, so necessary competencies have been acquired through additional work in laboratory. This work was carried out by the guidance of teaching staff VTS Nis and professional Samsung's team. Work in the development laboratory is based on the voluntary work of students and staff with the aim of acquiring new knowledge and skills from certain areas that were partially covered by contents of study programs. Clearly defined rules of operation, the current field, the recognition of the importance of the labour market as well as the inclusion of a higher education institution with all its resources into the business were sufficient guarantor of good results.

In the previous period in the laboratory have been developed more than 30 applications published on Samsung Apps portal for mobile phones, more than 20 developed applications for smart TVs. Among them is a first Serbian TV Apps for daily newspaper Blic. More than• 650,000 times users downloaded our apps• and more.

3. The issue of sustainability

The sustainability of team, its shape and form is disputed considering the different aspects. The first question is how to choose the team members? Do team members need to be students of the institution or only give a chance to the students? Do team members must be students or to give a chance to talented high school students to develop their skills and competencies? What type of education and training perform placement and how to transfer their knowledge? How to promote their results, and their competence to the work field? The organizational structure and the functioning of the team as well as physical capacities were solved with the help of responsible entities in VTS Nis.

However, the question of sustainability is crucial and require well defined plan and clearly defined development strategy with strictly emphasised hierarchical responsibility. The issue of sustainability in this case is completely correlated with the issue of student's interest to improve their knowledge in new technologies. Selection of team members begins after completion of the first year of study. All students as team members who participated in the project were given appropriate certificates with partners in this project verify the appropriate level of their competence. In other words, the sustainability of team, is correlated with results of the team, and with their position in the labour market. Simply defined set of competencies that a student has acquired have been determined by work filed need. Here again, we have to look at the nature of the competencies that the students have acquired the work in our laboratory. First of all it is a set of programming and design skills that are quite in demand on the global ICT market. The actual trends in ITC sector in Serbia (pay pal, subsidies from the state, IT popularity among young people, etc.) confirm the validity of our joint efforts.

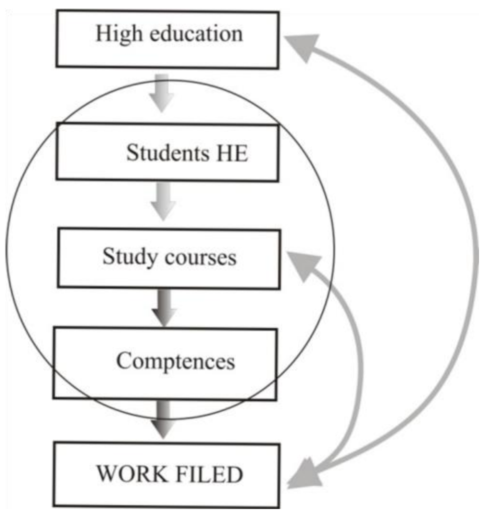

Figure 1. Position of HE system in the process of transfer technologies

As a possible solution for improving position of graduated, we defined three mechanisms that are in the domain HE institutions. The first mechanism is reduced to the certification of student competencies that are completely or partially outside of programs and student were gained through work in Samsung Apps laboratory. These certificates are usually treated as an additional quality in scrutinizing applications for the job. The second mechanism is based on the developed of scholarship possibility of the respective businesses and the third mechanism is an attempt switching capacity appropriate incubation centers [3]. The latter mechanism requires consideration of a large set of issues and might at first institution of higher education should not be in business, but given the realities of economic trends gives plenty of possibility for effective action, and thus to promote openness of institutions to the market [4].

The full success of presented model demands an involvement of other entities from Serbian education system in the future (Fig.1). After two years of experience in this field, the requirements for the appropriate level of competence which in content and scope fits into the framework of the secondary school system. Inclusion of this level of education from the standpoint of innovation is very important and can mean a critical step in terms of sustainability. Improvement of existing resources within the high education is possible through the introduction of new educational backgrounds where the aforementioned experienced could be implemented within a new items and new program contents within studies programs.

Conclusion

The enthusiasm of teachers, students and employees in higher education is a basic requirement for the development and faster recovery and global economic crisis. Opting for the knowledge economy and the development of technological and scientific capacity of the country Samsung electronics LTD., in cooperation with VTS Nis, established a Samsung Apps laboratory with aim to contribute to creation of the knowledge society. New technology demands a new competences and new skills, so it is need additional work of all subjects in the educational process. The work in the laboratory is based on the voluntary work of students and staff with the aim of acquiring new knowledge and skills from certain areas that were partially covered by contents of study programs. The issue of sustainability is systemic and at this moment is overcome by total commitment to work in the laboratory of the teaching staff and team members. The full success of presented model demands an involvement of other entities from Serbian education system in the future.

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2013 International Conference on Technology Transfer

Enhancing Entrepreneurial Self-efficacy Among Students as a Technology Transfer Instrument

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Abstract

Novi Sad proved to be the prosperous entrepreneurial university centre, with most spin-offs established by the faculty members. Considering students as the most important building block of future knowledge-based entrepreneurial society focus of this paper is on improved appreciation of environment in which young would-be entrepreneurs are created, or at least assisted. Valuing entrepreneurial self-efficacy as the core characteristic of successful entrepreneurs a questionnaire, distributed to 271 students at the University of Novi Sad, offered prolific testing base. Focusing on influencing factors on entrepreneurial self-efficacy special attention was given to the future occupation i.e. the faculty the respondents were coming from.

Keywords: technology transfer; entrepreneurial self-efficacy; spin-off; university entrepreneurship.

1. Introduction

An entrepreneurial society refers to places where knowledge-based entrepreneurship has emerged as a driving force for economic growth, employment creation and competitiveness in global markets. Serving as a channel for knowledge spillovers, entrepreneurship is the missing link between investments in new knowledge and economic growth [2]. The entrepreneurial university is seen as an important catalyst for regional economic and social development, particularly because it generates and exploits knowledge as entrepreneurial opportunities [22].

University has a leading role in the societies' development predominantly in the creation and dissemination of knowledge and technology. Key responsibility of University is to transfer knowledge that is created in its research teams to its students enabling them for all requirements that are lurking about in the murky waters of labour market once students graduate.

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Technology transfer mechanisms are frequently discussed in literature [23, 6, 21, 16 and 10]. However, the list of technology transfer mechanisms varies according to the specific purpose, focus and the perspective taken in these studies. For instance, according to the OECD [18] these mechanisms comprise joint labs between academia and business, spin-offs, licensing of intellectual property, research contracts, mobility of researchers, co-publications, conferences, expos and special media, informal contact within professional networks and the flow of graduates to the industry.

Appreciating the importance of all stated mechanisms of technology transfer greater significance in this research will be given to spin-offs. Spin-offs facilitate the technology transfer by the means of establishing a new company based on a technological innovation [20]. More specifically, spin-offs from higher education institutions are the formation of new companies by higher education institution members.

Novi Sad proved to be the prosperous entrepreneurial university centre, as it facilitates more than 70 university spin-off companies just in ICT sector in last 22 years, as is presented in figure C1 (Appendix C). The majority of spin-offs originated from the Faculty of Technical Sciences mainly established by the faculty members (professors and teaching assistants). Some spin-offs were established by students from exiting years of higher education institutions. It is those young entrepreneurs that are in focus of this paper. Considering students as the most important building block of future knowledge-based entrepreneurial society special consideration will be intended towards improved appreciation of environment in which young would-be entrepreneurs are created, or at least assisted.

The main focus of this paper is to better understand students' willingness to be engaged in entrepreneurial activities and to test for differences among them in several important aspects of University facilitation of entrepreneurial spirit. The research is conducted at the University of Novi Sad. The University of Novi Sad (UNS) comprises of 14 faculties with over 40.000 students. Being the second largest university centre in Serbia and largest in northern Province of Vojvodina University of Novi Sad is appreciative research base.

The research was conducted in three phases:

- A questionnaire was composed based on a body of literature and similar research attempts;
- A questionnaire was distributed to students in academic 2012/2013;
- Data was analyzed and conclusions drawn.

Based on data gathered several hypotheses are tested in the paper:

H1: *There is no difference between students concerning their willingness to perform their own business after graduation*.

H2: *The level of satisfaction with acquired business oriented knowledge and skills differ among students coming from different faculties*.

H3: *There is no difference between students concerning their willingness to master skills that could help them start their own business*.

2. Methodology

Inspired by the work of [15, 1 and 24] a questionnaire was conducted, tested and distributed to 271 students in 5 different faculties. Faculties chosen for the research were those that attract the majority of students, namely: Faculty of Economics, Faculty of Natural Sciences, Faculty of Medicine, Faculty of Agriculture and Faculty of Technical Sciences.

Focus of this paper is primarily identifying willingness of students to perform their own business after graduation. The question to test this variable was an open one with the opportunity for respondents to state their own perceived willingness on a scale from 0 to 100%. Of all 271 students that provided answers, for this specific question 14 have left a blank and another 14 provided answers lower than 10% being the lowest values and were characterized as outliers and were eliminated from all conducted analyses. Re-scaled scores were calculated initially by subtracting the lowest value (10%) and later dividing by the difference between the highest and the lowest value found within the correspondent group, allowing for the normalization of these values.

Afterwards, testing for the differences between five samples, representing five different professions or in our case faculties was conducted mainly using analysis of variance (ANOVA).

3. Students' entrepreneurial self-efficacy and future profession

The main focus of the paper is entrepreneurial self-efficacy among students. Entrepreneurial self-efficacy is among those universally used instruments for predicting performance [12]. Some research has proven a positive and significant influence entrepreneurial self-efficacy has on performance [3 and 9]. Individuals with high levels of entrepreneurial self-efficacy are more likely to demonstrate high persistence, concentration and satisfaction that lead to improved performance [7 and 14]. Self-efficacy is a psychological state generally defined as possessing self-confidence in performing a specific task [17]. Self-efficacy could be defined as self-confidence, believing one has necessary knowledge and skills in creating a business that will sustain and allow for pursuing a career of an entrepreneur. Measuring self-efficacy could be the problem. Stated above proves the importance of recognition and measure of self-efficacy especially among students that are the greatest potential base for future entrepreneurs.

The paper puts in focus differences among students concerning entrepreneurial self-efficacy depending on the future profession, or background. To test for selected differences a questionnaire was given to 271 students with different background. Students from 5 different faculties were questioned: Faculty of Economics (ECCF), Faculty of Natural Sciences (NS), Faculty of Medicine (MED), Faculty of Agriculture (AGRO) and Faculty of Technical Sciences (ENG). A special attention was given to the year they are attending in order to gather information from all students at the undergraduate level (1st – 4th year of higher education) in addition with first year of Master degree students, or 5th year of higher education.

Testing for self-efficacy implies testing for self-confidence in the business oriented aspect of life. The questionnaire provided students with the possibility to state the willingness of self-employment after gaining university diploma in the form of percentage points. Testing students of different academic year and different background for differences was conducted in order to arrive to conclusions whether higher education progress and background, as a future profession, have an impact on self-employment aspirations.

Thus, a hypothesis "*There is no difference between students concerning their willingness to perform their own business after graduation*" was tested.

Table 1. Willingness for self-employment depending on the future profession (ANOVA analysis)

Source of Variation	*Sum of Squares*	*Degrees of freedom*	*Mean Square*	*F- ratio observed*	*P-value*	*F critical*
Between Groups	2.3643	4	0.591067909	8.452972429	2.15E-06	2.40957301

Testing for the differences between five samples, representing five different professions was conducted using analysis of variance (ANOVA). F ratio observed (8.452972429) is significant ($p<0.05$) at the .05 alpha level, thus the null hypothesis that all five groups' means are equal is rejected. Analysis demonstrated significant differences between tested groups of students that are seen in table 1. Analysis proves the change in students' self confidence level depending on the background or future profession.

The lowest mean was detected for students coming from the so called natural sciences (34.94), while the highest tendency on average was expressed by the students of medicine and economics (65.72 and 57.62 respectively). Students of the agriculture and engineering were more modest and their answers on average were 50.80 and 49.02 respectively. However, mode values, or those occurring most often, for students coming from the faculties of: economics, medicine, agriculture and engineering were 50, while mode value for the answers of students from the Faculty of Natural Sciences is only 10. Descriptive statistics of the sample questioned are presented in table A1.1 (Appendix A).

It is evident that students of the Faculty of Medicine presented the highest willingness towards self-employment with the highest median and average values of their answers. This could easily be explained not by their innate entrepreneurial tendency, but by the current trend. After graduation they have two alternatives: a) to work in the national system of health care and receive salaries from the budget or b) open their own private practice and earn as much as they want or can. It is not necessary to have managerial and entrepreneurial skills, as diploma and highly specific knowledge will do the magic. Initial financial input is necessary, but it is relatively low compared to gain private practice will bring. This is why there is higher willingness towards self-employment among students of Medicine, with the distinctly highest median and average score.

Other intermittent result comes from students of Natural Sciences, with the lowest mean, mode and median score. The problem is that during their studies they are not even introduced, let alone "infected" by the idea of entrepreneurship and thus the mode (most frequent answer) is so low as only 10. Students from other faculties, excluding positive extreme from Medicine, are mostly unsure about their entrepreneurial future choosing mostly 50% willingness to start something on their own. Stated being the mode and median value of scores.

4. Students' satisfaction with acquired business oriented knowledge and skills

After determining the willingness to have something on their own and proving the existence of entrepreneurial will, at least, the level of satisfaction with offered classes, information and attitudes was tested with hypothesis "*The level of satisfaction with acquired business oriented knowledge and skills differ among students coming from different faculties*".

Hypothesis was made that not all faculties are providing what is needed for young would-be entrepreneurs. Different research has shown [11] the necessity of continuous following and adaptation of educational framework, especially regarding enhancing the probability of youth employment. Research conducted in Serbia [4 and 5] proved that probability of self-employment in the exiting years of academic education is lower than in those at the very start. The fact that students' self-confidence decreases during studies should not be neglected and stronger and more suitable training in acquiring knowledge and skills that are more adapted to market oriented situation, and less theoretical background is needed i.e. more practical examples should be introduced in order to make students feel more adapt for market survival [4]. Contrary to the hypothesis that university is responsible to "create" entrepreneurs presented in [4], there are those who propose that entrepreneurial behaviour is a planned behaviour and thus the students' decision to create a business in the future leads them to enrol in an entrepreneurship education program [13].

Putting the responsibility aside, i.e. the origin of entrepreneurial willingness, a test was conducted to better understand the satisfaction level with acquired business oriented knowledge and skills. Questions provided to test for these variables were closed ones and students could chose from offered pre-formulated alternatives both for their theoretical knowledge and practical skills necessary to start their own business:

- Excellent (1);
- Good without necessary improvements (2);
- Good with necessary improvements (3);
- Insufficient (4).

Testing for the differences between five samples, representing five different faculties was conducted using analysis of variance (ANOVA). *F* ratio observed for both knowledge and skills (4.192 and 3.656 respectively) is significant ($p<0.05$) at the .05 alpha level, thus the null hypothesis that all five groups' means are equal is rejected, and hypothesis formulated as "*The level of satisfaction with acquired business oriented knowledge and skills differ among students coming from different faculties*" is proven. Analysis verified significant differences between tested groups of students that are revealed in table 2.

Table 2. Satisfaction with acquired business oriented knowledge and skills depending on the future profession (ANOVA analysis)

Test	*Sum of Squares*	*Degrees of freedom*	*Mean Square*	*F- ratio observed*	*P-value*	*F critical*
Knowledge	8.898496809	4	2.224624202	4.192255437	0.002674857	2.40957301
Skills	11.07165784	4	2.76791446	3.656031813	0.006538087	2.409733235

Further, there was a need to test for correlation between revealed willingness and the level of satisfaction with acquired knowledge and skills needed for future business venture that could help better understand the gap that is evident amid offered knowledge and market requirements that are the only relevant factor after graduation.

Correlation coefficients are presented in table B1 (Appendix B) portraying weak negative relation between manifested willingness for entrepreneurial activity and the level of satisfaction with acquired knowledge and skills during academic advancement. Expressed differently, the higher the willingness for entrepreneurial activity the lower the satisfaction level with obtained knowledge and skills. On the other hand, correlation coefficient between satisfaction levels with acquired business oriented knowledge and skills portrays moderate positive relation i.e. the higher the satisfaction with obtained business oriented knowledge the higher the satisfaction with obtained skills and vice versa, that was expected. The most supportive result, from all faculties, is that mode and median responses, both for knowledge and skills, is 3 i.e. the answer "Good with necessary improvements" proving their willingness to acquire more business oriented knowledge and skills

Examining satisfaction with offered classes, information and attitude in general, present at the University of Novi Sad [5] offers beneficial suggestions to curricula changes in order to better respond to market requirements. Students should be offered a class focusing on soft skills development or enhancement in the entering years (first two years of university) as this is the period when they have the highest motivation and feel more confident, thus higher self-efficacy is expressed. Subsequently, students of exiting years (third and fourth year of university) should be given the courses focusing on confidence building, as the time when decision-making has to take place is swiftly approaching and their courage plunges to the lowest. This period should not be followed with general knowledge classes, but with practical and highly informative workshops, making students more prepared for the market and future employment [5].

5. Students' mastering business oriented skills

Final test was conducted to prove for students' willingness to learn more and acquire more business oriented knowledge and skills. Direct and close question was given to students, asking them to state their agreement with the statement "I am interested in mastering skills that could help me in starting my own business" on a 7 point Likert scale, one being the absolute negation of statement and 7 being absolute agreement with statement. Thus a hypothesis "*There is no difference between students concerning their willingness to master skills that could help them start their own business*" was tested.

Table 3. Willingness to master business oriented skills (ANOVA analysis)

Source of Variation	*Sum of Squares*	*Degrees of freedom*	*Mean Square*	*F- ratio observed*	*P-value*	*F critical*
Between Groups	37.00036363	4	9.250090906	4.373825307	0.001980295	2.410057813

Testing for the differences between five samples, representing five different faculties was conducted using analysis of variance (ANOVA). F ratio observed (4.374) is significant ($p<0.05$) at the .05 alpha level, thus the null hypothesis that all five groups' means are equal is rejected i.e. there are significant differences among students in their willingness to master business oriented skills. Results are presented in table 3.

It is observable that the students of Natural Sciences, previously proven to lack entrepreneurial willingness, provided the lowest responses. However, encouraging is the result that most answers gathered around 7, being the absolute agreement with the statement, portrayed with the mode results of all students (table A1.2 in Appendix A).

Proven high willingness to acquire more business-oriented skills by our students is a conclusion that should be a sufficient argument for changing our curricula and introducing more flexibility in working with students of all backgrounds and offering them first and foremost the encouragement for entrepreneurial activities and then all the necessary knowledge and soft skill that will be needed once they graduate.

6. Concluding remarks

Valuing entrepreneurial self-efficacy as the core characteristic of successful entrepreneurs a questionnaire, distributed to 271 students at the University of Novi Sad, offered prolific testing base. Focusing on influencing factors on entrepreneurial self-efficacy special attention was given to the future occupation i.e. the faculty the respondents were coming from.

Current curricula at the faculties of the University of Novi Sad does not offer entrepreneurial or business oriented classes at the faculties of medicine, natural sciences or engineering, except for some majors at the engineering faculty that are overlapping with business oriented classes, as is the case with agribusiness as well.

All tested hypotheses proved significant differences among students with different background concerning tested variables.

Firstly, there are significant differences among students of different faculties concerning willingness to perform their own business after graduation. The highest willingness was present among students of Faculty of Medicine, as it is the current trend in transition country to have increased interest in private practice. Result could have another implication as well. Students that showed the highest tendency toward entrepreneurship were from faculty that does not offer courses in entrepreneurship, or any business oriented courses at all. The potential is absolutely neglected and more strategically oriented approach is needed enabling students with necessary information for establishing their private practices and possibly enhancing their soft skills essential for enduring self-employment. As private practice requires more than one employee management oriented course should be offered as well. On the other hand, students of natural sciences that have revealed the lowest tendency toward entrepreneurship should be offered business oriented courses to better understand possibilities of applied science as this is clearly lacking in our schooling system.

Second, the satisfaction levels with offered and acquired business-oriented knowledge combined with the high students' willingness to master business oriented skills should be a stimulus for curricula adaptation, or at least alteration of teachers' attitudes towards entrepreneurial skills that should be mastered during academic advancement.

Scrutinizing the willingness of entrepreneurial activity among students as the result of the research provided the evidence that national policy and market incentives fostering entrepreneurship among youth are not enough, or are emerging late, as the most suitable policy would be providing students of all backgrounds with basic knowledge that is demanded the moment they enter the free market. Spin-offs are an important means of technology transfer from academic institutions to young people and encouraging them to engage in business venture should be one of the utmost goals of the university.

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Appendix A. Descriptive statistics

Table A1.1 Willingness for self-employment depending on the future profession

Faculty	*Mean*	*Mode*	*Median*	*Observations*
ECCF	57.62	50	55.5	88
NS	34.94	10	30	36
MED	65.72	50	61	29
AGRO	50.80	50	50	44
ENG	49.02	50	50	46

Table A1.2 Willingness to master business oriented skills

Faculty	*Mean*	*Mode*	*Median*	*Observations*
ECCF	5.693	7	6	88
NS	4.571	7	4	35
MED	5.481	7	6	27
AGRO	5.75	7	6	44
ENG	5.63	7	6	46

Appendix B. Correlation indices

Table B1. Correlation indices between entrepreneurial willingness and acquired business oriented knowledge and skills

	Knowledge	Skills	Willingness
Knowledge	1		
Skills	0.494063118	1	
Willingness	-0.306916015	-0.225904224	1

Appendix C. Figures

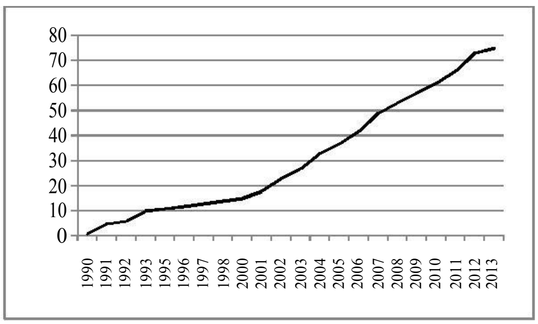

Figure C.1 Cumulative number of University of Novi Sad spin-off companies in ICT sector in period 1991 - 2013

2013 International Conference on Technology Transfer

Co-creation in Product Development - Students in an Innovation Contest

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Abstract

Considering that companies, especially SMEs, have limited resources to support their product development processes, their management has started to look for fresh ideas and competent individuals outside their borders. Co-creation is seen as a powerful engine for innovation. This paper focuses on the establishment of university-industry cooperation, by engaging Serbian students and researchers in product development processes of a company from Germany. This company has introduced four problems, two of them solved by chosen expert teams and another two by interested students. The paper shows potential and high level of performance identified in this case, by engaging a large number of students and experts outside the company through an innovation contest in comparison with the internal product development.

Selection and/or peer-review under responsibility of the organizers of the 2013 International Conference on Technology Transfer

Keywords: Co-creation, innovation contest, product development, students' engagement

1. Introduction

Shorter product lifecycles and rapid technological progress as the main characteristics of contemporary dynamic environment force companies to innovate and launch successful products to sustain their competitiveness. However, high R&D costs and limited resources challenge companies to change the way they develop their products. Companies are increasingly aware that they need to tap into both internal and external knowledge sources to accelerate innovation [1]. They turn to co-creation across innovation processes and allow the flow of knowledge over organizational boundaries, exploiting internal knowledge in more diversified markets, as well as identifying and absorbing external knowledge to support the internal innovation process [2].

Kirah defines co-creation as the continual feedback loop and collaboration with all stakeholders in a value network throughout any given process of designing, developing and implementing meaningful products, services, organizational and strategic changes [3]. In this view, innovation can be defined as a co-creation process within social and technological networks in which actors integrate their resources to create mutual value [4]. According to Brown and Hagel, co-creation is a powerful engine for innovation: instead of limiting it to what companies can devise within their own borders, pull systems throw the process open to many diverse participants, whose input can take product and service offerings in unexpected directions that serve a much broader range of needs [5].

Innovation is built on a foundation of creativity and sometimes on invention, resulting in the creation of new knowledge and learning within the organization [6]. Considering that companies have limited competences,

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they have started to distribute problem solving to larger groups of people, in order to mine collective intelligence, assess quality and process work in parallel [7]. Companies can gain competitive advantage by expanding their borders through widespread involvement and interdependence between actors at all levels, daily based information exchange, integration of business processes and joint work and activities.

The cooperation between the German company Carrier & Co.[*] and Serbian HEIs, Faculty of Technical Sciences from Novi Sad and Subotica Tech – College of Applied Sciences from Subotica, is presented in this paper. It focuses on the co-creation in product development, by engaging a large number of students and experts through an innovation contest. The results show high quantity as well as quality of contributed solutions, creating the pool of diverse product improvements that will potentially bring competitive advantage to Carrier & Co.

2. The concept of innovation contests

Innovation is the process of making changes, large and small, radical and incremental, to products, processes, and services, that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization [6]. To overcome limitations, such as increasing R&D costs, insufficient resources and unsatisfactory level of competences, companies may choose to outsource their innovation work by inviting external contributors to develop ideas or solutions to specific, pre-defined problems [8].

This open approach to product development offers a great opportunity for companies to access valuable knowledge from multiple sources (including small companies, universities and consumers) for the creation of innovations. This is the outside-in process whereby new ideas and technologies are acquired from partners and brought into the innovation pipeline [9].

Innovation contests are a mechanism to connect creative minds and expertise via crowdsourcing. They are a way to engage with external sources of knowledge (third parties, the "crowd"), such as individual entrepreneurs, students, experts and small firms, who are asked to submit interesting solutions for a particular contest challenge, that satisfy certain criteria within a defined timeframe [9]. Members of the crowd do not see nor have rights to use the proposed solutions: the outputs are closed and owned by the sponsor [10], who offers the prize to contributors of the best solutions in return for the right to use and exploit them. The rationale behind innovation contests follows the logic that the collective intelligence of a crowd produces better results than that of a small group of people [11].

Contests are a historically important and increasingly popular mechanism for encouraging innovation [12]. They are growing in popularity worldwide. An increasing number of organizations have adopted innovation contests as a means to realize innovative product or service solution [13]. On the other hand, researchers in this field are trying to fill the gap between large number of practical implementations and limited academic knowledge about this type of contests. Haller et al. point out that innovation contests with the strategic scope of corporate challenge have the potential to promote a set of goals on corporate level. They are organized by companies in order to: (1) collect user feedback and identify trends, (2) broaden the pool for idea generation, (3) collect the creative input (ideas, designs, concepts or solutions) to develop new products and services, (4) establish the corporate image, (5) support organizational change, (6) support social responsibility, and (7) interact with participants who show desirable characteristics for recruitment [14].

Bullinger et al. define an innovation contest as a/an (IT-based) competition of innovators who use their skills, experience, and creativity to provide a solution for a particular contest challenge defined by an organizer. They also defined ten design elements of innovation contests (Table 1.): (1) media, (2) organizer, (3) task/topic specificity, (4) degree of elaboration, (5) target group, (6) participants, (7) contest period, (8) reward/motivation, (9) community functionality, and (10) evaluation.

According to Boudreau and Lakhani, innovation contests are the right choice when it is not obvious what combination of skills or even which technical approach will lead to the best solution for a problem. They are most effective when the problem is complex or novel and when it comes to design problems, where creativity is crucial [16].

[*] Fictional name of the company, used for the confidentiality reasons.

Table 1. The elements of innovation contests (adapted from Bullinger et al. [15])

<table>
<tr><th>No.</th><th>Design element</th><th colspan="9">Attributes</th></tr>
<tr><td>1</td><td>Media</td><td colspan="3">Online</td><td colspan="2">Mixed</td><td colspan="4">Offline</td></tr>
<tr><td>2</td><td>Organizer</td><td colspan="2">Company</td><td colspan="2">Public organization</td><td colspan="3">Non-profit</td><td colspan="2">Individual</td></tr>
<tr><td>3</td><td>Task/topic specificity</td><td colspan="3">Low (open task)</td><td colspan="2">Defined</td><td colspan="4">High (specific task)</td></tr>
<tr><td>4</td><td>Degree of elaboration</td><td>Idea</td><td colspan="2">Sketch</td><td>Concept</td><td>Prototype</td><td colspan="3">Solution</td><td>Evolving</td></tr>
<tr><td>5</td><td>Target group</td><td colspan="4">Specified</td><td colspan="5">Unspecified</td></tr>
<tr><td>6</td><td>Participants</td><td colspan="3">Individual</td><td colspan="2">Team</td><td colspan="4">Both</td></tr>
<tr><td>7</td><td>Contest period</td><td colspan="2">Very short term</td><td colspan="2">Short term</td><td colspan="3">Long term</td><td colspan="2">Very long term</td></tr>
<tr><td>8</td><td>Reward/motivation</td><td colspan="3">Monetary</td><td colspan="2">Non-monetary</td><td colspan="4">Mixed</td></tr>
<tr><td>9</td><td>Community functionality</td><td colspan="4">Given</td><td colspan="5">Not given</td></tr>
<tr><td>10</td><td>Evaluation</td><td colspan="2">Jury evaluation</td><td colspan="2">Peer review</td><td colspan="2">Self assessment</td><td colspan="3">Mixed</td></tr>
</table>

3. The case of university-industry cooperation: The innovation contest

The Faculty of Technical Sciences and Subotica Tech – College of Applied Sciences have established the cooperation with Carrier & Co., an SME from Germany, that develops, manufactures and distributes high-quality, specialist retail products. With its continuous development and innovation focus, this company has become the market leader in Europe in the area of child carriers.

The cooperation is focused on problem solving in product development. The products of focus are child carriers of one of their brands (Fig. 1.). These carriers can be used as joggers, buggies or bicycle trailers, while children sit in their seats with the full protection of five-point frame anchored seatbelts, robust aluminum bumpers and an enlarged passenger compartment. The carriers are safety tested according to ASTM standards and have bicycle arm with axle hitch (and a second hitch), safety flag, buggy wheel and a large front wheel with wheel arms, insect and weather cover, separate seat area, reflective height and width markings, as well as innovative quick folding system.

Fig. 1. The product of focus - the child carrier (3 variants of use)

To collect fresh ideas and functional solutions of identified problems in their product development processes, Carrier & Co. has organized the innovation contest in cooperation with the Faculty of Technical Sciences and Subotica Tech – College of Applied Sciences. The Faculty of Technical Sciences from Novi Sad, with the support of the Department for Industrial Engineering and Management and the Center for Product Development and Management, has engaged the large number of students of Mechanical Engineering in this contest. These students have developed their competences during courses focused on product development, such as Product design, Product development and management in PLM, Assembly technologies and Design for excellence (DFX). In addition, the expert teams from Mechanical engineering and Mechatronics programs have been chosen to join this contest and contribute to problem solving. Another partner institution, the Subotica Tech – College of Applied Sciences, has engaged its students of Mechanical Engineering and Mechatronics. They have been supervised during the courses of Integrated product development and Development of mechatronical devices. Carrier & Co. has relied on skills and competences of young students and researchers from these two HEIs and outsourced its product development projects.

This innovation contest started in January 2013 and it is planned to be finished in July 2013. So far, the best concept solutions have been selected and accepted for further consideration. The innovation contest stages are shown in the following figure (Fig. 2.).

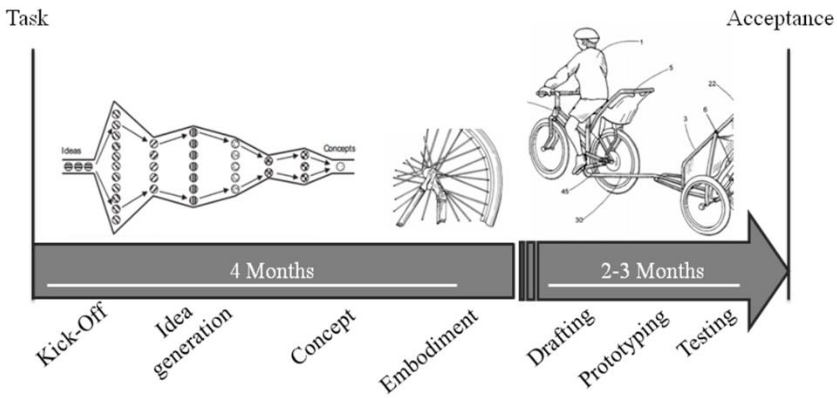

Fig. 2. The innovation contest stages

Carrier & Co. has introduced four projects that represent challenges for the improvement of: (1) compact hitch, (2) theft protection, (3) light, and (4) weight reduction. The first two projects were presented to students and another two to chosen expert teams. The company has offered monetary prize for the best concept solutions in each of four product improvement projects. Solutions had to fulfill certain criteria: they needed to satisfy defined functional requirements, to be technicaly feasible and to be suitable for further development and implementation.

The following table (Table 2.) shows the information about the number of students targeted in the projects, the number of students who took part in the projects, the number of suggested solutions and the number of solutions accepted for further consideration. It can be seen that greater number of solutions have been proposed by the crowd of students, than by the chosen expert teams. In addition, the number of accepted students' solutions also overcomes the number of accepted solutions proposed by the expert teams, even though they have 100% of acceptance.

Table 2. Participants and suggested solutions in the innovation contest

Project	Compact hitch	Theft protection	Light improvement	Weight reduction
Total number of students targeted in the project	80	80	The team of mechatronics experts from the Faculty of Technical Sciences	The team of mechanical engineering experts from the Faculty of Technical Sciences
Number of students taking part in the project	50	27		
Total number of suggested solutions	42	14	2	2
Number of solutions accepted for further consideration	**14 complete 4 partial**	**8 complete**	**2 complete**	**2 complete**
Percentage of accepted solutions (approx.)	43%	57%	100%	100%

This innovation contest can be described through the list of elements (Table 3.) defined by Bullinger et al. (2010). Concerning media choice, this innovation contest is run offline, through personal contacts among participants and organizers. It is organized by Carrier & Co. in cooperation with Serbian HEIs. The tasks are highly specific and call for elaborated concept solutions. Participants are students as individuals and expert teams, both with specific engineering competences. Contest period is very long, with the time frame of six months (during summer semester of the school year 2012/2013). Motivation to contribute one's competences to an innovation contest is fostered by a reward system that is as much as possible adapted to the needs of the target group [17]. Rewards are realized by monetary prize and social motivation, like positive feedback, reputation among relevant peers and self-realization. Community functionality is given through the elements which foster interaction, like information exchange and topic related discussion by the email or face-to-face during lessons or consultations. Evaluation of submitted solutions is realized by the jury, consisted of the company's CEO and mechanical engineers from the Faculty of Technical Sciences and Subotica Tech – College of Applied Sciences.

Table 3. The elements of the Carrier & Co. innovation contest (adapted from Bullinger et al. [15])

No.	Design element	Attributes					
1	Media	Online	Mixed	**Offline**			
2	Organizer	**Company**	**Public organization**	Non-profit	Individual		
3	Task/topic specificity	Low (open task)	Defined	**High (specific task)**			
4	Degree of elaboration	Idea	Sketch	**Concept**	Prototype	Solution	Evolving
5	Target group	**Specified**	Unspecified				
6	Participants	Individual	Team	**Both**			
7	Contest period	Very short term	Short term	Long term	**Very long term**		
8	Reward/motivation	Monetary	Non-monetary	**Mixed**			
9	Community functionality	**Given**	Not given				
10	Evaluation	**Jury evaluation**	Peer review	Self assessment	Mixed		

4. Conclusions

In comparison with internal product development, co-creation through innovation contests brings companies the opportunity to increase the number of sources of new solutions, by embracing the competences and intelligence that are not present inside their borders. Lakhani and Jeppesen claim that it is more effective to encourage a diverse group of people outside the company, or the discipline, to seek innovative solutions [18]. Companies need to define the challenge, attract the solvers and pay for their performance. This monetary prize is important in motivating individuals to participate and, as well, it has to be given in return for solutions in order to retain the IP rights to them [18].

The presented problem has to attract attention of the potential solvers. In managing the innovation contest, one of the most important things is to define the problem that is going to be presented to solvers. It has to be understandable, with all necessary details. This is a challenge, while companies always concern not to reveal too much and keep important details about their products and processes in secrecy from their competitors [16]. Co-creation can bring problems in terms of increased dependency on outside collaborators, costs of coordinating the co-creation process, the need for new management skills, different personnel management styles, and information confidentiality [19]. However, collaboration with third parties in product development brings a lot of benefits to companies. It increases speed to market, lowers costs, improves product quality and reduces risks in product development, by recognizing possible technology applications.

This case study indicates that a company should not necessarily engage its own resources to find the right workers, to incentivize and monitor their effort. Companies can benefit from involving a large number of innovators in their product development processes. By organizing an innovation contest, Carrier & Co. collected numerous solutions, it will choose the best one and award the winner for the effort and performance. Students are identified as a powerful source of innovative solutions and it is shown that there is a great potential for the cooperation between universities and industry in this sector.

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2013 International Conference on Technology Transfer

The Importance of the IEEESTEC Students' Projects Conference

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Abstract

It is well known that our learning and knowledge are developed in participation with other. A conference is the best place where you can exchange experience and knowledge with scientists in your field. In this paper, a brief overview of the IEEESTEC Students' Projects Conference is given.

Selection and/or peer-review under responsibility of the organizers of the 2013 International Conference on Technology Transfer

Keywords: IEEE; EESTEC; Student Conference;

1. Introduction

IEEESTEC Students' Projects Conference is organized by the Electrical Engineering Students' European Association (EESTEC) LC Nis, the IEEE Student Branch Nis, and the Faculty of Electronic Engineering, University of Nis and supported by the IEEE Electron Devices (EDS)/Solid-State Circuits (SSC) Chapter, the IEEE Microwave Theory and Techniques (MTT) Chapter, and the IEEE Serbia and Montenegro Section [1-4]. The conference was created as a result of the cooperation between IEEE SB Nis and EESTEC LC Nis, which is clearly visible in the name of the conference (IEEE + EESTEC = IEEESTEC).

IEEE is the world's largest professional association dedicated to advancing technological innovation and excellence for the benefit of humanity. IEEE has more than 116000 student members organized in 2354 student branches in more than 160 countries [5]. This is a great scientific potential which can be seen in more than 1300 IEEE sponsored conferences in 80 countries all around the world. It is important to note that one of the main goals of IEEE is corporation with similar associations. As a result IEEE-EESTEC Memorandum of Cooperation on the level of Serbia and Montenegro Section was prepared [6].

EESTEC is an international student organization which gathers all students from electrical engineering and computer science faculties and all the faculties that award the electronics engineer certificate, and has very similar goals as IEEE. The main goal of EESTEC is to encourage the development of international contacts between students and professionals [7]. Exchange of ideas and experiences between students of electronics and computer sciences is possible through workshops, exchanges, conferences, seminars, meetings and other activities. Currently, there are 50 EESTEC local committees in more than 20 European countries with more

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than 2700 members. Real cooperation between IEEE SB Nis and EESTEC LC Nis is demonstrated on the example of the organization of the IEEESTEC Conference, where both sides are completely satisfied with partnering.

2. About the IEEESTEC Conference

2.1. Goals of the IEEESTEC Conference

It is well known that the two main reasons to write a paper and to attend a conference are to hear presentations and to converse with other researches [8]. However, the goals of student conferences are much more complex:

- The basic idea was –'undergraduate students (or graduate students that have not yet started their Ph.D.) have the opportunity to learn how to write a paper'. Most of the participants wrote their first scientific paper, so it was a great opportunity to promote IEEE manuscript template for conference proceedings [5].
- The second aim of the conference is to present projects done by undergraduate students of technical universities to the public. It is well known that very important projects often remain unnoticed or never advance beyond the initial research phase. Presentation of realized projects on the day of the conference and publication in the proceedings of papers can significantly contribute to their promotion.
- The third aim is to allow direct conversation between the conference participants. Conference participants had opportunities for social gatherings with students and academic staff. Namely, students can understand what confuses people and they can receive their ideas and suggestions. Also, students could inform of what students from other faculties are doing, not only for the specific problem, but also for a much wider one. Finally, students can start to build relationships with other researchers in the field.
- IEEESTEC Conference promotes team work. Student teams propose, develop and present projects from one of the different engineering research fields (electronics, microelectronics, computer science, telecommunications, control systems …).
- Ideal opportunity for the promotion of technical science. Namely, high school students attend the conference and have a chance to see all of the projects. It can enhance their interest in the technical sciences, and can inspire research ideas of their own.
- IEEESTEC Conference is a great opportunity to provide a clear picture of students' projects for representatives of small companies in the region. So, representatives of companies can collaborate with the authors of the projects that are interesting to their companies. This is the fastest way of transferring knowledge from universities to small companies. Many students and many companies have taken advantage of this opportunity.

2.2. Motivation of students to participate in the IEEESTEC Conference

It should be noted that it is very difficult to say –'you should write a paper for IEEESTEC Conference'. Independent decision by the student to write a paper is very important. This indicates that students should be highly motivated to write a paper. Depending on the preferences of individual student our goal was to find wide range of different motivations:

- Previously mentioned aims are an important reason for a student to write a paper.
- On the basis of reviews, three best papers are selected. Organizers provide significant awards for the authors of the best papers. Also, the authors of the winning papers present them in a form of oral presentation. All other papers are presented as a poster.
- It can be very helpful in building up the CV and a great reference for future jobs. This is especially important if a student gets an award because awards do wonders for CVs.

- One of the winners of IEEESTEC Conference may compete for the IEEE Region 8 Student Paper Contest, held within the Region 8 limits. But, it is very important to note that only IEEE student members could be authors of the IEEE R8 SPC papers [9].

2.3. Progress of the IEEESTEC Conference

Significant engagement of conference organizers improves the conference in all segments. As a result, the conference is organized within the celebration of anniversary of the establishment of the Faculty of Electronic Engineering. So, many guests visit the IEEESTEC Conference, that is of great importance. In addition, the IEEESTEC Conference is a part of the annual activities of IEEE Serbia and Montenegro Section. Using support of the Faculty of Electronic Engineering and IEEE Serbia and Montenegro Section, the experience of all members of the organizing committee as well as various guidelines for conference organizers we keep the progressing trend of the conference [5,10,11]. This is clearly seen from the results shown in Table 1.

Table 1. Conference presented by numbers

Number of	papers	authors	reviewers	page of proc.	institutions	organizers
1st IEEESTEC, 2008	23	43	26	100	6	8
2nd IEEESTEC, 2009	29	58	34	132	9	7
3rd IEEESTEC, 2010	24	51	32	110	7	7
4th IEEESTEC, 2011	34	58	37	148	9	12
5th IEEESTEC, 2012	37	70	38	160	13	16

The best way of obtaining a clear insight into the progress of the IEEESTEC Conference is graphical illustration. As can be seen in Fig. 1 the progressing trend is clearly visible. All analyzed parameters showed a significant increase, from 61% (for number of papers) to 117% (for the number of institutions with the authors at the conference) from 2008 to 2012. The main goal of the organizers of the conference is to maintain this trend.

2.4. Other important information related to the IEEESTEC Conference

The basic idea is that the conference has to be more interesting. So, the organizers had created two more awards. On the day of IEEESTEC Conference a best project award, determined by votes of all authors, was also given. Also, an award was assigned for the work that has attracted the greatest attention of the audience, chosen via online voting. More than 24 000 visitors of the official website of IEEESTEC Conference voted [2].

It is very important to note that professors and teaching assistants from the Faculty of Electronic Engineering have very important role for the IEEESTEC Conference. It is recommended that each author has a mentor. Most of authors write their first paper ever, and in most cases mentors have to solve problem, rather than give direction. But we prefer that a mentor can help a student develop collaborative, problem-solving skills by organizing group projects. Finally, professors and teaching assistants have an important role during the reviewing process, as for each paper organizers have to provide minimum five reviews.

All the previous conference was clearly intended. First – cooperation between IEEE SB Nis and EESTEC LC Nis. Second – 125 years of IEEE. Third – 50 years of Faculty of Electronic Engineering. Fourth – 40 years of IEEE Serbia and Montenegro Section. Fifth - own anniversary of IEEESTEC conference, five years of the IEEESTEC Conference. The organizers' goal was to give a small contribution to the celebration of these important anniversaries. Articles about these events can be found in IEEE Solid-State Circuits Magazine, IEEE Electron Devices Newsletters and IEEE region8news [9,12,13].

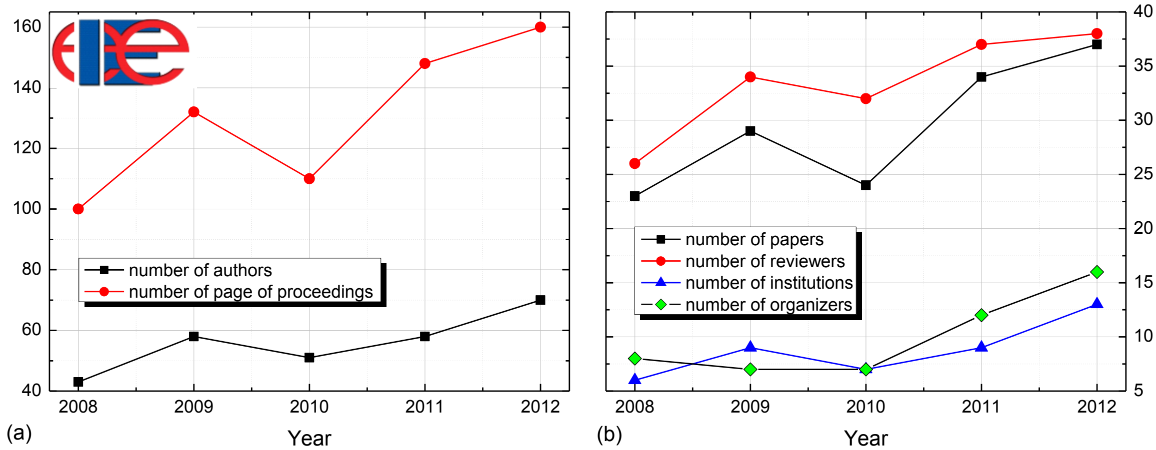

Fig. 1. Graphical illustration of the number of (a) authors and page of proceedings; (b) papers, reviewers, institutions and organizers at the IEEESTEC Conference in previous years.

3. Conclusions

Knowledge transfer is a key driver for knowledge – based society. IEEESTEC Conference is a great opportunity for promising students to show their work to representatives of small companies in the region. So, representatives of companies can collaborate with the authors of the projects that are interesting to their companies. This is the fastest way of transferring knowledge from universities to small companies. Many students and many companies have taken advantage of this opportunity.

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2013 International Conference on Technology Transfer

iDEA Lab: Empowering university – industry collaboration through students' entrepreneurship and open innovation

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Abstract

Universities are primary sources of new knowledge production and innovation in Serbia and crucial element for technological change in vital segments of economy. Therefore knowledge and technology transfer from universities is an extremely important factor. In this paper an introduction to the iDEA lab, student centred co-creative ecosystem is given, including its background, specific goals, and expected impact. iDEA lab represents and innovative way to link universities and industry as well as to include students in technology transfer.

Keywords: entrepreneurship; open innovation; co-creation; living lab; start-up accelerator; students; university;

1. Introduction

Faculty of Technical Sciences is the undisputed leader in knowledge and technology transfer at the University of Novi Sad and in Serbia. Effective collaboration with businesses based on innovative activities, and entrepreneurial climate created at the Faculty, influenced and motivated a number of researchers and teachers to start their entrepreneurial ventures. As a result, more than 70 successful companies have been created during the last 15 years. These companies employ more than 2000 people, of which over 90% are highly educated professionals, have a total annual turnover of over 50 million, exporting over 50% of its product and services [1]. These companies represent the future, the knowledge-based economic development of Novi Sad and the seed for the development of the knowledge region.

However, the results in encouraging students to start their own entrepreneurial ventures did not follow these results. Recent study related to entrepreneurial aspirations of students' at University of Novi Sad [2] showed that majority of students (83.1%) had thought about starting up own business, but they changed their minds, from being employer to being employed – during studies because they were not supported (space, mentorship, risk reduction) to try it. Evidence from several studies [2-6] show that this is common problem at Western Balkan countries and highlights the following:

- Very small percentage of students is ready to start their own business after graduation.

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- High majority of students admit that they are getting knowledge and acquire skills during studies that are only useful to the public sector or to very big enterprises.
- Education and training in entrepreneurship is academically driven.
- Entrepreneurship is dominantly thought at business and economic departments, rarely to other students.
- Students well understand that the market in each of the WBC is very small, but they lack the means and support to successfully connect throughout the region.
- There is little if any knowledge about financial instruments of the equity and participation type.
- Companies from the region have underdeveloped open innovation practices (if any), thus not exploiting available resources such as inventive and creative individuals.

This situation is additionally amplified by very low level of university – industry collaboration in WBC [5-7] which prevents students from getting real world experience through hands on experience in the workplace.

Bearing this in mind, the purpose of the paper is to describe **iDEA Lab**, an innovative solution that is conceived as a co-creative and supportive environment which should systematically encourage students' entrepreneurial intentions and open innovation approach in university-industry collaboration. This approach may be described as a win-win-win situation, as it benefits all the three involved parties: students by gaining relevant experience and starting up their career, university by being involved in additional start-ups and industry by providing them with new ideas and potential collaborators. Reflecting the objectives, the remainder of the paper is structured as follows: in Section 2, we present the origin of the idea; in Section 3 we define and describe iDEA lab; while in Section 4 we conclude with expected impact and results.

2. Inspiration

The concept of iDEA lab is inspired by growing number of start-up accelerators and living labs in Europe and the statement from Rethinking Education [8] that: "All young people should benefit from at least one practical entrepreneurial experience before leaving compulsory education". However, its origin is rooted in experimental ecosystem Media Centre that was operational at the University of Novi Sad between 2004 and 2008. The Centre offered students the opportunity to use small room with several computers, some video recording equipment and fast internet connection without restrictions. Approximately, 30 students took part in activities of the Centre during four years, conducting small-scale media projects and serving as a production hub for the University's marketing department, while also being able to experiment on their own concepts. As a result, students who were engaged with the Centre started several companies and found an easy employment. However, this ad-hoc initiative ended because of the lack of systematic support (trained staff, developed services, bigger space) from the Faculty side.

Seed accelerators are a modern, for-profit type of start-up incubator. Unlike traditional business incubators, in which companies can share offices for years, accelerators are structured like boot camps designed to turn tentative ideas into prototypes or market-ready products in a few months, putting small groups of entrepreneurs through intensive training and mentorship. An accelerator relies on three main stakeholders: start-ups, investors and mentors. This network is crucial to the accelerator and the absence of any single one of these stakeholders arguably makes it impossible for the accelerator to function. The primary value to the entrepreneur is derived from the mentoring, connections, and the recognition of being chosen to be a part of the accelerator, while the most important stakeholder is the investor for whom the accelerator provides a service [9]. According to Miller and Bound [10] the accelerator program model comprises five main features whose combination separates it from other approaches to investment or business incubation: 1) an application process that is open to all, yet highly competitive; 2) provision of pre-seed investment, usually in exchange for equity; 3) a focus on small teams, not individual founders; 4) time-limited support comprising programmed events and intensive mentoring; and 5) cohorts or 'classes' of start-ups rather than individual companies. The number of start-up accelerators is constantly growing. In 2011 there were over 200 start-up accelerators in the US and Europe [11].

Living lab can be defined as physical region, virtual reality, or interaction spaces, in which stakeholders form public-private-people partnerships (4Ps) of companies, public agencies, universities, users, and other stakeholders, all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts [12]. Knowing that living labs are basically environments for innovation and development where users are engaged in studies targeting new solutions and discovery of innovation opportunities [13], it is expected for students to provide innovative solutions, but also to get stimulating experience in this type of environment [14]. Living labs are driven by two main ideas: i) involving users as co-creators on equal grounds with the rest of participants and ii) experimentation in real-world settings. Living labs provide structure and governance to user participation in the innovation process [15] and they turn users from observed subjects to active co-creators of value and explorers of emerging ideas, breakthrough scenarios, and innovative concepts.

3. What iDEA lab should be

The core idea behind iDEA lab is to provoke (stimulate, motivate) students and young researchers to actively use their intellectual potential to generate innovative ideas. It is conceived as open space (200–300 m^2) in the heart of University of Novi Sad that welcome students who have starting ideas or creative potentials, but who lack skills and resources to realize that potentials. The lab environment will provide full hardware and software, training, mentoring and networking support for the growth of students' ideas. Through iDEA lab students will get the opportunity to develop and commercialize these ideas by two routes – entrepreneurial (pursuing their own creative ideas) or collaborative (working on problems submitted by existing companies). Key activities in iDEA lab will be:

1. Individual, group and hybrid idea generation activities are crucial. Students will enter the lab with their own ideas, but idea generation process will be stimulated as well by companies, which will submit challenges that need to be solved. In this way, students will actively participate in open innovation projects.
2. Trainings will help students to obtain necessary entrepreneurial skills and knowledge to bring their ideas to the next level. Courses will be designed to respond to specific needs of students (would-be entrepreneurs), SMEs and regional industry with the primary goal to improve students' entrepreneurial skills and abilities to practice creativity and start-up new business; as well as to participate in open innovations.
3. To help development of students' ideas into business, a pool of mentors (successful entrepreneurs, senior managers, designers, engineers, marketing experts) will be formed. Mentors will have task to help ideas succeed with 1:1 mentoring, giving talks, and advising.
4. Networking (with other students, mentors, VCs, business angels and interested companies) is basis for new connections and collaborations between lab users who do not know each other. As a part of idea development and start-up process, different events which link would-be-entrepreneurs and potential sources of financing (government programs, VC founds) will be organized.
5. Practical realizations, like creation of multimedia content, development of apps for mobile and tablet devices, simple prototyping, simulation and testing of new services, software testing, lead-user and ordinary-user testing, service providing and many others are the core of the iDEA lab concept and necessary for developing idea into innovation.

It will bring students, researchers, entrepreneurs, SMEs, solution and service providers, users into co-creative environment, cross different perspectives and deepen understanding about complex interactions between technologies and market; and thereby substantially increase the likelihood for both high potential start-ups and successful open innovations. iDEA lab will be physical and virtual space where innovative products and services can be conceptualized and validated then spun out into new venture initiatives. It is expected that focus of iDEA labs will be mainly on ICT and mobile applications, media and creative industries, energy and environment, local and rural development.

4. Conclusion

Besides serving as a cross-disciplinary and multi-stakeholder platform for entrepreneurship, collaboration with industry, innovation and commercialization, iDEA lab at University of Novi Sad will offer a unique environment for problem- and work-based learning and improve educational experience for students at large and prepare them for active role at labour market. iDEA lab will be partly included in teaching process. This will enable not only to entrepreneurially oriented students, but students at large to become an integral part of new product and service developments, and new venture creation and thus get chance to enhance own employability.

Through the iDEA lab students will get the right skills to enter the labour market or to create their own business. They will practice their creativity, learn how to work in a team and use their knowledge and initiative. Start-ups created through the project will directly effect on employment, especially if new young entrepreneurs hire fellows. Academics and staff from industry partners will update existing and develop new knowledge and skills and become able to support and mentor innovative ideas. iDEA lab will support regional collaboration and networking. Regional industry, high-tech SMEs, business incubators as well as research institutions will benefit from improved innovativeness and an entrepreneurial workforce which has the right attitude for the job.

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Comparative Analysis of Students' Internship in Serbia and EU – An Approach for Improvement of University and Enterprise Cooperation

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Abstract

A significant number of international projects in Serbia are employed in order to enhance the connections and cooperation between academic institutions and industry. TEMPUS JP 510985-2010 Improvement of Students' Internship in Serbia is ongoing project that deals with the issue of internships improvement. In this paper are presented experiences from the project realization emphasizing the comparison between EU and Serbia experiences in the field of internships realization. In the end, the brief list of future activities which should improve internships and university-enterprise cooperation are given.

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Key words: Internship; students practice.

1. Introduction

Number of documents and declarations define necessary steps and measures that will eventually lead us to knowledge-based society and economy. Bologna Process drives towards the employability of university students. Serbian Universities generally accepted Bologna Declaration suggestions but number of problems still exists. In the December 2009, Government of Republic of Serbia published document "Revised and Extended National Program for Integration of Republic of Serbia in EU" [1]. This document states that development of human resources is one of the most important issues. It is also stated that is necessity for improvement of knowledge and skills and better integration of Universities and economy. It is clear that precondition for faster development of Serbian economy and public sector is improved skills and competences of graduate students. On the other hand, EU report from 2009 "Serbia 2009 Progress Report" on page 29 states: "Little progress can be reported on the reform of the education system in relation to labor market demand. The gap between

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demand and supply of skilled employees continues to be an obstacle to increasing foreign direct investment and developing new branches of the economy” [2]. According to this report and number of national and regional analysis it is clear that the reform of educational system is necessity and the most important corner stone is assurance of acquisition of practical knowledge and skills. The reform of students’ internship is the crucial for improvement of employability and practical skills. The problem of employability is underlined in all previously mentioned documents. European Commission Directorate-General Education and Culture in 2007 published study “Linking the worlds of work and education through Tempus” that states fact that in countries like Serbia cooperation between academic community and economy is undeveloped. Universities must recognize the need to engage closely with the environment in which their students will find employment (through students practice, usage of companies’ physical resources and preparation of students for employment). Unfortunately, cooperation between universities and enterprises in Serbia in area of practical student education can’t be characterized as satisfactory. Absence of communication with students, graduate students, employers and Universities and dialogue (with main topic of needed practical knowledge and skills) is also evident. According to Bon declaration cooperation of Universities and enterprises could be straightened through: internship and trainee exchange, joint research and lifelong learning.

From all above mentioned it is clear that much greater attention must be devoted to the practical training of students, at all levels of study and in all disciplines that recognize it as an indispensable and unavoidable segment of educational process. In the section 2 and section 3, the models of internship in EU and Serbia are presented and in the section 4 the comparison of models and measures for improvement internship in Serbia are presented. Taking into the consideration the structure and content of accredited study programs in Serbian universities in general basic and most important area for practical training of students is linked to, above all, the content and method of conducting mandatory professional practices – students’ internship (practical placement). The main focus of TEMPUS JP 510985-2010 project is students’ internship and the target groups will be Universities, enterprises and students. In order to achieve better interaction between universities and enterprises this project have intention to contribute to improvement model of students’ internship in social sciences, humanities, business and management, natural sciences and technologies. The project activities should enhance communication channels between Universities and enterprise through which transfer of know-how from universities to enterprises in the particular fields will be achieved.

2. Internship experience in EU

In this section, the experience from EU Tempus partner universities: (1) Univerza v Ljubljani, (2) Aristotle University of Thessaloniki, (3) Politecnico di Torino, (4) Coventry University is presented [3].

2.1. Internship experience from Univerza v Ljubljani

The current situation at the Faculty of Mechanical Engineering (Univerza v Ljubljani) shows that different forms of practical training are organized:

- One month of summer internship 1 and one month of summer internship 2, organized in July or August, and after the 4th and 8th semester of the old University study programme, and providing student practical training in partner institutions. Both summer internships are compulsory for all students.
- A one month summer internship is organized in July or August, after the 2nd semester of the old High professional study programme and provides students with practical training in partner institutions. This summer internship is also compulsory for all students.

- A six month student internship is organized in the 7th semester of the old High professional study programme and is carried out in partner institutions or in laboratories at the Faculty of Mechanical Engineering. This internship is very important and is also compulsory for all students.

Due to the Slovenian university reform (according to the Bologna Process), student internship has become an integral part of the curriculum of the engineers and a way to obtain an evaluation of the activity in university credits.

2.2. Internship experience from Aristotle University of Thessaloniki

The Students' Internship has been added to the under-graduate studies since 1999. The internship provides practical training of the students in partner institutions, through the course "Training in firms". This course is an elective offered during the ninth and tenth semester. It is an optional course for all the students, independent to the choice of the area of specialization. The course does not provide any academic credits and does not count as one of the 18 in total elective courses. During the implementation period 1999-2007, 395 students have been participated to the internship project, while the target number of students for the current 2007-2012 project is 210. The basic elements of the Students' Internship framework are summarized in the following sections. In particular the objectives of the current Students' Internship Project 2007-2012 are:

- To improve the mechanisms and the content of internship.
- To reinforce the mechanism for finding partner institutions (industrial firms/organizations/consulting and technical bureaus) offering internship positions.
- To diffuse the internship institution and its benefits among potential partner institutions and to enhance the collaboration of the Greek industry with the Department.
- To further diffuse the short-and long-term benefits of internship project among the students.
- To contact the students to potential employers.
- To reinforce the mechanisms for continuous evaluation and improvement of the internship project.
- To develop new and innovative training activities for the students.
- To achieve the long-term economical feasibility of the Students' Internship project, by improving the relations of mutual trust between partner institutions and Department.

The Students' Internship is considered as an essential element of the educational process of mechanical engineers, which actively contributes to the integration of the productive potential of the country.

2.3. Internship experience from Politecnico di Torino

Years of experience have proved that the value of the internship can be recognized both from the point of view of the student and of the host company:

- In order to experience the real work student must face the true problems and find a solution, all that in cooperation with other people. It is not anymore the simple exercise made only by student itself, but it is a team work in company circumstances.
- The host companies consider internships to be both a doorway towards hiring and a moment of integration between academic and operative skills aiming to form professional persons at the end of the academic path. Such experience is important for the company since it allows it to evaluate a possible applicant.

Currently there are three types of internships, established at Automotive Engineering course:

1. The internship performed in an automotive company

During this time, the student under the supervision of an engineer who is working in the company and an academic tutor from Politecnico, has a real work experience. The student will be supported by the engineer in the development of the assigned project, and also, he will collect all necessary data for the preparation of final thesis. In almost all cases, the internship experience is preliminary step, which is providing useful information and database for MSc. Thesis.

2. The internship performed at Politecnico di Torino

Besides the internship in a company, students can experience the internship at Politecnico di Torino, usually working in the frame of projects that Automotive Engineering faculty is offering in the collaboration with industry. In particular, Formula SAE and Idra Car are projects which are concerning the design and development of auto-cross racing cars with small formula styles and advanced lightweight materials that are produced in the collaboration with partner enterprises in Turin and successfully demonstrated in several racing competitions in Italy and Europe. The production strategy of these cars consists in a concurrent analytical and experimental development, from the initial conceptual design and coupon testing, through the stages of element and subcomponent engineering, to final component manufacturing. In this way, students can follow the complete chain of product genesis – from design to manufacture.

3. The internship performed abroad

An internship abroad is a great opportunity for student not only to make work experience, but also to develop other types of competences like the improvement of language knowledge, of the culture, and of the lifestyle of the host country. As far as the carrying out abroad of the internship is concerned, the procedure is different with respect to an internship done in Italy, because all the bonds imposed by the host country have to be considered. Mostly all of these internships are performed at foreign European universities, and only small number in foreign companies.

2.4. Internship experience from United Kingdom

The Faculty of Engineering & Computing at Coventry University comprises of a family of five departments with each offering their own suite of undergraduate and postgraduate programmes.

- The Built Environment
- Engineering & Knowledge Management
- Computing & Digital Environment
- Mechanical & Automotive Engineering
- Mathematics, Statistics & Engineering Science

Students are enrolled on to four year sandwich degrees. These comprise of two years of undergraduate study followed by one year on an industrial placement (Professional Training) and finally students return for the final stage of their degree programme.

From the day they join the faculty all students are introduced and exposed to importance of employability leading to employment.

The Professional Training programme (module) seeks to provide students with work based experience that is relevant to their course, together with opportunities to study the various functional areas within organizations and to extend a student’s sense of responsibility and reliability both as an individual and as a member of a team. During the module students gain a variety of professional skills in employment related to their programme of study, and the ability to apply these to problems in real work situations. Students should be able to relate and apply theoretical and practical experience gained during the first two years of their course to their experience during professional training, while making a full and useful contribution to the activities of the organization providing the professional training.

There are many benefits to students who take part in a professional training year. Primarily it is an opportunity for a student to put theory in to practice. It provides valuable work experience which can enrich a student curriculum vitae. A student can develop their softer skills needed in a modern work environment. They gain ideas and perhaps a client for their final year project. Over the duration of the placement the employer also gains a deeper understanding of the student, how they work and fit in within their organization. On occasions a student may be offered a bursary or even a conditional graduate opportunity.

3. Internship experience in Serbia

Promotion of importance of student internship and volunteering programs are mostly presented through the channels such as Centres for Career Development and Student counseling. Also, the promotion of internships are held at the faculties, presentations on lectures or info stands in the lobbies of the faculties, where promotional materials are distributed to students.

Centres for Career Development usually have student-associates on every faculty of the University, informational boards are placed on most of the faculties. In the few past years, Centres for Career Development have organized different activities such as Scholarship Fair, which is now a regular semester activity. At the University of Kragujevac, there is the manifestation Student Days. It serves for career guidance promotion, promotion of the University of Kragujevac and all its faculties, promotion of scholarships, internship and volunteering programs in the companies and firms, as for promotion of entrepreneurship and innovation and encouraging of youth to realize their business ideas. In the coming period, it is necessary to start the organization of Internship and Employment Fair, where students can get in direct contact with potential employers, inform themselves about the possibility of professional development, internship and volunteering programs in given companies, which also represents the possibility for them to leave their biographies in order for the companies to have them in their potential employee base. Centres for Career Development possess a large network that links students and student organizations within particular faculties which may be used for strengthening of the network between the Universities, students and enterprises. The Centre for Career Development in Kragujevac is planning to create a database consisting of all the students that are studying on each of the faculties of the University of Kragujevac that would be available to our partner companies for the selection of candidates for their internship programs. In this database, students will be able to upload their biographies with an option to update them, so that interested employers can always have up-to-date information at their disposal.

4. Conclusion

Although students' internship on undergraduate or graduate studies is recognized part of curriculums on accredited programs on significant number of departments on universities in Serbia, it is obvious that it represents certainly the most neglected and the least developed segment of education. Unlike the other curriculum subjects at universities, which have clearly defined adherence to the department and courses, and specified professors and associates who are the carriers of teaching activities, student internships is general "public activity" without clearly defined responsibilities and ways of engaging teaching staff in their realization. Universities in principle do not have clearly defined concept and model of student professional practice – internships', there are no corresponding programs of work, methodology and defined tasks and objectives.

From the analyzed issues it can be concluded that three of four selected universities (Univerza v Ljubljani, Aristotle University of Thessaloniki, Coventry University) cover wide area of study fields (all relevant study fields for this project), while one of them (Politecnico di Torino) is leader in applied and technical sciences with huge expertise and influence worldwide. The preliminary analysis which is made on described problem show that the improvement of practical professional training of students could be realized with coordinated actions in the following directions:

1) The significant improvement in ways of organizing and performing the mandatory students' internship which should become one of the important elements in education and not only formal activity. This includes

certain changes at the universities that are related to clearly defining of the tasks, obligations and responsibilities related to planning, organization, management and control of the realization of students' internship.

2) Analyzing of models for organizing and realization of student internships in EU countries through a co-operation with EU universities that are members of the consortium for the implementation of the project. Considering that in Western European countries, the concept of student internships is much better organized and planned, and that cooperation between universities and enterprises in this area have a great tradition, one of the objectives of the project is detail analysis of current concepts and models of professional student practice - internships, organizing in the EU and transfer of all positive experiences and ideas in order to define the final outcome of a model that matches the specific demands of the environment in Serbia.

3) There is necessity to improve University infrastructure and resources for SI. The role, organizational capacities and professional capabilities of Career centers should be straightened. It is also important to improve, train and educate academic supervisors and mentors for the realization of the students practice. It is also important to improvement of resources on universities that should enable that preparation for professional practice for needs of specific companies could be performed at the universities themselves or in enterprises but with significant use of universities equipment and other resources (in order to provide preparation for placement and to pass occupational safety procedures).

4) Popularization of organization of student internships in enterprises and institutions in Serbia which should contribute to widening of potential internships providers base. Preliminary research and surveys show that there is significant interest, but that concrete initiatives must be generated by the universities in the form of organized promotion of the concept and spreading of information's to all potential partners about the possibilities and the opportunity which this form of cooperation could enable. Representatives of a selected potential internships providers will be joined to the study tours and visits to universities in the EU during which they will be in position to see from first hand, applied methods for the organization and implementation of student internships.

5) Practical work with students which should verify the defined ideas, models and methodology of work. During the realization of the project students' internship, on both undergraduate and graduate studies, will be organized. The pilot internships and their results will be subject to detailed analysis and will serve to define certain modifications and amendments of the proposed models and methodology for realization. This will be a base for improvement of other forms of University – enterprises cooperation by training, education and promotion of innovation, technology transfer and cooperative education.

Students usually have clearly built awareness of needs for additional professional training and practical education. Their requests to universities and the results of conducted benchmarking and opinion polls shows that this is the most common and most important remark that they have regarding the content and structure of the reformed and accredited study programs and curriculums.

Acknowledgements

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Track 6: EU projects as a Chance for Development

2013 International Conference on Technology Transfer

EU Projects – Opportunities and Challenges for HEI

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Abstract

Even though the importance of higher education is recognized worldwide, the situation in Serbia is far from desirable. Generally, Serbia is facing great challenges in the European Union accession process, namely in terms of having to adjust to the acquis communautaire (the total body of EU legislation). Fortunately, The EU accession process presents also a major opportunity to benefit from the financial resources of the EU budget, overcome problems and make progress in all sectors. In this paper, EU funds that are mainly oriented towards higher education sector will be elaborated and new opportunities for 2014-2020 will be described.

Keywords: challenges, innovation, higher education, research, development, horizon 2020, framework programme

1. Introduction

Even though the importance of higher education is recognized worldwide, the situation in Serbia is far from desirable. According to the statistics of the National Employment Service from February 2013, there are 59.615 unemployed people in Serbia with the university degree[1]. Simultaneously, one of the targets from the Strategy for development of education in Serbia 2020, aligned with Europe 2020, is to have a share of at least 40% of the younger generation with a tertiary degree[2]. A major cause of such situation is believed to be the lack of communication between tertiary institutions and labour market. Therefore, as a theoretical solution on national level, it is suggested to form a specialized institution that would analyse the needs of the labour market and assist higher education institutions when creating new study programmes. So far, this institution has not been established. Another disappointing fact in social terms is that in Global Competitevness Report 2008-2009, Serbia was ranked 131 out of 134 countries in brain drain, while in 2012-2013 it reached 141 position out of 144 countries included in the research[3-4].

Generally, Serbia is facing great challenges in the European Union accession process, namely in terms of having to adjust to the acquis communautaire (the total body of EU legislation). Fortunately, the EU accession process presents also the opportunity to benefit from the financial resources of the EU budget, overcome problems and make progress in all sectors. By joining the EU, Serbia will have access to substantial financial resources that will support development goals and speed up the growth and development of its economy and society as a whole. In this paper, EU funds that are mainly oriented towards higher education sector will be elaborated and new opportunities for 2014-2020 described.

2. EU funds and Higher Education Institutions

European Commission recognizes higher education institutions as the ‘key stakeholders’ in European research. According to the Commission, European universities employ one-third of European researchers and produce 80% of fundamental research in Europe[5]. Consequently, there are many EU funds intended for the institutional reforms of higher education on the one hand, and those with the purpose of investing explicitly

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into research and development, on the other hand which all generally needs to increase the competitiveness of the European higher education area on the world market.

2.1. Tempus and Erasmus Action 3

Funds intended for the process of higher education reform and promotion in partner countries are Tempus and Erasmus Mundus Action 3. Firstly, Tempus supports projects in the EU's surrounding area that facilitate university modernisation, mutual learning between regions and people and understanding between cultures.

Its specific objectives are[6]:

- To promote the reform and modernisation of higher education in the partner countries;
- To enhance the quality and relevance of higher education in the partner countries;
- To build up the capacity of higher education institutions in the partner countries and the EU
- To overcome the fragmentation of higher education between countries
- To enhance inter-disciplinarity and trans-disciplinarity;
- To enhance the employability of university graduates;
- To make the European Higher Education Area more visible and attractive in the world;
- To foster the reciprocal development of human resources;
- To enhance mutual understanding between peoples and cultures of the EU and of the partner countries.

Secondly, the Erasmus Mundus programme presents a co-operation and mobility programme in the field of higher education which promotes the European Union as a center of excellence in learning around the world. Even though 90% of assets from the 930 million euros budget go to scholarships, under the Action 3 it focuses also on enhancing the attractiveness of, and the interest in European higher education. Additionally, it supports activities that improve its profile, visibility and accessibility, as well as issues crucial to the internationalisation of higher education, such as the mutual recognition of qualifications with third countries[7].

2.2. Research oriented funds

Since 1990s, Serbian R&D system has been changing gradually by diversifying sources of income and activities, by closing R&D institutions and by reducing reliance on domestic R&D activities. All this has brought serous brain drain of highly educated people and absence of middle-aged researchers. Moreover, Serbian public investment in R&D in 2007 was 0.35% of GDP, which is far from targeted 3% of GDP set in the strategy Europe 2020[8]. In the following diagram, gross domestic expenditure in R&D (hereinafter GERD) is depicted, which shows Serbian low ranking in the region.

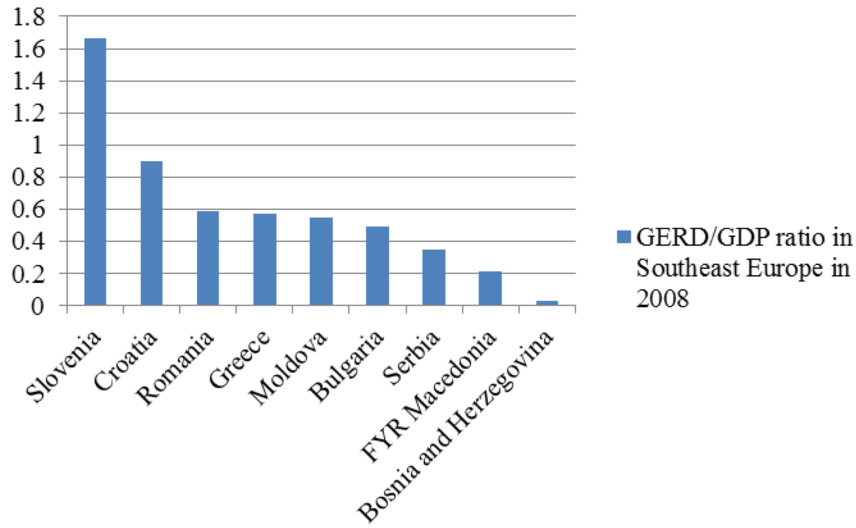

Figure 1: *GERD/GDP ratio in Southeast Europe in 2008*

Still, it is believed that the opportunity for Serbia to participate in EU framework Programmes for R&D will to a large extent improve the situation in R&D sector. Some of those opportunities are Seventh Framework Programme (FP7), Competitiveness and Innovation Framework Programme (CIP), Instrument for Pre-Accession Assistance (IPA), etc. Among these, the most relevant one is Seventh Framework Programme (FP7), which will be elaborated in the following section.

As was the case with previous Framework Programmes, FP7 has been designed by the European Union in order to support collaborative research, development and innovations in science, engineering and technology. Its main strategic objectives are:

- To strengthen the scientific and technological base of European industry;
- To encourage its international competitiveness, while promoting research that supports EU policies.

Within the Seventh Framework Programme, there are five major building blocks. The biggest in budgetary terms, is the subprogramme called *Cooperation*, which has the ambition to help Europe gain leadership in key areas of science and technology by having our best brains from across Europe working together. The second programme is called *Ideas*. This programme is intended to foster competition and excellence in frontier or fundamental research. Furthermore, programme *People* enables tens of thousands of researchers to benefit from fellowships for research training, while the fourth programme, *Capacities*, aims at ensuring scientific and technological capacity-building, for example in the area of infrastructures or at helping European regions to gear up their scientific potential. Finally, the programme for *Nuclear research* and training activities comprehenses research, technological development, international cooperation, dissemination of technical information, and exploitation activities, as well as training. The total budget for FP7 amounts over 50 billion euros. The following picture shows the allocation of the FP7 budget across the programmes[9].

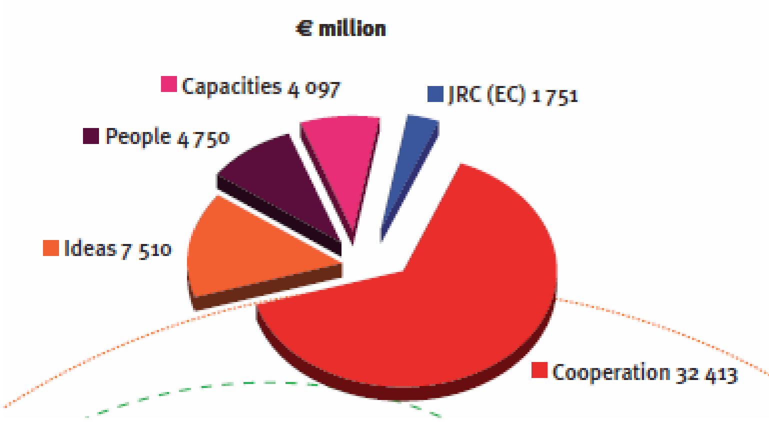

Figure 2: FP7 Budget

2.3 Mobility opportunities in Serbia

In Serbian Strategy for development of education 2020, it is planned for higher education institutions to have at least 10% of foreign students[2]. On the University of Novi Sad example, since it approximately has 50.000 students, this would mean having at least 5.000 students from abroad. It is straightforward to say that this is a rather ambitious goal, which is forcing universities to work hard and use all the expertise and help available from the European Union. One step towards achieving this goal is inclusion of Serbia in Erasmus Mundus Programme, which has brought many benefits in terms of facilitating and enabling both incoming and outgoing mobility.

The Erasmus Mundus programme is a co-operation and mobility programme in the field of higher education which promotes the European Union as a centre of excellence. Main objectives of the programme are:

- To enhance quality in European higher education;
- To promote intercultural understanding through co-operation with third countries.

It comprises 3 Actions. First Action consists of Erasmus Mundus Masters Courses (Action 1A) and Erasmus Mundus Joint Doctorates (Action 1B) and presents the central component around which Erasmus Mundus is built. Masters and Doctoral level programmes are offered by a consortium of higher education institutions in at least three different EU and/or Third countries. The courses are developed in such manner that each student needs to spend a study period in at least two of the three institutions, after which they are being awarded with a recognised double, multiple or joint degree. Action 2 provides support for the establishment of cooperation partnerships between EU HEIs and HEIs from targeted Third Countries with the objective of organising and implementing structured individual mobility arrangements between the European and the Third-Country partners. Scholarships vary in length - depending on the priorities defined for the Third Country concerned, the level of studies or the particular arrangements agreed within the partnership. Potential applicants can be students, scholars, researchers or professionals. Action 3 has been described above, since it has institutional character.

The Erasmus Mundus programme has a budget of 930 million euros, 90% of which go into scholarships[10].

2.4 New opportunities for HEI- 2014-2020

On 29th June 2011, the European Commission published its proposal for the next Multiannual Financial Framework (MFF) 2014-2020. It proposes the financial basis for the period 2014-2020 and sets the frame for the follow-up structure of all current EU programmes, as well as the entire EU budget.

One of the three priorities of Europe 2020 is smart growth - developing an economy based on knowledge and innovation. In terms of higher education sector for the moment being there are two programmes which seems will be the pillars of the 2014-2020 period.

2.4.1 Horizon 2020

In the future period Horizon 2020 will be the key financial instrument aimed at securing Europe's global competitiveness. It will combine all research and innovation funding currently provided through the FP7, CIP and the European Institute of Innovation and Technology (EIT).

Its major objectives in terms of research and innovation which are in line with the Europe 2020 are to[11]:

- Strengthen the EU’s position in science with a dedicated budget of € 24 598 million. This will provide a boost to top-level research in Europe, including an increase in funding of 77% for the very successful European Research Council.
- Strengthen industrial leadership in innovation € 17 938 million. This includes major investment in key technologies, greater access to capital and support for SMEs.
- Provide € 31 748 million to help address major concerns shared by all Europeans such as climate change, developing sustainable transport and mobility, making renewable energy more affordable, ensuring food safety and security, or coping with the challenge of an ageing population.

2.4.2 Erasmus for All

Apart from Horizon 2020, new financial period will bring another major novelty. That is new programme named Erasmus for All, which will bring together activities previously covered by a number of separate programmes (including the Lifelong Learning Programme, Erasmus Mundus and Youth in Action) and will also include activities in the new area of European competence, sport.

The proposed budget for the programme, that is due to start in 2014, is EUR 19 billion and its main operational priorities are:

- The learning mobility of individuals;
- Cooperation on innovation and good practices;
- Support for policy reform.

Within the programme, there are many innovative proposals, such as the Erasmus Master's degree student loan guarantee scheme - aiming to promote mobility and access to affordable finance for students doing their Master's degree in another member state. Finally, the programme aims at supporting Europe 2020 strategy for growth and jobs, given that education and training have an essential role in overcoming one of the most difficult periods in the history of Europe. Serbia will be included fully in the Programme, as well as all the countries geographically located in Europe[12].

3. Conclusion

It is Sir William Fullbright who said: "We must try, through international education, to realize something new in the world -- by persuasion rather than by force, cooperatively rather than competitively, not for the purpose of gaining dominance for a nation or an ideology but for the purpose of helping every society develop its own concept of public decency and individual fulfilment".

For these reasons EU funds represent a major opportunity for development of Serbian higher education from both institutional and scientific perspective. It is on us to increase the awareness of all the relevant stakeholders and social groups in order to overcome the challenges of European Union accession process and to exploit opportunities which EU funds are bringing in best possible manner.

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Social Media Innovations for Realization of the iKnow Project

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Abstract

The introduction of social media has made a lot of innovations, not just by establishing a social network, but also by initiating a new marketing channel and applications in various different business areas, especially in collaborative activities, or when attracting a huge number of students. Engineers and business managers have foreseen its importance and regularly implement it as a sophisticated technology transfer.

In this paper we give an overview of social media progress and several examples of its usage in various areas, such as marketing, collaborative learning, engineering, etc. We present our experience in realization of the iKnow project, like using it for agile development, marketing, technical support, quality of service, usability and user experience analysis.

The limits of its usage are infinite constrained only by one's imagination. A lot of technology transfer and start up enterprises are using social media as add-on value to existing businesses, creating added value.

Keywords: Social media, social networks, collaboration

1. Introduction

Social computing is a phenomenon attracting a huge population. The latest data from various social network providers September - October 2012 period indicates fascinating facts about social networks [1], for example, more than 1 billion Facebook registered users then Tencent QoQ and Qzone [2] reaching 784 million and 597 million registered users in China, Windows Live over 330 million etc. Last data made in March 2013 shows even higher numbers, reaching 1.11 billion active users at Facebook [3] and 825 million and 611 million respectively for QoQ and Qzone [4].

We started the iKnow project [5] in October 2010, as a TEMPUS project, mainly funded by the EU commission. The wider iKnow objective was to modernize student activities within University Management by innovative and knowledge management IT supported design with eServices capable to integrate in future eGovernment services in Europe and approaching Information Society with knowledge based economy. The main part of the project concerned development of e-Services for students. Chorbev et al. [6] present in depth analysis on the architecture and its implementation.

The consortium decided to include social networks as an innovative solution in most of the phases of the project realization. We have tried to use it as a support in all relevant areas. This paper presents our experience with implementation of social media in project realization, starting from collaborative development of relevant

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technical documentation, than in agile development of the software, marketing of the product to prospective students, technical support for product usage, enabling a channel for feedback and ensuring quality of service, realization of surveys for user satisfaction and usability, etc.

The rest of the paper is as follows. Section 2 presents state of the art of the social network usage, and Section 3 our experience with using social media for project realization. We also discuss the potential of the social networks and present what happens beyond the state of the art in Section 4. Finally, conclusions and future work are summarized in Section 5.

2. State of the Art

Social computing is a new trend initiating the social revolution. The number of users attracted by the new technology is enormous and keeps increasing on a daily basis. Examples from March 2013, as disclosed in Facebook's quarterly earnings report, show that 1.11 billion people registered and actively use the site each month [7]. If Facebook were a country, it would soon become the world largest country.

A more astonishing value is the number of Facebook likes reaching 4.5 billion and content items shared reaching 4.75 billion [8]. They have even defined special indicators, like DAUs (Daily Active Users) and MAUs (Monthly Active Users), with an increase of approx. 25% year-over-year.

The usage of short messages is also increasing, for example, Twitter is currently seeing about 400 million tweets per day [9], or 4.630 tweets per second.

Trust in social media has also increased. Recent statistics show that 90% trust peer-to-peer recommendations via social media compared to 14% of people trust advertising [10]. The applications of social computing are numerous, starting from collaboration sites, marketing, technical support, customer relationship management etc. Social computing finds its usage in most of companies. As of August 2012, 69% of online adults use social networking sites [11]. Half of all social media users are between 25 and 44 years old, but the age distribution varies widely across social networks. LinkedIn is the oldest network, mainly attracting business people, with 79% of users aged 35 and older [12].

Revenue analysis shows that advertising has the highest share (85%) over other sources, like payments, fees, etc.

Social networks media are breaking records, for example it took 38 years for the radio to reach 50 million users, 13 years for TV, 4 years for Internet, 2 years for Facebook [10] and 4 months for Gangnam Style to reach 1 billion Youtube broadcasts [13].

Latest research shows that the main reasons to use social media are curiosity and fun, and then for learning, experimenting and communication. There are a lot of studies concerning the reasons why people use social networking, [14, 15, 16, 17].

A factor analysis of gratifications obtained from Facebook revealed six key dimensions: pastime, affection, fashion, share problems, sociability, and social information. Comparative analysis showed that Facebook is about having fun and knowing about the social activities occurring in ones social network, whereas instant messaging is geared more toward relationship maintenance and development. [15]

Kaplan and Haenlein [18] discusses several challenges and opportunities of social media. The first group of their classification addresses self presentation social networks like blogs, social networking sites. e.g. Facebook [19] and virtual social worlds, e.g. Social Life [20]. The other classification group addresses self-disclosure social networks, like collaborative projects, e.g. Wikipedia [21], content communities, e.g. Youtube [22] and virtual game worlds, e.g. World of Crafts [23].

Some universities have even stopped distributing e-mail accounts, as this is seen as out-dated, in favor of using of social media.

However, there is a constraint because the new technology for providing social media mainly attracts young people, less than 30 years old. Fig. 1 [11] indicates that older people are not using Internet as much as other age groups, even though the number of registered users is increasing.

Similar to this, Fig. 2 shows the age distribution on social networks and online communication [12], pointing out that older people are not using the social networks as mush as younger. We have identified that the age distribution problem is in the usage of complex technology and design that is not appropriate for older people, so a more sophisticated solution will make more equally distribution among different ages.

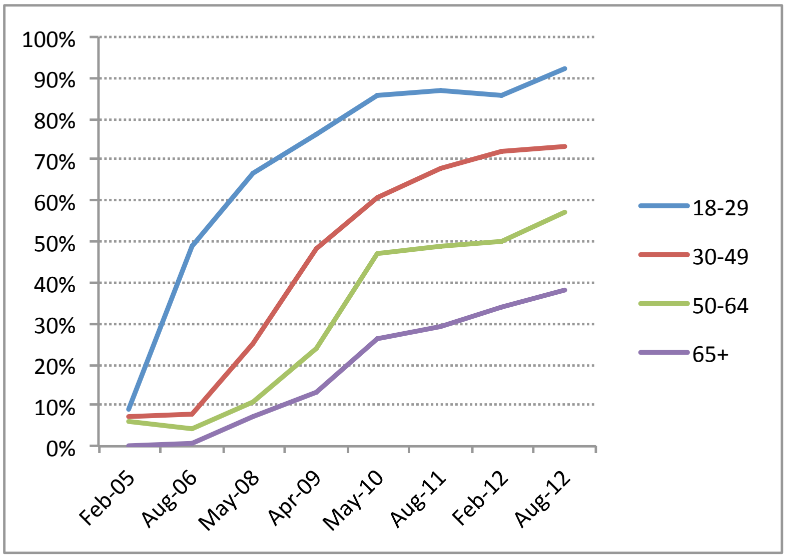

Fig. 1. Number of Internet users [11].

3. Using social networks for the iKnow project

The project web site was opened in October 2010, after the project started. It mostly covered activity descriptions and reporting, but it was not aimed to be a document management system, where the participants will exchange information and documents. According to the Project Steering Committee's decisions to use most sophisticated innovative and knowledge management technologies we tried to implement social media in as much as possible project realization phases.

The first activity planned within the project was development of relevant technical documentation. Although we have organized ourselves in smaller groups, each with a dedicated task, we had to collaborate among ourselves most of the time. The introduction of social media was not only a replacement for exchanging e-mails, but enabled exchange of short comments, smaller Internet traffic, etc. The final conclusion was that *collaborative development of technical documentation* via social media channels resulted better than using convenient e-mail communication and enabled more features, like discussions and resulted with faster decision making and realization of needed documentation.

A very interesting application of social media was in *agile software development*. A standard bug reporting system with issue tracking was installed to support the communication among the project team and the software company provider, since the product had to be developed from scratch and design phase. Although the bug reporting system was efficiently used and it helped a lot of in solving technology problems, it can not provide any help in the evolution phase of agile development, when the requirements are more details specified or even changed to support better ideas and solutions. The introduction and usage of social media for solving these open questions was a significant tool to bring better conclusions in relatively short time.

The discussed channels addressed project execution teams, while the next examples targeted the prospective students of the electronic services within the iKnow project. We had established two channels, the CSE Facebook page [24] and the CSE Twitter profile [25]. More details and statistics on usage, including visits, viral reach, number of posts, likes, topics discussed, etc. are reported by Jovanovikj et al. in [26], [27], [28].

Probably the usage of social media was the best tool for *marketing* the target group of young population, like the prospective undergraduate students. Our survey [28] has shown that social media reached almost all the prospective students (more than 98%), while the radio, billboards and press media reached less than a quarter of the sample (less than 25%). This fact is just one part of the complete story.

The possibility to use social media as an interactive channel by establishing discussions with your friends and the administrator was shown to be an added value to the marketing, since all the questions that were asked by

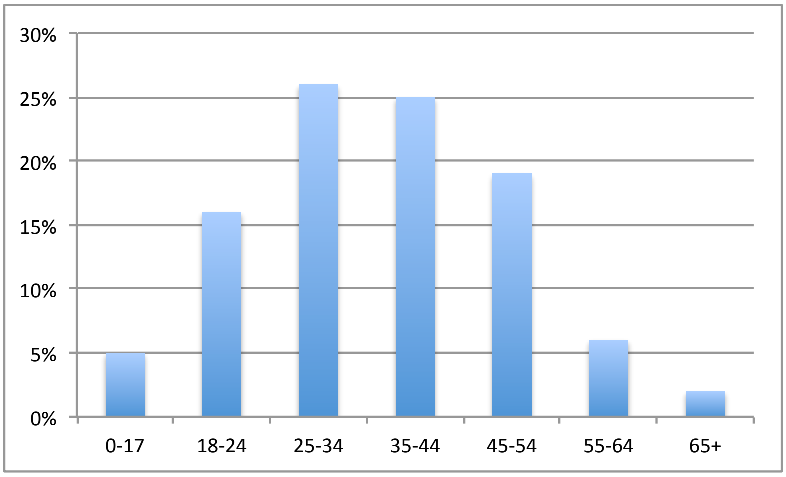

Fig. 2. Age distribution on social networks and online communities [12].

prospective students were answered immediately by the other students, or at most in 2 hours by the administrator himself. This enabled the realization of *a two way interactive and collaborative Q&A channel* much better the conventional web based pages.

In the beginning we did not consider social media as a tool for *technical support* on software usage. We actually reacted very fast and enabled a special channel within our social media for technical support, immediately after we had found how social media was efficient enough to support the Q&A channel. The innovation was to enable an interactive technical support, immediately when a student asks how to perform a certain action, the answer came from his friends or by the administrator. Most of the students also browsed the history and found answers before they started to ask a question. However, when a certain bug was discovered, immediately all social network users know about it. Although this affected us project leaders, it also happened to be a good motivation for the software provider company, who had to react immediately, and solve the problems fast.

Social media enabled an efficient *feedback channel*. It happened that somehow, the project realization was all the time under the eye of all stakeholders, and they had a chance to react immediately, not just to report a bug, but also to suggest a new way to realize a certain activity, or to add a new feature, etc. This was added value to the project.

We hope that establishing the social media channel actually made better *Quality of Service*, of overall realization of the project, especially in the deployment and implementation phase. All the comments given by stakeholders were gathered and analyzed by the project management team, in smaller excalations, the project manager made all the decisions, but for more complex situation, the project management team made relevant decisions.

Finally, we had realized that social media was actually used in almost all aspect of *customer relationship management*. It established a nice collaborative tool to contact all the customers, it enabled an efficient Q&A channel, technical support, it gave chance to access mass population in a very efficient way.

The project analyzed several surveys for user satisfactions and evaluation of software usability. We have found that the results are confirming those conclusions made by the usage of social media. The established two way interactive channel, the possibility to discuss the problems with those that also target them, to enable a collaborative environment in all activities concerning the students as target group in the iKnow project was a great experience we are very satisfied of.

4. Beyond State of the Art

Social computing is an emerging technology in all living areas and business to enhance the capabilities of learners to use interactive multimedia and social networking. The concept of Social Media is top of the agenda for many business executives today [18].

The workload of continuous interaction with large number of people will be reduced through scalable cloud solutions including new social media channels. Current social computing networks target mainly the young generations in terms of entertainment, and are adapted to be used by personal computers, tablets and mobile phones. However, the new emerging concepts change the way of thinking and understanding reality, and adapt it to a broader target groups and disciplines.

For example, online collaborative learning is an emerging idea [29]. The desire by students to undertake programs and courses via the Internet and access resources online is forever altering the nature of formal education. Many institutions and educators have been caught largely unprepared for the radical changes forced upon them. Therefore, researching the teaching and learning techniques that are effective in the online environment is both urgent and important. The educational changes necessitated by the new computing and communication technologies are profound. The new environment is one in which students are more likely to come from a diverse range of backgrounds, have differing levels of technical and language abilities and the desire to study at times and in places of their own choosing. One such paradigm that holds significant promise is that of online collaborative (or group) learning [30]. The power of online collaboration is perhaps best exemplified by Wikipedia [21].

Integrating social networking in other technologies will make stronger synergies and possible applications. It opens a very complex social space of new services achieving the best user acceptance.

Future Internet and social networks will include a huge number of Internet-connected sensors, including cameras, TV sets and microphone arrays, realizing the concept of technology assisted living and smart houses. Pervasive computing and ubiquitous computing are such examples [31]. Based on these sensors, emerging applications will be able to collect, filter, analyse and store large amounts of data captured from the social networks, as well as related metadata captured as part of perceptive multimedia signal processing algorithms. The ability to search this information in a scalable, effective, real-time and intelligent way can empower a wide range of added-value applications in the areas of surveillance, social networking, smart homes, security and more. In addition multimedia search engines for user profiled content should be able to support ambient/intelligent synthesis of related content in real-time.

5. Conclusion

The consortium decided to include social networks as innovative solution in most of the phases of the project realization. We have tried to use it as support in all relevant areas. This paper presents the experience we had in implementation of social media in project realization, starting from

In this paper we have presented the potential of social media and our experience in realization of the iKnow project. We have integrated social media whenever and wherever it was possible, including the following areas:

- collaborative development of relevant technical documentation,
- agile development of the software,
- marketing of the product to prospective students,
- interactive and collaborative Q&A channel,
- technical support for product usage,
- enabling a feedback channel,
- ensuring quality of service,
- customer relationship management,
- realization of surveys for user satisfaction and usability, etc.

The lessons learnt show that usage of social media resulted with increased efficiency in several cases, and opened doors to a wider audience. We contacted more prospective users, and social media enabled realization of several business activities as a more cost-effective solution, than traditional channels. Especially, we are very satisfied with its usage in collaborative agile development, enabling technical support and accessing a high number of students better than any marketing media channel, as well as with the establishment of an interactive multimedia tool. Social media is definitely best for sharing information, experiences and best practices among young population. The idea of collaboration and social inclusion embedded in the ICT technology solutions works almost perfectly.

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Technology Transfer in the European Union

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Abstract

Efficient innovation processes require the implementation of new technologies which are often not commercially available on free markets. Especially for SME it is a big challenge to transfer new technologies into their own innovation processes. For that they need to know how and where to receive adaptable technologies and how to transfer them into sellable products and services. On the other hand technology suppliers, like research institutions or universities, have available developed technologies not knowing how to spread them to enterprises and markets. Within Europe crossborder technology transfer further is inhibited by intercultural differences and blockades. This paper gives an overview of the KBB Trans project, funded by the European Union, with the aim to support national and international technology transfer within the European Union. First, after giving introduction and definitions, an overview of the KBB Trans project is shortly given. Secondly, the basis model for national and international technology transfer focused on SME and barriers and obstacles of these technology transfer activities will be presented. Thirdly, this paper shows content and design of a programme for the training of professional technology transfer facilitators and how to disseminate this training and the facilitators within the European Union for supporting technology transfer activities. Concluding we reveal our first practical experiences during our applied sciences in doing national and cross-border technology transfer by the usage of our special trained technology transfer facilitators.

Keywords: Technology Transfer; , Technology Transfer Facilitators; SME; Innovation; absorptive capacity; applied sciences; EU-funded project

1. Introduction and Definitions

The escalation of technological competition, the shortening of life cycles and the increase in the cost of researching and development challenged especially small and medium sized enterprises (SME) in being efficient in their innovation processes.[1] For SME it is a big challenge to transfer new technologies into their own innovation processes. For that they need to know how and where to receive adaptable technologies and how to transfer them into sellable products and services. On the other hand technology suppliers, like research institutions or universities, have available developed technologies not knowing how to spread them to enterprises and markets. Therefore technology transfer between science and industry is becoming increasingly important over the last years. So, in the actual case technology transfer can be defined as the transfer from one

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[1] [1] Vorbach 2010.

organization or individual to another and may comprise transfer of data, information, knowledge and technology.[2] In this context technology transfer focused on the transfer of knowledge and technologies between technology suppliers (science) and technology adopters (industry, especially SME). In this technologies are defined as scientific and technical knowledge and technics for solving problems referring to the development of new goods and services and therefore for realization product and process innovations.[3] According to OECD-definition there is to distinguish between high, medium and low technologies[4] which are all included into technology transfer processes in the present case. Initiation and implementation of technology transfer processes are characterized by a number of challenges shown below. There are two main reasons for inhibited technology transfer activities of SME within the European Union. First, there is a lack of knowledge about technology transfer possibilities on both ends of technology transfer processes. In the European Union approximately 99 % of the enterprises in the non-financial sectors are SME.[5] Especially in border and rural regions there is a low extent of innovations in these companies.[6] Especially here technology transfer could keep small businesses alive. Secondly, there is also a 'mental gap' between science and industry to be identified which inhibits successful technology transfer.[7] Science and industry has a different dominant logic and they often speak a totally different language. Besides giving information about technology transfer possibilities, closing this gap is the most important task for supporting science and SME in doing technology transfer. As a consequence this paper gives answers to the following questions: (1) How to support and disseminate technology transfer between science and SME especially in border regions of the EU? (2) How to close the 'mental gap' between science and SME and minimize technology transfer's barriers and obstacles? (3) How to train and deploy technology transfer facilitators for supporting sustainable technology transfer processes? These questions will be answered by giving an overview of design and content of the KBB Trans project, an applied science project funded by the European Union, with the aim to support national and international technology transfer activities within the EU.

2. The KBB Trans Project

The KBB Trans project started on the first of October 2012 and will be running to the last of September 2013. It is funded by the life-long learning funding programme Leonardo da Vinci by the European Union.[8] The lead partner and coordinator of the project is the University of Applied Sciences Styria FH JOANNEUM GmbH.[***]

Participating partners are:

- brainplus- Unternehmensberatung Schabereiter, Austria
- Innofinanz- Steiermärkische Forschungs- und Entwicklungsförderungs GesmbH, Austria
- Javna agencija za tehnoloski razvoj Republike Slovenije, Slovenia
- Nottingham Trent University, England
- Unione Regionale delle Camere di Commercio Industria Artigianato Agricoltura del Veneto – Unioncamere del Veneto, Italy
- European Business & Innovation Centre Network, Belgium
- Kozep-dunantuli Regionalis Innovacios Ugynokseg Nonprofit Kft., Hungary

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The aim of the project KBB Trans is to transfer the training course on the topic technology transfer to other partners in Europe. Transferring means, that each partner attend a train-the-trainer course on the

KBBtechnology training courseand each partner has to carry out this course also in the country where the partner is coming from. The technology transfer training course shown below was developed under the frame the KBB project.[9] The KBB project has been developed to boost the activities of technology transfer in the region between Styria/Austria and Slovenia in order to provide the relevant stakeholders with the methodology for technology transfer training and to work on pilot projects in companies in the border-region.

3. The Technology Transfer Model

The technology transfer model[10] depicted in figure 1 shows the basic approach in the KBB Trans project to close the gap between science and the SME for minimizing barriers and obstacles in the whole transfer process.

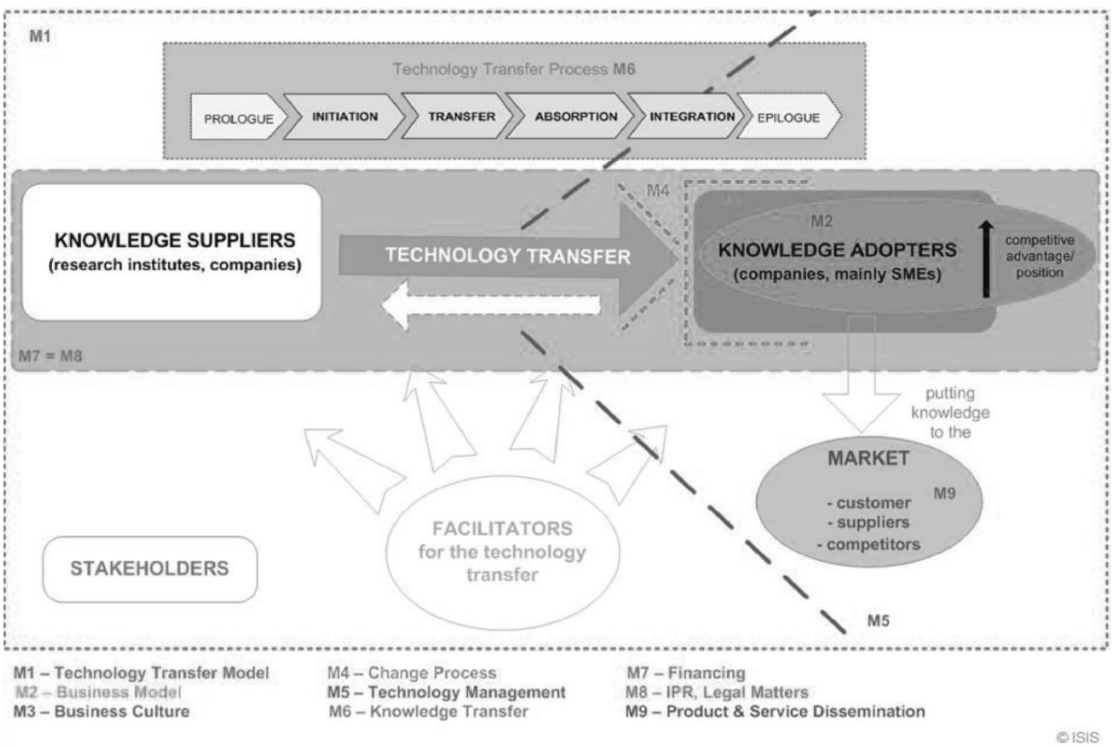

Figure 1: Technology Transfer Model§§§

[9] www.kbb-si.at.eu
[10] [8] Fichtel, 1997; [9] Hofer, 2007; [10] Krogh/Köhne 1998; [11] Markman et. al 2005; [1] Vorbach, 2010; [12] Yi-Tong/Scott 2005 §§§ [1] Vorbach, 2010 (Quelle ISIS)

It can be obtained from figure 1 that the model comprises the technology transfer process itself which is typically a two way process between knowledge suppliers (science) and knowledge adopters (SME). The transfer process consists of six phases to run through: prologue, initiation, transfer, absorption, integration and epilogue. In the *prologue phase* knowledge adopters perceive their need for new technologies in their internal innovation processes. Therefore they try in the *initiation phase* to find adaptable technologies from available technology suppliers. Afterwards in the *transfer phase* the basic technology transfer process happens and the new technologies get transferred from the supplier to the adopter. For that different methods are on hand, e.g. joint accomplishment of research projects, master thesis and dissertations, personal transfer and contract research. In the subsequent *absorption phase* new technologies should be tested and adopted to the technology adopter's internal innovation processes. This ends in the *integration phase* with well integrated and running new technologies in the internal processes of the companies. Finally in the epilogue phase may some adjustments are necessary given by the technology and knowledge suppliers. During these phases, several barriers, obstacles and resistances may arise and have fallouts to the transfer outcome. Like described above insufficient market transparency of knowledge and technology suppliers, insufficient information about potential partners and their supply, limited competence to identify suitable partners and demand and the 'mental gap' between science and SME are the major barriers in technology transfer processes. But there can be some more barriers and obstacles identified like difficulties with establishing contact, difficulties with articulation of corporate (technological) need and problems, lack of trust and of interest in transfer activities, wrong mutual perceptions of the partners, uncertainty and concerns regarding transfer activities during the transfer process, insufficient motivation of both partners during the transfer process, insufficient absorptive capacity, lack of financial, infrastructural and personnel resources and inadequate qualification of staff. Identifying and minimizing these transfer-inhibiting factors in a critical aspect for doing sustainable technology transfer processes. For that, as seen in figure 1, well trained *technology transfer facilitators* (TTFs) could be installed. The essential task of TTFs is to interconnect technology suppliers with adopters, to support them during the whole technology transfer process in order to improve and intensify transfer activities and additional to identify transfer-inhibiting factors and to set appropriate measures to minimize or avoid them. Hence they are intermediaries which play the role of boundary-spanners, which take knowledge and technologies from one domain and apply it in another. So TTFs typically offer support in the form of consulting and information services as well as direct transfer services and they strive to improve preconditions for a successful transfer on the part of both science institutions and companies.

4. Training for Technology Transfer Facilitators

In the project KBB Trans a holistic training course on several issues on technology transfer was developed. The course targets all main areas of technology transfer and offers the TTFs know-how in the most important aspects of the daily work as a technology transfer expert. The TTFs need to be trained in several topics shown below. The training takes about one week and is designed in a modular way, so the trainers get trained in different modules, each for a specific content. The preparation of the modules and the provision of the attendees with the information needed is done using an eLearning platform which offers both, a file up- and download area and tools for synchronous working. Using that tools, the training could be provided from any place in the world and the attendees would not have to travel to the place where the course takes place. Attendees of this training course should have a technological background and a network within science and industry. Being a TTF requires access to a wide range of technology experts. According to these attendees of the KBB training courses are well selected and coming from universities, business incubators and technology parks.

4.1. PROJECT KBB Trans training course:

TTFs need a deep understanding for the functionality and barriers of technology transfer processes and change management and consulting as well as knowledge in business modelling, marketing and legal aspects. Followed the modules of the KBB Trans training course are shortly presented.

4.1.1. Module technology transfer models

This module covers the analysis of the knowledge transfer system and its framework, academia-industry collaboration, stakeholder analysis of the transfer system, knowledge transfer processes in general, technology transfer process models, obstacles and hindrances in the transfer processes, supporting factors and resistances in the transfer processes, technology transfer as service innovation, feasibility studies and business cases in technology transfer projects.

4.1.2. Module business models

The main topic covered in this module is the explanation of business models. The participants of the course have to know exactly what they are needed for. Other topics covered are the 7C Model to describe business models, deriving a successful competitive strategy based on a company's business model, monitoring and controlling the implementation success via the balanced scorecard model.

4.1.3. Module change process

This model handles the following topics: dynamic organisational development; constructivism in organizational development & leadership; systemic way of consulting; methods of process consulting; overview of phases of a change process.

4.1.4. Module technology management

To work with new technology participants have to know about technology assessment, technology evolvement, disruptive technological changes, technology adoption, technology management, technology foresight activities, technology scanning, scouting and hunting, technology calendars, trees and roadmaps, technological trajectories, internal and external technology marketing, risk management & technology management.

4.1.5. Module knowledge transfer

The knowledge about basics of knowledge management and knowledge transfer, knowledge transfer phenomena, knowledge sourcing, knowledge transfer processes & innovation processes is essential for technology transfer facilitators. Therefore this module handles this topic and shows the participants how to use that knowledge for upcoming projects.

4.1.6. Module product& service dissemination

The following topics are covered in this module: basics of marketing & marketing mix; basics in public relations & information design; basics of internal marketing; use of multipliers in change communication; use of new media in communication.

4.1.7. Module Market& Technology alignment

This module describes the role of business models within current technology competition, provides a strategic framework for business modelling and describes the design of key elements of a business model, namely the value proposition, the revenue mechanism and the design of a value network.

4.1.8. Module EU- and national IPR´s

Knowledge about legal aspects of technology transfer, especially in the field of intellectual property right is fundamental. The module focuses on intellectual property right in the context of patents (utility models), designs, trademarks and copy rights in Europe.

4.1.9. Module EU-funding programmes

In this module an overview on existing funding programmes on innovation and technology transfer in Europe is given. Furthermore each partner worked out also national funding programmes on technology transfer.

5. Conclusion and Practical Implications

Technology transfer facilitators are the main tool to get technology transfer projects started and keep them running. Those people are trained in technology transfer processes, business modelling, change management, funding procedures, project management, innovation management and all relevant legal aspects. The TTFs get in touch with SME, find out about their current situation and the technologies used and evaluate the possibilities of implementing new technologies into the business. The next step is to find partners which can provide the knowledge and tools to help the SME to implement the new technology. The first communication between the science and the companies is initiated and moderated by the TTF which will also monitor all steps and changes within the project. If problems occur, the TTF will act as mediator and try to solve them together with the companies involved. After successfully finishing the project, the TTF will keep in touch with the SME to see if the new technology can be used in the intended way. After the first KBB training course 12 pilot projects on technology transfer between science and SME in the Austrian-Slovenian border region were realized in this way. The experiences made in this pilot project shows that the 'mental gap' between technicians and managers of SME is the main challenge TTFs has to handle with. That requires well-trained competencies in consulting and a deep understanding of technician's dominant logic as well as manager's dominant logic. For that we recommend to deploy TTFs with a background from both sides. Furthermore technology transfer processes are characterized by phenomena of change processes. For that we would extend further training courses with a deeper training in change management, communication, consulting and coaching. Last but not least we recognized that technology transfer processes aren't totally predictable and unforeseen events normally emerge. This needs flexibility of all participants and a good project management during the whole process.

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Track 7: Technology Transfer

2013 International Conference on Technology Transfer

Challenges of Cloud Computing in Technology Transfer

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Abstract

Cloud computing is a new technology which is in the period of transition between early adoption to early majority stage, expecting that soon it will reach the mass usage lifecycle. A lot of technology oriented challenges address clouds, starting from application redesign, to developing new elastic and scalable solutions, to security issues, and enabling increased performance with reduced costs. In this paper we address some of these challenges and cloud computing innovations. We will especially refer to them as very attractive to young entrepreneurs and companies in the technology transfer.

Keywords: Cloud computing, SaaS, PaaS, IaaS, security

1. Introduction

Armbrust et al. define cloud computing, as the long-held dream of computing as a utility, with the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased [1]. Cloud computing is seen as the great network-tech breakthrough, that might bring us to the ”cloud society” after the PCs and the Internet brought people to the ”network society”, with prediction that all the everyday usage of PCs will be transferred into the clouds (virtualized mass-computational servers which cooperate on the Internet)[2].

Cloud Computing refers to applications delivered as services over the Internet and also the hardware and systems software in the data centers that provide those services. In general, cloud computing is web-based processing, whereby shared resources, software, and information are provided on demand to computers, smartphones, and other similar devices [3].

There are lot of could providers on the market, mainly offering infrastructure and platform shared resources, and new emerging cloud providers of software services. Typical examples include Google [4], Salesforce [5], Amazon [6], Microsoft [7], Xen [8], Zoho [9], etc.

The market trend for cloud-enabled devices is also growing. According to the recent sources [10], there are more iPhones sold daily (> 378.000) than average number of babies born on the planet (avg. 371.000). The emerging cloud devices have been used in most environments, and for example are mostly likely to be the devices used in Kindergartens instead of chalkboards. Another example in favor to cloud devices is that eReaders have surprised traditional book sales. All these facts support the usage of cloud solutions and cloud-enabled devices in each area of business and life. According to a Manhattan Research survey [11], more doctors use

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hand held devices, such as iPads for decision-making in the UK than any other European country, within specific hospitals. They are used for accessing 3D medical images and holding urgent case conference between teams and the technology is also widely used for education.

The challenges seen in the cloud computing area, making it a hot topic for research and development, are in the design, modeling, developing and creation of various cloud applications. The problem is not exposed in a simple transfer of a web-based application from on-premise to a cloud environment, but there are a lot of open issues to be solved. For example, a simple application is not designed to be elastic and scalable. Other examples include configuration of optimal resources, i.e. virtual machines (VMs) to achieve maximum performance for minimal costs, ensure proper measures to enable sufficient security, etc.

In this paper we refer to several challenges in application of the cloud computing area, attractive for young entrepreneurs and other companies in technology transfer, expecting that a lot of research and development activities will be realized in the forthcoming period.

The rest of the paper is organized as follows. Section 2 addresses the relevant definitions and basic concepts. We give overview of state of the art of existing solutions and implementations in Section 3. The main discussion of open research questions and development challenges are presented in Section 4. Finally, Section 5 presents the conclusions.

2. Background

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics (on-demand self-service, broad network access, resource pooling, rapid elasticity, measured service), three service models (Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS)), and four deployment models (private, community public and hybrid cloud) [12], as depicted in Figure 1. The services are offered as three major types: IaaS, PaaS, SaaS and customers can select to migrate services to public clouds, build their own private cloud or both, i.e. build hybrid cloud, either commercial or open source clouds.

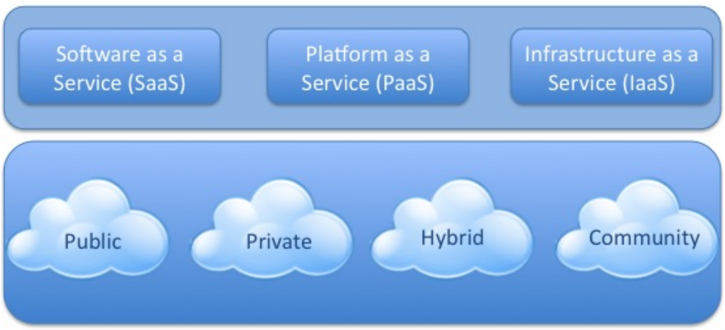

Fig. 1. Visual model for cloud service and deployment models [13]

Each cloud has different benefits. The public cloud offers scalability, elasticity and cost reduction, but lacks security [14]. The company will be more secured in private cloud, but it is more expensive and lacks scalability and elasticity [14]. Building its own private cloud is the most secured solution. Figure 2 depicts different levels of security, scalability and elasticity for each cloud deployment model.

The generic cloud computing based ICT framework to support the design process of migration to clouds will consist of specification of the core architecture platform, based on virtualization techniques to store database, applications and cope with increased computing and communication demands.

Cloud computing has already emerged as a new paradigm for hosting services, applications and data on the Internet. It provides new technical and business features: lower capital investment costs (CAPEX) and operating

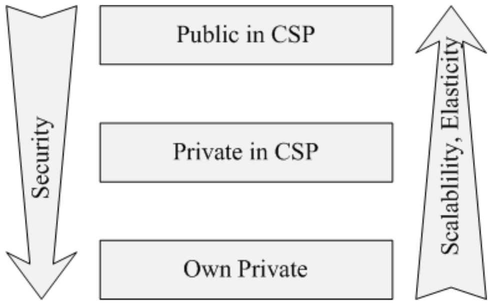

Fig. 2. Different levels of security, scalability and elasticity for each cloud deployment model

costs (OPEX), highly scalable and elastic resources, easy access, reduced maintenance expenses, and access from everywhere[15]. Very important is the payment model, i.e. ”pay-for-use” [16].

Despite the business benefits, cloud computing raises several security challenges that depreciate the cloud consumer business continuity: data privacy and protection, regulatory and standards compliance, loss of control, data location, heterogeneity, complexity, and interoperability, multi-tenant environment, and disaster recovery - RPO and RTO compliance and effectiveness [17]. However, regardless of the security concerns, the cloud market growth is rapid.

In addition to their proven business applications, cloud platforms are also suitable for hosting online learning applications. They provide a sustainable environment to host both the application and the training data. Cloud architecture provides a flexible environment for e-learning deployment [18] and is easy to maintain, is scalable and covers geographically unrestricted population of users.

3. State of the Art

The most used cloud service is IaaS. Open source clouds (OpenStack [19], OpenNebula [20], Eucalyptus [21], etc.) are oriented to different target groups such as enterprises, small clouds, or scientific clouds [22]. Commercial Storage Clouds provide remote storage (for example, Amazon’s S3 [23], SimpleDB [24], SQS [25] or Microsoft’s SQL Azure [7]). PaaS use is also growing with the most common Google App Engine[4], Windows Azure[7] and Force.Com [5].

The most powerful cloud feature is building scalable and elastic SaaS applications that are still in their early adoption phase in the cloud market. Although all major global ICT companies have already migrated their services in the cloud, the software is still not offered with pay-for-use, like hardware resources are.

The main power of the cloud is SaaS, i.e. using the services only through a web browser and Internet connection. The customers do not need administration nor maintenance. Google’s Drive [26] and Microsoft’s Office 365 [27] are the first step into SaaS offering. SAP have already migrated to the cloud and are changing the licensing policy [28]. More and more companies use CRM SaaS application, such as SalesForce [5].

The cloud computing paradigm offers dynamic, scalable and elastic resources to its customers. It is the newest generation of computing after Mainframe, Personal Computer, Client-Server Computing, and Web. Gartner [29] forecasts 19.6% growth of public cloud services market, or a total of $ 109 billion worldwide in 2012. Cloud computing solutions are preferred especially for realizing systems for interoperable content, and for connections to other systems.

Building a prototype for scalable and elastic applications offered as a service will retain the minimal performance regardless of the number of concurrent users and their requests and using several methodologies for security evaluation [30] will increase trustworthiness [31] among providers and consumers.

4. Challenges Beyond State of the Art

In this section we will describe several challenges for cloud computing, especially those that are hot research and development topic.

Challenges will facilitate scalability and virtualization, offering the possibility to support the highest level of SaaS cloud model and dynamic service orchestration. Potential users will not need to install the components; they can access the service through a web browser and Internet connection. The system will retain its performance regardless of the number of concurrent users.

However, all cloud frameworks do not provide the same scalability. For example, Eucalyptus cloud is the best open source cloud framework to build a public cloud services (IaaS) with homogeneous pool of hypervisors. while OpenNebula is the best for building private or even hybrid clouds with heterogeneous virtualization platforms [32].

Migration of existing applications onto a cloud is not a trivial action. The customer has to choose among different providers, has to decide upon service model etc. Usually, the first dilemma is the selection of cloud deployment model. A private cloud offers increased security, but a public cloud offers elasticity and scalability [14].

Recent research shows that cloud providers can take enough measures to ensure the security of private clouds. The most common cloud providers are certified with some security standard [17], such as ISO 27001:2005 [33]. Ristov and Gusev [34] evaluated the conformity of the most common open source cloud frameworks with ISO 27001:2005 security standard. Although all of them reach a high level of security, only CloudStack conforms with the ISO 27001:2005 control objectives that depend on the cloud framework.

The next issue is *development of elastic and scalable solutions*. Here we will tackle several challenges:

- How much can we increase the number of application users requiring more processing power and storage requirements? In this case the idea is to switch from a smaller sized VM to a larger sized VM. This enlargement can not support infinite resources as we wish, at certain point we have to reorganize the application in a such a way that it will handle various processes on different VM instances via a *broker module* which will activate instances of VMs.
- If the application is built for a single company with active users, can it be used for more companies? In this case the application should be re-organized to handle different companies to use the same application and interface, but to think of it as a *multi-tenant environment*. A typical case of desired profit is when a software company would re-use the software, i.e. will sell more instances of the same software. In this case, it will sell only the access and stage of the application.

The idea of the broker module is not new, it has been present for a while. Cloud providers would like to simplify the problems only by allowing selection of pre-defined sizes of requested VM resources, and usually leave this problem to be solved by the operating system environment that schedules different threads to various VM instances. However, a clever software solution is the one that schedules various software modules to different VMs [35]. The existing solutions should be redesigned taking into account the possibility to change the size of required resources, i.e. to activate various VMs.

Another open problem is associated to the motivation to build your own broker module within the application, and be in charge of scheduling. Performance is not usually proportional to the required resources [36]. Cloud providers would like to sell more resources to customers, while the customers would like to use maximum performance from the leased resources. We define this problem as *performance scalability*.

The multi-tenant environment exposes a complete software redesign. All database procedures need to be redefined with access rights defined by the given authorization module. The authorization module would also be linked to an authentication module or use a kind of a cloud web service, such as using a Facebook account to login in the system.

A very important challenge is associated to the *security*. Virtualization, multi-tenancy, and outsourcing the company data and application outside of a company's security perimeter provide additional security challenges. The major security threats in the cloud are: data protection, network and virtualization security, application integrity and identity management [37]. Therefore, the companies and cloud providers should adapt their traditional incident management security policies to cloud computing [38].

Another challenge is using *interoperable content*. This challenge is connected to the data stored and used in the existing SaaS applications. The challenge is especially exposed, when one would like to take all of its data and move to another provider and SaaS solution. For example, if we are using a simple CRM software, we would like to move all our clients, agents and info about the relations they have made. There is no standard about this issue and cloud providers are defining their own APIs to support a kind of interoperability. Even a simple case of migrating contacts from one cell phone to another sometimes is a nightmare, since different providers do not support each other.

The problem is also exposed when the customer would like two different cloud applications to exchange data and information. For example, a CRM application to exchange customers with an e-ordering and an e-invoicing solution. *Content as a service* is a new innovative concept, based on the interoperability challenges, especially when built up in the interactive systems designed.

5. Conclusion

We have analyzed recent trends in the cloud computing and explained why it is a promising new technology. The state of the art analysis describes latest achievements and solutions offered on the market. In this paper we have also described several beyond the state of the art cloud computing challenges that are lately a hot topic for research and development of new solutions. They are also a huge target in the technology transfer, due to the enormous applicability in various areas.

To summarize, the described challenges are:

- migrating applications onto a cloud
- development of elastic and scalable applications
- broker module optimization of resources
- enabling multi-tenant environment
- cost effective solutions with performance scalability
- security
- interoperable content
- content as a service

The overall motivation of a young entrepreneur or a company is to build cost effective cloud solutions in the near future just in time before the mass usage of cloud computing. The timing is perfect for the early 2020s.

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Problems of Knowledge Transfer in Organic Food Production

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Abstract

The paper analyzes how knowledge is distributed inside the so-called "networks" in agriculture. Networks are forms of organization in which knowledge is transferred along a chain of actors and organizations (eg. between research laboratories, companies, etc.). The emphasis is on knowledge transfer in agriculture, especially on differences between knowledge in organic and conventional agriculture production. While in conventional production standardized or codified knowledge prevails, in organic food production there is a need for tacit and localized knowledge. It has been concluded that further development of organic agriculture needs a different approach to the transfer of knowledge to farmers, keeping in mind the particularities related to such production.

Keywords: knowledge; agriculture; transfer; organic food production.

1. Introduction

In the modern world where information overload coexists with growing uncertainty it may not come as a surprise that some theorists argue that knowledge is the most important economic resource and learning is the most important process (Lundvall and Johnson, 1994). To better understand the growing importance of knowledge in economic activity we have to consider the composition of knowledge itself. According to Lundvall and Johnson (1994) at least four different types of knowledge can be identified that may be relevant: *know-what* that is close to what is commonly referred to as "information" and is usually consists of knowledge "of facts." *Know-why* refers to scientific knowledge regarding the principles and laws and this form of knowledge was important for technological change in certain fields, such as chemistry or electronics. Reproduction of know-why is organized in specialized organizations such as universities and industry should engage in certain relationships with such institutions in order to have access to that kind of knowledge. *Knowhow* usually refers to the skills, abilities and it is typically "closed" knowledge within a system that is jealously guarded. However, as the complexity of knowledge increases, companies are coming into a situation where they have to have certain relationships with other organizations to axis tale of the know-how trends.

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Know-who, this kind of knowledge has become important with the growing complexity of modern life and is primarily related to social skills. Know who is primarily related to the possession of information "who knows what" and "who knows how things are done", etc. Most importantly, it involves social skills that enable individuals and organizations to access know-how with others, which is important if one takes into account the large dispersion of know-how skills.

The neoclassical theory assumes that all agents (market participants) are equally able to use knowledge in order to efficiently perform activities, because it is assumed that economic competence (broader definition would mean the ability to solve problems) is present in relatively large scale. In practice, however, there are significant variations in the forms of knowledge and the main difference is the ability to create knowledge within the system and to adopt one from the environment.

Due to these shortcomings of neoclassical paradigm it is considered reasonable to turn to the theoretical approach where learning and innovation are at the center of analysis. Great ridges changes that have affected the food sector in the period after the Second World War must be considered with the use of science, technology and logistics. In industrialized food chain, there is a trend to unify the knowledge of farmers in the codified and standardized forms and in organic agriculture there is an increased level of local, tacit forms of knowledge. For these reasons it is necessary to understand how the knowledge is transferred in organic agriculture, the fundamental differences in the transfer of knowledge between conventional and organic production.

2. Conventional agricultural production and knowledge

In recent years, great emphasis is placed on research of an economy of knowledge. However, when it comes to agriculture and food sector, this aspect is rather neglected. Among other things, it is necessary to come up with an answer why the question of knowledge is neglected in the food sector. Discussion about economic knowledge has often passed agriculture and food production, giving the impression that in these areas there are very little innovation and the application of knowledge processes. Pejanović and Njegovan (2009) state that "... innovation is a new method of production of familiar goods, discovery and production of new types of products, the introduction of new production combinations." However, important innovation in production, processing and retailing in food sector (almost beyond recognition) in post war period were largely ignored by those involved in the knowledge economy.

It is often assumed that although major changes have occurred in the areas of food processing, agriculture has retained its traditional characteristics (such as a large number of small producers, family farms, etc.). However, the processes of food production at the farm level are selectively and gradually changed (Glavaš-Trbić, 2012), and although to some extent this change can be identified as the agricultural revolution, this revolution took place while retaining some traditional features-eg. large number of family producers.

According to Goodman et al. (1987), the process of agricultural industrialization was driven by two imperatives: first, the appropriation where elements once integrated into agriculturally production were extracted from it and transformed into an industrial activity, and then sold back to agricultural production as "inputs", and second, replacement where agricultural products were first cut down to industrial inputs and then rapidly replaced by manufactured non-agriculture components. These two imperatives are used in a growing food industry network, so that the structure of food sector was transformed in favor of an increased share of industrial inputs. The farm itself has remained a permanent factor or transformed food chain, as stated by Goodman and Redclift (1990), family farms have shown a remarkable capacity to adapt and incorporate technological innovation without losing their "family" basis.

As a result of innovations in the sixties, the rotation is considered "obsolete" and many farmers believed they could have almost complete freedom of farming, at least in terms of controlling weeds. According to Ward (1994), "thirty years, since 1950 till 1980, witnessed the chemical revolution in British agriculture. Manufacturing practice was changed and the use of pesticides in general terms ... became the basis of crop production." This revolution has set agriculture on a separate development path associated with the constant use of innovative technology that aims to increase output and productivity.

Basically, what happened with the knowledge base of agricultural producers with the chemical revolution? Crop production followed the rhythm of nature, so the farmers' knowledge was adapted to these rhythms. Knowledge was localized: it was intimately related to the farm and the local ecosystem. However, with the wide use of chemicals, the connection between the farm and the local ecosystem has to some extent been lost. Thus, tacit knowledge, which was established from farm to farm, where the farmer was able to use his "intimate" and personal knowledge related to soil and farm, acquired from experiences of generation, gave way to standardized, codified knowledge related to chemicals. This change in the form of knowledge had other social and economic consequences because the farmers began to rely, and in some respects depend not on their skills and knowledge of the farm, but on external sources, extension or chemical industry.

In this way, knowledge becomes the property of large and powerful institutions that exists at the beginning (and end) of the production chain on the farm. In short, as the market for agricultural inputs grew the form of tacit knowledge diminished. While the conventional model of agriculture was developing slowly and smoothly, producing each year large quantities of product with less noticeable external effects, the farmers could afford to change their local knowledge for the increased output. However, since the conventional model was driven into a crisis, farmers' vulnerability became apparent. The crisis of conventional agriculture occurred because of three main reasons: first, the increasing cost of agricultural support (production of food surpluses), secondly, expressed concern about the quality of food and the third, externalities. Contrary to the trends that were expressed in the sixties and seventies, which involved replacement of tacit knowledge with standardized, today farmers are faced with the opposite problem-especially problems related to the transition from one model to another. One of the questions is how farmers can effectively reconstruct their knowledge in order to accomplish this transition.

3. Organic agriculture as a new technology

Principles and standards of organic farming make a radical shift from the conventional paradigm of production. According to the Soil Association in Britain, certified organic production is the production that is: (1) more coexisting with natural systems rather than dominating it, (2) builds soil fertility; minimizes pollution and environmental damage, (3) reduce the use of non-renewable resources (no chemicals), (4) ensures fair treatment of animals, (5) protects and improves farm environment, (6) takes into account the wider social and environmental impacts of agricultural systems. According to Tomaš (2011), organic agriculture is a part of sustainable agriculture production and the goal is to preserve environment. However, the principles and legislation in organic production are at a different stage of development. In other words, the regulatory rules are still being developed and tested and are therefore still subject to change, all of which increases the risk and uncertainty as the main obstacles for conversion to organic agriculture.

Conventional agricultural production on most farms reached the level of what can be called a habit or routine. This fact is primarily associated with the transfer of production knowledge from generation to generation, since the changes in production technology dates back to the fifties and sixties. These habits and routines are deeply embedded in agricultural production, since agriculture is not just a job but a "way of life." In contrast, organic farming represents a radical discontinuity with the past, nearly complete interruption with the network paradigm of conventional knowledge production, especially with networks that are associated with the use of fertilizers and pesticides. Instead of increasing the cumulative knowledge, which is typical for most conventional innovation, the process of conversion to organic production requires innovators to forget most of the knowledge that was required for intensive production.

"…the role of forgetting in the development of new knowledge has been underestimated. The enormous power of habits of thought in the economy constitutes a permanent risk for blocking potentially fertile learning processes. It may be argued that some kind of 'creative destruction of knowledge' is necessary before radical innovations can diffuse throughout the economy. Old habits of thought, routines and patterns of cooperation, within as well as between firms, have to be changed before technical change can begin to move ahead along new trajectories" (Johnson, 1992).

Forgetting has to be followed with the acquisition of new knowledge, and this is not easy in organic agriculture because, generally the entire sector of innovation in agribusiness with laboratories in chemical companies, government extension services, research centers at universities and research units of leading companies, are focused on gathering, testing and diffusion of knowledge related to industrial food production. This problem of learning is more difficult having in mind the fact that the process of diffusion of innovation is very specific in organic production: organic production was not "discovered" and initiated by the scientist and related services and distributed through advisory services, rather, on the contrary, it was developed by the environmentally consciousness producers and later studied and analyzed by scientific institutions with the result that the formal knowledge legs behind production practice.

In other words, the knowledge deficit can be understood as a system of favoritism at the expense of organic agriculture that extends from the formal to the informal authority of the state, but no less important, to the pressures of farmers from conventional production at the local level.

4. Transfer of knowledge to farmers

"Resurrection" of local knowledge takes on a broader meaning in decentralized chain of organic food production, as it includes not only producers but also consumers. In contrast to the industrial production chain (where the consumer is mostly passive and neglected) the consumer is trying to take more active role in the decentralized organic chain, commonly known as a scheme of direct distribution or local food production supported by consumers.

However, before starting organic production it is necessary to make a decision about converting to this system of production and to start with the implementation. Conversion process involves stages of awareness, evaluation, trial and adoption, and includes the farmer in the new form of collaboration in which their local knowledge is respected and used rather than debased and dismissed as in conventional production paradigm.

The problems of farmers in the conventional systems are linked, nowadays, to their positioning in networks of food production which, for a long time, have been the subject of industrialization and standardization, where the farmers have found themselves squeezed between powerful suppliers and more powerful supermarkets. Problems of state support to agriculture have become evident from the fifties onwards. Searching for ways to reduce costs the government is "pushing" all farmers in more efficient production: farmers were under considerable pressure to adopt the most productive technologies in order to decrease their costs. With subsidies directed towards agriculture, farmers have had a security and finance to invest in new technologies. In the second half of XX century the key innovation in the sector of agricultural production was the potential use of chemicals in weeds and pests control.

However, with the growing problems in conventional agricultural the need to replace this type of production with other became obvious. Organic farming is one of the possibilities, and the technology itself is a form of innovation for conventional producers. All innovations, according to Dosi (1988) include a fundamental element of uncertainty. One of the "founders" of evolutionary approach put it together in a statement “all knowledge and habit once acquired become as firmly rooted in ourselves as a railway embankment in the earth“ (Schumpeter 1934).

Organic agriculture reintroduced the local knowledge, that is, knowledge depended on the context. Later needs to combine this knowledge with new forms of external knowledge are challenge for the traditional extension system at the same level as it is a problem for farmers. In this interactive advisory model, the role of advisors is to act as a facilitator of the learning process within the farming community, rather than as "messengers" of the system. Kopke (2011) states that some of the basic characteristics and the problems they have to faced in this new advisers model. She says that first of all it is important to provide historical data on organic production and market in order to familiarize farmers with the standards in organic farming and organic practices and to explain the role of the organic production. Also, it is important to become well acquainted with the farm, the crop rotation, weeds, pests and diseases, etc. It is necessary to explain the farmers the procedure for applying for certification, key elements related to the plan of conversion, financial implications, and so on.

During the conversion of farmers fundamental issues that need to be clarified (to restore the system tacit knowledge that existed before) are (Kopke, 2011):

1. Family situation: affection, value, goals, motivation, contracts, job opportunities, education, conflict of generations, the influence of the neighborhood;
2. Site conditions: air, soil, latitude, relief, water availability, the alternative sources of energy;
3. Infrastructure: buildings, machinery, quotas, storage, transport resources;
4. Livestock: races, types, number, animal welfare, the capacity of stable, facilities for manufacturing/processing, sanitation facilities, health conditions of animals;
5. Rotation design: household needs, the needs of the nearby markets, technical requirements, regional problems with diseases or pests, the possibility of building soil fertility;
6. Crop selection: genetic resources, biodiversity, quotes, problems with weeds, the expected level of yields, soil type, vegetation period;
7. Nutrient management: sources of nitrogen, N_2 fixation, legumes, green manuring, time, inherited fertility;
8. Production methods;
9. Availability of labor: family, hired labor, location, quality;
10. Distribution channels: local market, export requirements and wishes of consumers, publicity, transport, cooperation and quality;
11. Gross margin;
12. Investment, loan status, rates and availability of grants.

Production method in organic agriculture is specific and it depends on location. Applied researches are dominant, although this does not imply discrimination or disrespect for fundamental science. General, internalization of knowledge and facts and understanding of successful transfer is more important. Applied knowledge that fits individual goals is what is required. In organic farming, there are no recipes or standards that may be applied. The proper implementation of methods and techniques in organic farming in number of cases is determined by the conditions of the site. Any education related to agriculture will always require a practical component of lectures on the field.

However, a holistic approach to the research of organic agriculture is also necessary. It implies (Kopke, 2011):

- Systematic research, including perennial crops and experiments with systems of production,
- A participatory approach involving all stakeholders in research, including research on the farm, and
- The inter-disciplinary approach to research involving "non-agriculture" disciplines of social sciences and humanities, and combines them into a systemic research methodology.

Local knowledge is required by producers in the decentralized food chain must be more than technical knowledge?-Farm: it must include knowledge of the market (in particular the characteristics of the local market) and "know who" (know-who) knowledge related to the network through which manufacturers can come to market that are not just local.

5. Conclusion

The question of economy of knowledge, innovation and technological development is a question which has not been given sufficient attention in the agro-economic literature. The system of conventional agricultural is increasingly showing its negative characteristics, including environmental pollution. In response to these problems, new farming systems are established but not without difficulty.

The process of conventional agriculture is in crisis since seventies and the weakness of the economic situation of farmers came to the fore. One of the important aspects of this weakness is their dependence on external, specialized sources of knowledge, because it weakens their ability to explore new agricultural practices. In the organic system farmers have to forget practices that were used in the conventional production system, and must re-learn how to practice agriculture in a way that is more in line with the eco-system and the rhythm of nature. This process of food production also involves learning new forms of distribution of which some are highly localized. Organic agricultural production is a possible solution of certain problems of conventional agriculture. However, for farmers to convert to organic production system it is necessary to adopt new knowledge and innovation. Refusal of re-education is as a barrier to organic agriculture just as weak financial incentives is because without the support of public-designed to help farmers to acquire the skills necessary for this form of production- conversions will be a problem to only a few farmers who are committed to environment preservation.

Model of organic food production involves the use of tacit knowledge in combination with a week standardized forms. This combination tends to re-evaluate local knowledge, local eco-system and local identity so that farmers can again become "agents of knowledge", with the possibility of greater autonomy and control in their relationships with other actors in the food chain and the means of production on the farm.

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Hand-held Interactive Globe Navigation System with Geographic HCI Technology to Improve Spatial Thinking

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Abstract

This paper introduces the design and development of hand-held 3D interactive globe using micro-electro-mechanical systems (MEMS) CHR6dm and ZigBee wireless technique with broader interactive coverage range usage in order to navigate Google Earth (GE) via movement on hand and body, which integrate geographic technology and human-computer interaction (HCI) design altogether. The hardware components, web-based software architectural realization and technological problem solving of this embodied communicational Earth navigation system are described and successful usage of developed product demonstrates the technological feasibility of this designed sensor system for gesture interaction. Moreover, combined with the theory of constructivist learning and spatial thinking that is essential to human intellectual development, the application and training for the purpose of improving spatial thinking ability are designed and presented.

Keywords: Education; Geography; Google Earth; Human-computer Interaction; Spatial thinking

1. Introduction

With the rapid and emerging technological development of computer and smart computational platform, human-computer interaction (HCI) is increasingly crucial and drawing the society's attention as it could help human beings and computer to interact and understand better each other. Focused on user requirement and preference, geography and location awareness related technology, knowledge, electronic solutions and visualization methodologies are more and more important to HCI areas covering social computing, mobile computing, natural user interfaces, social network analysis, and disaster response, etc. Conversely, the corresponding geographic application, research and projects involve the technology of HCI so as to make full use of modern advanced technology-mediated interaction and intelligent computational technology. There is no doubt that the integration and combination of geography and HCI can bring more convenience on human being's life. For instance, location-based devices and services including GPS and GSM positioning which are general class of computer program-level services and hardware system used to include specific controls for location and time data as control features, have made the process of locating specific object on the world feasible, convenient, and automated [1 - 3]. In addition, geosocial networking, i.e. foursquare app, MapQuest Vibe service, and We&Co iPhone app, and so on, which fuse geographic services and capabilities such as geocoding, geotagging and location-based services, enrich social networks for the purpose of connecting and locating users [4, 5].

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Especially, supported by modern spatial data structure and data processing, geographic information visualization technique, graphical presentation language, graphical overlay on map, geometric networks, geostatistics and spatial data mining, geographic information system (GIS) designed to capture, store, manipulate, analyze, manage, and present all types of geographical data, has been exploited to a vast range of applications covering commerce, science, government, and military [2, 6]. Furthermore, some virtual globes such as Google Earth (GE), Bing Maps, and Microsoft Virtual Earth, etc., which integrate simple user interface and publish tools including application programming interface (API) and scripting languages with the capability of easily creating and sharing geographic information and tools, have changed the face of geographic data dissemination and quickly achieved a level of popular acceptance far beyond that previously typical of geographic information systems [2, 7].

In current K-12 and undergraduate classroom, advanced GIS system and GE have been put into class materials and practice for geography teaching and spatial thinking improvement. As one of human being's intelligent elements involving logical-mathematics, spatial, linguistic, bodily-kinesthetic, musical, interpersonal, intrapersonal, naturalistic and existential, spatial thinking relates to analysis, problem solving, and pattern prediction involving objects and their spatial relationships [8]. It can include geometry and geometric thinking, mathematical transformation of information, engineering and architecture, astronomy, geography, informatics, modeling, video gaming, and the arts as well. Spatial thinking is keeping receiving increased attention in that knowing well about Earth where we actually lived both including geology and ecology not only expand business and trade covering range, but also improve our normal lives, such as: journey, meeting people in the world, going to other countries to study or work, and so on. Moreover, analysis and research results of studies for students at school over the past 50 years indicate that spatial thinking can effectively influence science, technology, engineering, and mathematics – STEM disciplines [9].

In the multiple learning methods, like: adaptive learning, auditory learning, collaborative learning, experiential learning and team learning, etc., constructivist learning advocating that students ought to actively participate in understanding and constructing knowledge during study process in order to learn and grasp knowledge replacing normal passive receiving knowledge from the environment, has been an important place in the field of geography education [10, 11].

Our work is to investigate and design ways for people to interact with computers when solving problems concerning geographic space and spatial phenomena. We integrate a hand-held globe with embedded inertial sensor system and one virtual Earth navigation system - GE which maps the Earth via the superimposition of images obtained from aerial photography, satellite imagery and GIS 3D globe. User navigates GE through rotating the globe in the hand along up-down and left-right orientations and moving it forward and backward towards GE so that user can accommodate the natural manner by which people think about spatial problems. Our developed interactive tool exemplifies constructivist learning application and natural interaction which could provide more natural and sensing capabilities for new machines to support spontaneous ways of discovering the real world via human senses including gestures, expressions and movements. Some practices and lessons using this hand-held interactive Earth navigation system are designed with the goal of promoting spatial thinking ability.

The contributions of this paper contain:

- The hardware prototype development of movement sensor system with ZigBee wireless technology for the purpose of larger coverage range gesture interaction.
- The software platform construction utilizing web-based technology.
- The application and training design for improving spatial thinking

The paper is organized as follows. In Chapter 2, we introduce related works regarding GIS and virtual globes, with special focus on education and spatial thinking enhancement. In Chapter 3, the developed 3D hand-held embodied communicational globe navigation system with geographic HCI technology is described, and technical solution and problem solving of this web-based 3D navigation platform are presented. In Chapter

4, we illustrate the training methodology to enhance spatial thinking ability applying this hand-held interactive globe communicational tool. We conclude the paper in Chapter 5.

2. Related Work

J. Schoning et al. [12] investigated virtual globes related usage through survey in recent years and they discovered that the applications and tasks are relatively simple without any spatial thinking. Subsequently, they introduced a new two layers spatial thinking-oriented virtual globe data type – Explicitly Explanatory Spatial Data (EESD) and developed a multi-touch virtual globe to enhance the possibility of spatial thinking and facilitate the corresponding thinking of question “why” about wide virtual globe usage related scenarios.

A. M. Bodzin et al. [13] focused on enhancing earth science education and developed innovative earth science middle school spatial learning materials which use Web GIS with advanced visualization and geospatial analysis including Javascript APIs, Flex, and Silverlight that can be hosted on any ArcGIS Server.

P. Marty et al. [14] analyzed the reasons why existing globe applications, e.g. GE are not suitable for education. Furthermore, they presented some solutions to bridge the gap by creating thematic and topographic maps on a virtual globe application for teaching purpose. Their cared techniques involve the preparation and display of the map tiles, and also focus on an appropriate placement of map labels which considers the dynamic projection of virtual globes.

In contrast with the research and design introduced above, this paper presents a suite of more natural gesture communicational Earth navigation system with fewer cognition loads. With our designed training of spatial thinking, this system could bring more vivid, activated, and intuitive effect on learning and teaching.

3. Hand-held Interactive Globe Navigation System

3.1. CHR-6dm AHRS

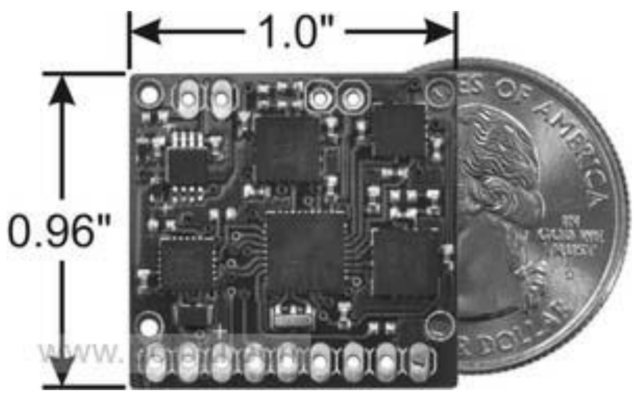

Fig. 1. CHR-6dm AHRS hardware

Our chosen CHR-6dm board shown as figure 1 integrates one 3-axis gyroscope, one 3-axis accelerometers, one 3-axis magnetometers, and a 32-bit ARM Cortex processor with the Extended Kalman Filter (EKF) embedded on the board. This board is a cost-effective orientation sensor providing yaw, pitch, and roll angle outputs at up to 300 Hz over a simple TTL (3.3v) UART interface.

Besides, a Xbee series 2 OEM RF module is connected to this CHR-6dm sensor system because of the broader coverage range, longer battery supporting periods, priority of faster connection to network and lower cost of ZigBee technology [15]. This wireless connection could help gesture communication with much better freedom.

3.2. 3D navigation platform system with gesture interaction

Applying network resource and information transmission technology which could connect this spatial thinking training tool with network and provide more possibilities to supply personalized learning function that exploit learner personalized data and learning history to form learning style for study progress analysis and improvement, to this 3D earth navigation platform system using gesture interaction, web-based platform is built with database and dynamic client-server information interactive web technology.

We configured XAMPP (Cross, Apache HTTP Server, MySQL, PHP and Perl) [16] and integrated Asynchronous JavaScript and XML (AJAX) technique to support database and dynamic client-server interactive web technology.

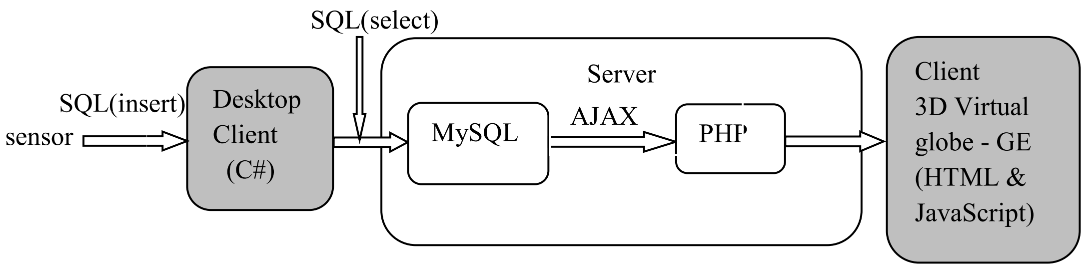

Fig. 2. System software architecture based on XAMPP and AJAX

In this system architecture expressed on Figure 2, MySQL database is the real-time data storage and exchange center which construct bridge between the sensor and GE. Sensor data acquirement is realized by desktop C# program and GE needs to be updated by web-based application. Nevertheless, the communication between desktop program and web-based application cannot be realized by themselves. Therefore, database is designed in this architecture to solve this communication problem. Yaw, pitch and roll angles outputted by EKF and accelerometer measurement, are stored to a database with real-time processing and integration calculation realized by C# serial port communication and sensor configuration software embedded with SQL insert sentence. Client with JavaScript sends asynchronous request by AJAX's XMLHttpRequest object to server which implements requested PHP script. SQL select sentence in PHP acquires real-time data from MySQL. Furthermore, server returns the data to client which updates to GE on the screen. The globe navigation is driven by movement in the following way: The rotation towards left-right orientation changes the yaw angle of sensor attitude estimation, which corresponds to longitude changing; up-down rotation movement controls the roll angle attitude variation that moves latitude placement; forward-upward moving towards GE on the screen makes it zoom-in and zoom-out.

4. Application and Training Design for Improving Spatial Thinking

GIS and geospatial technologies learning have been proved with high correlations with students' spatial thinking abilities [17, 18]. As this hand-held interactive globe system is navigated by hand and body gestures which are understood as more natural and direct expressions than traditional interactive ways as keyboard and mouse, it is effective to improve spatial thinking as corresponding cognition load carried by interaction is reduced. Additionally, the effects of using embodied interactions to improve learning performance have been analyzed by some previous research. The research and theory toward embodied views of cognition has occurred and Embodied Cognition means when we perceive, act, interact with things and events in the surroundings, our bodies can link minds to the world. Barsalou indicates that embodied states can truly influence cognition and can be influenced by cognition as well [19, 20]. Moreover, our developed hand-held interactive globe navigation tool apply the constructivist learning approach that expects students to play an active role of engaging in study and research for deep knowledge acquirement and application, thereby promoting the exploration of cerebrum covering spatial thinking.

Stated by National Research Council, the conceptualization of spatial thinking involves three components interpreted below [21, 22],

- Space

The meaning, understanding and application of location, distance, direction, connection, movement, distribution, network, pattern, scale, latitude-longitude, adjacency, intersections, and regions.

- Representation

Visual displays and linguistic description of spatial information, for instance: maps, models, diagrams, graphs, plots, charts, schematics, illustrations, and spatial languages; the effect of map projections; how features can be displayed cartographically as images, points, lines, and polygons.

- Reasoning

Cognitive processes that combine space and representation related knowledge to problems solving and decision making via analysis, classification, hypothesis, generalization, and evaluation.

Integrated with these three important factors of spatial thinking and referred to some spatial thinking ability lessons from [23, 24], we design a series of experiments and tasks to train spatial thinking ability utilizing our developed hand-held interactive globe navigation system. Participants need to hold on this globe embedded with movement sensor system and move it to navigate GE shown on the screen. Left-right rotation on globe changes longitude, up-down rotation movement controls latitude variation, and forward-upward moving towards GE on the screen makes it zoom-in and zoom-out. The picture below describes the initial posture and navigation methods.

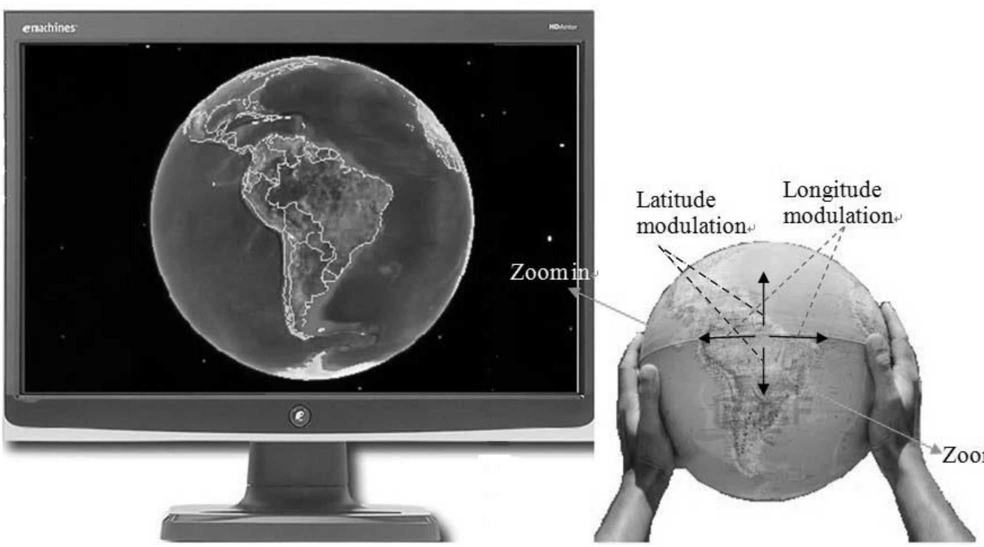

Fig. 3. Initial posture and navigation methods of trainer for spatial thinking capability exercise

The experiment methods to improve spatial thinking are explained as the table 1 below following the sequence from simple to complex and from space understanding to reasoning ability.

Table 1. Designed training cases to enhance spatial thinking ability

Task number	Task description	Spatial thinking ability to train
1	Participants navigate GE from equator to 90°N, from 90°N to 90°S, from 90°S to equator.	Comprehending orientation of up-down and vertical, latitude, north/south.
2	Participants navigate GE from 0° to 90°W, from 90°W to 90°E, from 90°E to 0°.	Comprehending direction of left-right and horizontal, longitude, west/east.
3	Participants navigate GE to view continent, country, city, and street.	Comprehending direction of forward-upward, zoom in/out, adjacency, border, and region.
4	Participants navigate GE to show specific example for point, line, and area.	Comprehending the representation of point, line and area.
5	Participants draw 2D map of navigated 3D view in GE chosen by teacher.	Training the ability of transforming perceptions, representations and images from one dimension to another.
6	Participants image and coordinate views on GE from different viewpoints and draw it. Then, control hand-held globe to navigate GE to actually rotate this chosen object and scene to compare.	Training the ability of projection, mental-rotation ability, perspective-taking ability and envisioning what an object would look like if seen from another position.
7	Participants use basic elements of aerial photo interpretation (tone, size, texture, pattern, shadow, site, and association) to identify objects in aerial photographs.	Training three dimensional visualization skills.
8	Participants navigate GE around specified location set by teacher, and then select related map block from given map block group and make them form the whole map	Comprehending spatial association and training the ability of spatial comparison and graphing a spatial transition.
9	Participants navigate GE and select an ideal location for imaginary object considering multiplex spatial information such as land use, elevation, population density, and so on.	Comprehending overlay and dissolve and training the ability to infer a spatial aura and influence.

5. Conclusion

To realize more natural interaction with fewer cognition loads and put constructivist learning methodology to spatial thinking improvement practice, we design and develop 3D gesture communicational globe tool integrated with CHR-6dm AHRS, ZigBee and virtual globe – GE technology. Web-based software architecture and technological methods are presented as well. The implementation and realization of the hardware and software system construction prove the feasibility of this designed 3D hand-held interactive globe navigation system controlled by embodied information. Furthermore, the series of spatial thinking training are interpreted. This paper advises that spatial thinking skill could be promoted through virtual globe learning system with more natural, direct HCI method and active learning method with more actual participation. This product with spatial thinking training cases is being tested by students came from primary schools and Universities, and their feedbacks are positive. In the future, we will execute Spatial Thinking Ability Test (STAT) [23] on the team who practice our product with spatial thinking training to analyze our product performance.

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Improving Knowledge Transfer Between Science and Industry Across CAPINFOOD Project

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Abstract

The main objectives of CAPINFOOD project are to strengthening the capacity of institutions to support the innovations in the food sector and to promote public awareness on benefits of innovations making the sectoral innovation easier through transnational cooperation. Although the food industry represents an important sector in the economies of the South East European (SEE) countries, the innovation in this sector is not at a satisfactory level mostly due to non favorable environment and deficiency of society's support. Across the CAPINFOOD project, the main barriers of innovations have been exploited by focus group with institutions in 9 countries (Hungary, Slovenia, Italy, Greece, Romania, Bulgaria, Serbia, Bosnia and Herzegovina, Montenegro). Thrain the trainers courses on knowledge transfer have been provided in all 9 countries and a service manual for innovation supporting services is in the phase of development at this moment. The staff members of the partners trained at the courses act as principal national trainers for transferring the new knowledge at national level. After the end of the project the sustainability will be assure by the SEE forum that will be performed for transnational collaboration in order to enhance innovation in SEE by exchange of experience and integration of knowledge.

Keywords: Knowledge Transfer, CAPINFOOD project

1. The importance of knowledge transfer

The improvement of knowledge transfer as a highly important topic for the South-East Europe (SEE) research agenda is one of the main objectives of CAPINFOOD project [1]. This project will provide practical tools for innovation supporting institutions for transferring knowledge generated by research and development (R&D). Knowledge transfer represents a process of capturing, collecting and sharing of knowledge, skills and competence [2]. It is a multi step process to facilitate transfer of information, technology methods, results, products or practical tools from the research sector to the industry according to their needs. In the SEE countries the investment of time and money in the research are not usually reflected through the patents and knowledge protection as well as implementation in the food sector. On the other hand, knowledge remains in

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universities and research centers. The solution of this problem can be find by the creation of networks of knowledge transfer across scientific research and industry which CAPINFOOD project aims to strengthen [1]. It is aiming to utilize the experiences of the collaboration of the National technology Platforms "Food for Life" as new consultation mechanism of industry, suppliers, customers, researchers, institutions, consumer organisations.

Although the large enterprises usually have their own R&D department it has become increasingly difficult to rely only to internal knowledge production [3]. The distribution of knowledge created by science has become more important especially for small and medium enterprises (SMSs) that could not afford the cost of R&D for innovation of their production processes. In order to implement the new products, services or systems in the food industry the researchers need to convince the SMSs, about the benefits and feasibility for investing time, efforts and money into the application of the results of R&D activities. Exchange of views and interaction between the SMSs and research providers is necessary throughout the whole process of the implementation of an innovation project.

1.1. *The main barriers for innovations*

The low levels of knowledge distribution from science to food industry (SMSs) were attributed to many barriers. On the side of the SMSs the most common obstacles are luck of trust, luck of suitable information to start cooperation, luck of awareness of available information, luck of skills, high costs of investment, limited resources for the implementation of the innovation, luck of customer responsiveness as well as languages and culture barriers [2]. On the other side the providers of knowledge encounter with the luck of ability to transfer knowledge to a non-specialists, luck of on-site visits and face to face contact with industry partner and language and cultural barriers [4]. Removal of these hurdles and the improvement of knowledge transfer are considered as a driving force for the economic growth [5, 6].

2. Different tools for identifying needs of food industry and the role of Capinfood project

The food industry in SEE countries consists mainly of SMSs. It is not unusual that their entrepreneurs and managers do not have an academic degree which means that they are not educated to obtained the scientific information. Scientific language is very hard to comprehend without appropriate background of knowledge. For a successful knowledge transfer, information has to be presented into a comprenhensive form that would be well understood for the food industry.

Various means of knowledge transfer exist and have to be used: publications, presentations and demonstrations by expert researchers. Also, there are several possibilities to identify the industry needs and trends, across:

- Questionnaire surveys;
- Focus groups;
- Informal discussions during industry meetings/conferences.

The knowledge donors should collecting informations about the activity of the industry, established good overview of the typical problems and cover available R&D results and practical solutions. For quality surveys the questions should be carefully prepared. It should be clear and similar in style avoiding scientific vocabulary. It should also take into account the time limitations of the respondents and restrict time of the surveys to the necessary minimum [2].

Focus group could be created with participants from several companies with the aim to discuss about typical research and innovation needs of the food industry or with the participants from only one company which would be useful to explore specific company needs. For the preparation of the focus group it is important to careful prepare the discussion outlines taking into account that discussion among participant do not exceed the general topic. Therefore it could be recommended to use the trained moderators who will know how to direct the discussion, highlight and summarize the most important points [2].

On-site visits and interviews are important tools for successful and comprehensive knowledge. For a good interview it should define typical problems, identify the main trends of the market and the challenges for the food sector. Also, it should provide practical solutions in the potential area of interest of the company. The partners in a process of knowledge transfer should build up their relationship based on confidence. It has to be clear that providers of knowledge and the receiving entity will equally benefit from this process [2].

Within the CAPINFOOD project the course on knowledge transfer based on the training material [2] for the key staff of the project partners has already been organised. Thereafter the staff members of the partners trained at these courses have been acted as principal national trainers for transferring the new knowledge at national level by organizing national workshops to the stakeholders of innovation framework. These workshops should contribute to science and industry to think more innovatively about new approaches to solve existing problems and offer future innovative solutions, products, services.

In addition, across CAPINFOOD project a conceptual framework will be prepared to analyse current innovation systems and develop food innovation strategies and tools for improvement. The focus groups created with institutions in each SEE country indicated barriers and driving force of food innovation. The guidelines for the enchancing of dialogue with the policy makers in the countries as well as the joint communication strategy to increase recognition of food innovation, has already been developed.

A national promotion campaign will be delivered in each SEE country. An intelligent knowledge distribution management tool will be developed and implemented to improve access to young people to promote carrier and entrepreneurship in food sector. Without doubt the career development of young scientists is of outmost interest for the knowledge-based economy.

The overall aim of CAPINFOOD project is to highlight the importance of a rapid and efficient knowledge and technology transfer into the food sector and to encourage the connection of conventional food-processing technologies with new sources for innovation. We believe that this will be one of the key issues for the development and success of SEE food industries in the global marketplace.

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