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WBCInno International Conference 2015

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September, 2015 Novi Sad

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Preface

On behalf of all organizers, we would like to welcome you to the International conference WBCInno'2015. This conference with title "*Modernization of universities through strengthening of knowledge transfer, research and innovation*" is envisaged as a final network event within the project 530213-TEMPUS-1-2012-1-RS-TEMPUS-JPHES, but it is also open to the wider scientific community. The purpose of the conference is to provide an international forum for the exchange of useful information over the broad spectrum of fields covered by entrepreneurship, knowledge/technology transfer, university and business cooperation.

The above-mentioned topics have resulted in 35 papers being submitted and reviewed, with 93 authors from 8 countries. Accepted papers will be presented through oral presentations (23) or posters sessions (12).

We would like to thank all members of the Program Committee and of the Organizing Committee for their work in putting together a very interesting and high quality program. We are very grateful to all authors of the papers for their efforts to prepare excellent papers for the WBCInno'2015 international conference.

We thank you all for coming to Novi Sad, Serbia and wish you a very interesting, stimulating and enjoyable time at the WBCInno'2015 conference. We hope that it will be a regular feature in subsequent years.

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SESSION 1: Innovations and University-Industry Cooperation

An Evidence Based Framework for Facilitating Knowledge and Technology Transfer – an International Perspective

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Building on the first-hand experience of partners within the WBCInno project and through working with other practitioners in Knowledge and Technology Transfer (KTT) within Europe, parameters affecting the success of growing good quality KTT endeavours have been explored.
A framework for approaching and managing the development and implementation of KTT activity has been established. This framework is constructed in such a way that it can be adopted and adapted to suit the needs of any organisation regardless of current activity, aspirations and KTT activity maturity.
The framework encourages development of tailored prioritisation at all levels and includes a number of key stages from the development of KTT related Key Performance Indicators (KPIs) through to identifying and fulfilling KTT related staff development needs.
Within the WBCInno project five universities in the Western Balkans have utilised the framework and created organisation specific plans to grow KTT activity. Some of the universities were already highly active while others might be described as fledgling KTT participants.
This paper also explores some of the challenges faced, particularly around stakeholder engagement, encouraging adoption and recognising that different cultures have to be accommodated when working across a diverse range of organisations and economies.

Key words: Knowledge and Technology Transfer, KTT, Development Framework, Western Balkans.

1 Background

This paper is based on part of the WBCInno project which has been running with a consortium of 17 partners from the EU, the Western Balkans, businesses and academia. The WBCInno project aimed to "Modernize WB universities with well-functional and harmonized business support structures and services; facilitate socio-economic development of knowledge-based society in the WBC region; 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, which in turn has the ultimate goal of creating strong entrepreneurial universities and innovative regions; and increase the number of start-ups, spin-offs, and new projects/services/businesses" [1].
The work discussed here relates to the development of a framework known as the 'Western Balkans Regional University Innovation Platform (UIP)' which aims to support the development and growth of a range of Knowledge and Technology Transfer (KTT) activities including commercialisation of research, collaboration between universities and enterprises, and establishing start-ups and spin-offs. The framework also considers and addresses the issues of managing and supporting these activities to optimise success as well as considering ways in which success can be measured and reported.
Though consideration has been given to the needs of enterprises, the focus has been on developing KTT support from a university perspective, given that an assessment of factors influencing KTT within all three strands of the "triple helix" (businesses/university/government) suggests that it is primarily up to universities to influence KTT as the widest range of drivers and blockers is within their gift [2].
The UIP framework has been developed with a target audience of Western Balkan universities per se, though it is equally relevant to any knowledge based partner looking to grow the volume and quality of its KTT activity. A pilot has been running with the five Western Balkan universities who have been members of the consortium and as such have fed into the framework development as well as testing its efficacy.
It is recognised that no two universities will be at exactly the same stage of development. Each will have different strengths and opportunities, and consequently will require different support mechanisms. Furthermore any framework that is to be implemented successfully must support the target users and be seen as an asset rather than a burden; consequently early stakeholder engagement in the detailed 'design'

stage of all aspects is essential in order to obtain buy-in, particularly in the light of historical experiences of infrastructure being established which has had only a limited life. The variance in requirements between and within organisations leads to the need for a framework which maintains flexibility, enabling customisation for each university and further enhancement over time. Customisation must be defined in collaboration with the university itself, and in particular with those expected to engage directly with the framework; customisation by the intended users is to be preferred.

2 Process

Underpinning the development of any appropriate framework is a sound understanding of the parameters influencing the support mechanisms which will be most beneficial to universities. It is clear from work of this project [3] that a single dictated model will not fit all universities as there exists a range of readiness for and development of KTT activity. Furthermore it is transparent that some areas in universities demonstrate clear pinnacles of success, while others are in need of significant support and will benefit from a well-resourced UIP as they seek to grow the KTT activity in quality, scope and volume.

A number of pieces of significant work underpinned the development of the UIP including:

- A review of EU and regional policies and recommendations related to knowledge transfer and innovation which identified the current 'global' environment within which KTT operates, as well as identifying strategic recommendations which are already in place (but not necessarily fully implemented) which aim to facilitate growth of KTT activity and hence grow regional wealth [3].
- A review of best practice within the EU which built on the experience of European partners and a number of other EU knowledge based organisations outside of the consortium. This yielded a number of examples of different KTT models and practises from which to learn, but also accepted that models utilised within the EU may not be directly appropriate for the WBC partners [2].
- A benchmarking exercise of each of the five WBC partner universities carried out by the EU partners through questionnaires, interviews and visits to each of the WBC partner universities which highlight the KTT activities, capabilities, limitations and constraints on a university by university basis [3].
- A mapping of the innovation and KTT potential of the partner WBC universities, by the WBC universities themselves. This yielded printed and on-line catalogues for each university [4, 5, 6, 7, 8], providing a sound base on which to promote the capabilities of each university and to facilitate the building of fruitful partnerships with other organisations and enterprises.

During the benchmarking visits to each WBC partner, discussions explored the potential roles of the UIP framework and associated KTT offices. These gave a key opportunity to move from a position where individuals felt they were having a process inflicted upon them, to one of having a real opportunity to influence the creation of a framework that could provide added value, promote a strategic approach, and support the work of individuals. While the background work provided a sound underpinning to the creation of the framework, it was during these discussions that the impact of the local culture and environment were elucidated and consequently the key areas of the framework were established.

The work described above allowed an initial framework to be drafted for comment and debate before this became a formal proposal to the WBC university members of the consortium. The framework is in the form of an Action Plan for universities, but in its raw state contains no priorities or timescales. It gives a starting point which needs customising by the university, noting that for some a number of the actions will already have been started or even completed, while in all cases priorities will need to be decided, often on a faculty by faculty basis.

3 Core framework elements

The framework developed within the WBCInno project addresses seven areas which are seen as key to successful and efficient KTT growth and some of these are visited below.

3.1 Establishing a good understanding of what is trying to be achieved

The understanding of what is trying to be achieved has to permeate through the organisation, with objectives cascading through the hierarchy so that the performance of those delivering work 'on the ground' supports the faculty and university aims. In this way the university is more likely to support the work of the faculties and conflicting visions can be avoided. It is not a trivial task and is likely to take a number of iterations to agree objectives and associated key performance indicators (KPIs). During this development process it is important to work across the hierarchy, building on existing strengths while shaping and fitting with strategic aims. A key outcome will be a set of KTT KPIs for the University which is acceptable to the Rectorate, noting that KPIs should follow the SMART principle [9], extending this so that

measurement of performance against KPIs is not onerous and where possible is part of the standard management tracking systems. Context is important when setting targets, for example in many WBC regions, unlike in most EU countries; demand pull from the private sector is very low in terms of requests for R&D projects and the need for qualified graduates.

Closely linked to these university KPIs will be more specific sets of KPIs for the faculties, these being evolved with strong input from professors and researchers. These in turn will cascade down to research groups and individuals and it is when the implications of this are considered that the reality of needing to liaise at all levels during the KPI formulation stage becomes more apparent; ultimately individuals will be required to deliver and if KPIs do not map on to their expertise, career trajectory and motivation failure will be ensured, especially in an academic environment. It is important to set up systems for collecting KPI records in a non-intrusive way (possibly via some dedicated record keeping programme) ideally with outputs then being aggregated automatically to enable faculty and university performance to be reported readily on a regular basis.

3.2 Supporting staff in developing their KTT capability

It is imperative to avoid a culture of setting expectations of growth without appropriate support. Part of this will be about equipping people with the skills and knowledge required to grow their own personal KTT activity in line with the faculty and university strategic aims. A good starting point is to establish the staff view of what they see as their development and support needs, which is likely to be linked closely with section 3.3 below. Discussing training and development needs with Professors, Researchers and others engaged in the KTT modes is valuable, but those with lesser levels of KTT expertise and those not yet engaged should not be excluded from the exercise. This is likely to yield a considerable list of activities which would support the development and growth of KTT, but the findings will need to be analysed so that a programme of events can be established that will satisfy circa 80% of the demand.

During the 'establishing needs' and 'training delivery' phases, thinking should be wider than one's own institution. For example, local Business Incubators (BIs) and Science Technology Parks (STPs) may have residents who would benefit from, or could contribute to training events. Similarly other universities may wish to partake in events and such arrangements could facilitate an environment of Life Long Learning, often on a 'quid pro quo' basis. High quality delivery is important and use of other WBC and EU expertise should be considered, alongside using in-house capability where appropriate.

3.3 Establishing KTT support offices

Unless built on a sound understanding the needs of the KTT community there is a risk that KTT offices will be perceived as an overhead that contributes little but utilises scarce financial resource. Professors and Researchers are an invaluable knowledge source, as are staff in BIs and STPs who may form a part of the client base. The opinions of these people should be used to establish a priority list of the support mechanisms which would be most valuable in developing and supporting the KTT portfolio. This will not be a 'one size fits all' scenario and each university will need to define what best fits its current situation through a detailed 'requirements specification', complete with estimated resource requirements and costing. Services offered might for example include IPR support, record keeping, internship management, network administration, sourcing funding opportunities, bid drafting, and promotion of the 'offer.

It is also important to establish a mechanism for ongoing review of the effectiveness of the KTT unit including monitoring of KPIs and feedback from users regarding the usefulness of the services offered. This is not only as a sanity check but also to enable regular review and modification of the support offer.

3.4 Understanding, promoting and implementing the 'offer'

It is often difficult to establish what is available in terms of expertise and facilities within any organisation and this is equally true in the university sector. An activity which yields useful results for promulgation to internal and external audiences is to establish a catalogue of existing research and innovation potential. The initial task is not trivial, but once a catalogue is established, routine updating as new facilities are developed and expertise is enhanced should form part of the updating cycle and ought not to be onerous.

Once the potential offer is understood internally, prioritisation can occur and plans can be established regarding where to focus effort and over what timescale, forming the basis for a five year planning cycle. This will inform plans for the university, faculty and individuals and is equally applicable to active KTT staff and those who are yet to engage. Appropriate financial, managerial and administrative support will need to be planned in parallel, mapping onto other areas such as staff training and growing KTT support.

Promotion of the offer is imperative, e.g. through university wide 'show and tell' events targeting the public, local businesses, and university staff. These will enable the wider community to better understand the research and KTT work of the university and will potentially stimulate opportunities for partnership.

4 Outcomes, Reflections & Challenges

Some of the WBC universities within the consortium were already highly active in KTT and have a long track record which includes notable successes. Others might be described as fledgling KTT participants, but in all cases there is a need to assure the future and enable growth in an effective and efficient way. Even the most successful will need to work to maintain and grow that success as the operating environment changes and staff, the core resource of any business, progress through their careers.

The framework development process was met with a range of attitudes. Some engaged with a scepticism built on a history of infrastructure being inflicted upon them with little consultation, with their best hope being to "be left to get on with it". Others perceived it as an opportunity to engage in discussion, learn from others and feed into something that would support them in working towards their KTT aspirations. All engaged happily in conversation, debate with varying levels of vigour, and commented on proposals.

The WBC universities, the faculties within those and individuals had diverse priorities and were at different points on their KTT development journey. However, all were keen to learn from each other, were happy to share information and opinions, and recognised that flexibility of the framework was necessary if it was to be applicable across even the five pilot WBC universities.

The full proposal for the framework [3] was agreed by the WBCInno consortium in first quarter of 2014. It was then enhanced by each university with specific timelines, priorities and details to fit with their aspirations and circumstances. This process was completed by the universities themselves without intervention enabling ownership of the priorities and timelines to be in the appropriate place.

5 Conclusions

The project highlighted that KTT infrastructure and performance indicators must be directly relevant to users, add value and be easy to use. Flexibility must enable current needs to be met and adaption to accommodate the needs of a changing KTT scenario. Engaging stakeholders from the outset is imperative if success is to be achieved; history has shown that if infrastructure is ill-conceived and not designed around well-defined needs the risk of failure is high. The UIP framework encourages a focussed approach without unnecessary additional constraints.

There are numerous excellent examples of successful KTT within the consortium which provide learning opportunities to be shared through events within and between organisations. The challenge is to nurture the momentum that has grown during the project and ensure that work already completed results in real growth of KTT activity in an economic and political climate that is often seen as not being conducive.

Acknowledgements

The author acknowledges the funding from the European Union through the TEMPUS scheme and thanks all partners within the WBCInno project [1] who assisted in the development of the framework.

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Modes of Knowledge And Technology Transfer: Selected Case Studies And Key Characteristics

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In the initial work package of WBCInno project which has been carried out in a consortium of 17 partners - businesses and academia - from the EU and the Western Balkans a study was conducted to characterize knowledge and technology transfer (KTT) activities of eleven European Universities and RTOs[1]. The aim was to characterize the modes of KTT and to highlight different approaches that lead to successful university-business collaboration. A quantitative comparison of the effectiveness of the investigated KTT modes can act as a guideline where to invest scarce resources .

Key words: Knowledge and Technology Transfer, KTT, Western Balkans.

1 Background

This paper is based on part of the WBCInno project aimed to "modernize of WBC universities through strengthening of structures and services for knowledge transfer, research and innovation" [1]. Specific objectives within WBCInno were

- "To establish a University Innovation Platform (UIP) at five WBC universities for integration and focusing of innovation potential and for fostering technology transfer and commercialization
- To reinforce existing and to establish new university structures and services in the areas of knowledge transfer, research and innovation" [2]

2 Introduction

The objective for the creation of the presented case studies was to highlight good practice of academic institutions` offices responsible for assisting and promoting KTT between university and businesses.
To achieve well-structured responses a questionnaire was compiled and sent to the 5 EU based WBC-INNO partners. They were asked to identify and involve offices which meet the following criteria:

- EU based offices at or in close cooperation with a university,
- at least 10 years of existence (track record),
- Experience with all or most "modes" of KTT mentioned in table 1.

3 KTT offices and their characteristics

3.1 KTT offices presented

The following 10 universities (and 1 RTO) were identified and agreed to be characterized in the study:

- Delft University of Technology (NL), Valorisation Centre
- Graz University of Technology (AT), R&T House
- POLIMI Politecnico di Milano (IT), Servizio Valorizzazione Ricerca
- ZLC Fundación Zaragoza (ES), Logistics Center
- University of Alicante (ES), Oficina de Transferencia de Resultados de Investigación
- University of Brighton (UK), Centre for Collaboration and Partnership
- Vienna University of Technology (AT), Research and Transfer Support
- University of Vienna (AT), DLE Research Services and Career Development
- Hamburg University of Technology (DE), TuTech Innovation GmbH
- University of the West of England, Bristol (UK), Faculty of Environment & Technology
- University of Wales (UK), Global Academy

[1] http://www.wbc-inno.kg.ac.rs/pub/download/13933172475858_knowledge_and_technology_transfer_between_science_and_businesses_academic_ktt_offices_experience_and_good_practise.pdf

3.2 Characteristics of the KTT offices

3.2.1 Support services for different modes of KTT addressed by the offices

Table 1: Support services for different modes of KTT addressed by the offices and relative workload (blank: KTT mode not addressed).

	TU Delft	TU Graz	POLIMI	ZLC	Univ. Alicante	Univ. Brighton	TU Vienna	Univ. Vienna	TU HH	Univ. Bristol	Univ. Wales	arithmetic mean (total = 100%)
R&D collaboration / contract research projects, sc./tech. services	◑	◑		◕	◕	◑	●	◕	◕	◔	◔	42%
Commercialization of R&D results by patenting, licensing	◔	◑	●		◔	◔	◔	◑	◔	◔	◔	22%
Entrepreneurship: spin-outs from university, start-ups	◔	◔	◔		◔	◔	◔	◔	◔	◔	◔	8%
Student mobility, career services	◔	◔		◔		◔				◔		6%
Student projects with businesses	◔	◔		◔	◔	◔			◔	◔	◕	11%
Mobility of academics between science and businesses	◔				◔	◔			◔	◔		3%
Involvement of businesses in curricula development	◔				◔	◔				◔		2%
Lifelong learning, training courses	◔					◔		◔	◔	◔	◔	5%

About half of these service organisations can be regarded as integrated KTT offices whose services cover most of available KTT modes while others are specialized in a specific KTT mode (e.g. commercialization of R&D results). Apart from one, all offices deal with services to initiate and administrate R&D collaboration/contract research and technological service projects. The three most comprehensive fields of activity in the KTT offices surveyed are "assisting R&D collaboration/contract research projects/scientific/technological services" (42% average workload), "Commercialization of R&D results by patenting, licensing" (22%) and "Student projects with businesses" (11%).

3.2.2 Number of persons in the office dedicated to KTT, staff qualification

There is a large variety in terms of human resources devoted to KTT in these organisations. On average (mean) they have 25 dedicated staff, though considering the median value the "typical" office has a staff of 10 persons. It has also been noted that in some cases KTT staff is not co-located but distributed across different offices within the organisation.

Table 2: No. and qualification of persons in the office dedicated to KTT (arithmetic mean of responses)

No. of staff	* 25
Qualification of staff in % (total=100%)	
• science / engineering graduates	58%
• law / business economic graduates	22%
• other graduates	5%
• administrative qualification	13%
• technical qualification	2%
• other qualification	0%

* Median: 10 persons

3.2.3 Sources of funding for the offices

The university budget is in most cases by far the most important budget source for these KTT offices with an average share of more than 60% of the office budget. The university budget is usually planned and granted for a period of at least 3 years which makes planning of services feasible. On top of this most of the offices compete for and successfully attract other public sources which account for another ¼ of the budget (on average). Private income (15% of office budget on average, only 4 offices) is generated e.g. by fees for the management of R&D-projects, proactive KTT activities funded by regional agencies and fees for training.

4 Key findings

4.1 Effectiveness of different modes of KTT

Table 3 below compares the everyday workload dedicated to specific modes of KTT presented before to a qualitative assessment of its individual effectiveness.

Table 3: Effectiveness versus workloads for different modes of KTT

ranking in this table by workload (average)	**Effectiveness** 1 (very effective) to 5 (very little effect);	**Workload** % of total
R&D coll. / contract research projects, scientific/tech. services	**1.30**	**42%**
Commercialization of R&D results by patenting, licensing	2.67	**22%**
Student projects with businesses	2.44	**11%**
Entrepreneurship: spin-outs from university, start-ups	2.30	8%
Student mobility, career services	**2.00**	6%
Lifelong learning, training courses	2.22	5%
Mobility of academics between science and businesses	**2.00**	3%
Involvement of businesses in curricula development	2.60	2%

The importance of "promotion and administration of R&D collaboration or contract research projects responding to Scientific and technological services" is recognized as it is also top-ranked when it comes to effectiveness of KTT measures. However the commercialization of R&D results by patenting and licensing, even though it is second in terms of workload, ranks lowest in terms of effectiveness. Two studies [3] [4] provide some backing for this assessment:
According to the Knowledge Transfer Study 2011 license income of European universities is highly concentrated with "… the top 10% of universities and research institutes earning appr. 85% of all license income (the vast majority i.e. 80% of reported license income is from biomedical inventions). Universities earned, on average, €500,000 of license income per 1,000 researchers p.a.". In comparison Universities with a focus on applied R&D usually generate 25 to 50% of their total budgets from „third-party income", e.g. RWTH Aachen 48%, TU Munich 42%, ETH Zurich 25%. Taking into account that European universities make a total of circa 20% of their budget from "third party income" (according to [4] defined as "all income other than direct national/regional public funding and student financial contributions") the contribution of IP income to achieving greater financial autonomy in times of decreasing public budgets is somewhat limited, or at least a matter for a handful of very successful universities.

4.2 Ways to motivate university staff / students to get involved in KTT

In order to increase researchers´ motivation for an extended involvement in R&D collaboration/contract research projects with businesses the following activities are regarded as most relevant:

- individual consulting on funding opportunities for given projects or project requests; help with legal questions and contract-management to minimize administrative effort; support services for the management of projects obtained from R&D grants schemes
- Communication: good preparation of businesses` cooperation requests by e-mail to accelerate decision-making by the scientists/technologists;

- Training courses by KTT office for researchers in project management, funding opportunities and collaboration with industry.
- Strategic aspects: appointing professors with industrial experience (academics in the engineering and applied sciences are generally very keen to work with potential users of their knowledge and expertise); involvement of key researchers in thematic R&D and innovation platforms set up between industry and university; inclusion of KTT in annual appraisal and performance discussions; including KTT performance in staff promotion routes.

Researchers will be more inclined to consider commercialization of their R&D results by patenting/licensing if the following activities or framework conditions are provided:

- Financial incentives: these can be lump sums (irrespective of revenues from their IP) and/or monetary participation in revenues from their IP (often a 1/3, 1/3 ,1/3 rule applies – university, research group, researcher receive equal parts of net revenue)
- Awareness/appreciativeness/recognition: Inventors` Event (festive presentation of inventors, presentation of good practice cases in technology commercialization)
- individual consulting on IPR questions with respect to inventions, innovation and business contracts
- Communication: Proactive invention and innovation scouting by the KTT office
- Training courses for researchers in IPR issues, in particular IP in collaboration with industry.

4.3 Key elements for reporting KTT performance

Overall KTT performance of a university cannot be directly attributed to the KTT offices` activities only. Considering the average headcount of these administrative offices they usually act as facilitators and advisors in a subsidiary function. Typical KPI (key performance indicators) for KTT offices include:

- # of consultancy cases/meetings with researchers and/or businesses (pre-project phase, funding opportunities)
- # of invention disclosures handled (if applicable)
- # of and income from (eg public funded) projects assisted in the application phase
- Share of self-financing (if applicable, eg by commercial services, post-award administrative services, involvement in KTT projects consortia)

5 Conclusions

For the establishment of new academic KTT offices some key factors should be considered: They should have clear strategic objectives and provide incentives for faculty staff which should be focussed on regional outreach as primary and additional income for the university as secondary performance indicators. IPR revenue expectation should not be exaggerated, “low hanging fruits” such as student projects, testing and measuring services and contract research should be promoted. Additional income for the office may be generated by assisting (pre-award) and administering (post-award) R&D projects. Indispensable prerequisites for all these activities are comprehensive and up to date catalogues of available expertise and infrastructure.

Acknowledgements

The authors acknowledge the funding from the European Union through the TEMPUS scheme and thank all partners within the WBCInno project [1] as well as from the mentioned universities.

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Methodological approach to innovation management

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This paper presents the methodology for transforming the research results into innovations on the market based on "chain link" model proposed by Kline and Rosenberg. It includes five steps: market research, analytic design and technical feasibility, detailed design and test, redesign and production, distribution and marketing. Each step is described with recommended activities that researcher/innovator should realize in innovation process. The paper also briefly presents INNO platforms for innovation management that were developed and launched within WBCInno project at five universities in the Western Balkan Region.

Key words: innovation cycle, methodology, innovation, collaborative platform

1 Introduction

Innovation is one of the principal catalysts for growth and success of businesses today. It has been widely recognized that efficiency in business operational management alone is not sufficient any more to create competitive advantage in the market game. In order to differentiate from the rest of the competition, enterprises are bound to introduce innovations in their business management, marketing, production process, services, design, etc.

In order to facilitate the transformation of research result into innovation in the academic sector, i.e. at universities and institutes, this paper provides the basic guidelines for innovation cycle based on "chain link model suggested by Rosenberg and Kline. Innovation modelling and steps in innovation cycle are presented in more details in the publication Methodology Guide for Innovation [1]. The Guide was one of the major outputs of I3E project, within the South East Europe programme, which gathered 15 partners coming from 8 countries of the SEE area.

This paper also presents principles and results in practical implementation of innovation management specially adjusted to university needs, through launching of five collaborative web platforms for innovation management at five universities in the Western Balkan Region. The methodology for development and structure of the platforms are elaborated in more details in publication [2] developed within the WBCInno project.

2 Innovation modelling - chain link model

The process of transformation of research result/idea into innovation represents the innovation cycle and can be analysed in three phases. The first phase of the cycle is the phase of idea conceptualization which starts from the idea or research result itself with the potential for commercialization and ends with a prototype. The second phase includes the analytical design and testing of functional prototype as preparation for production. The third phase encompasses the production and launching on the market. It is very important for the innovator and his team or organisation, to understand the passes of innovation process and to apply appropriate techniques and methods for innovation management in order to have successful innovation on the market. Since innovation management is specific and unique for each organisation, there is no one innovation model that can be suitable for everyone. On the contrary, the number of recommended models is constantly increasing providing new perceptions of the innovation practice.

One of the frequently used models is Kline and Rosenberg "chain-link model" (see Fig. 1). This model defines the set of steps to be undertaken in order to transform a research result to innovative product, process or method, which makes it especially appropriate for university students, researchers and staff.

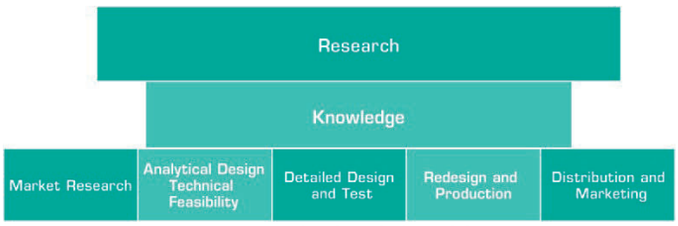

Figure 1 The chain link model

The starting point is research and knowledge of the innovators (both individuals and organisations) which is exploited throughout the process of development of a product or a process. The inventor/researcher and innovator can be the same or different entities depending on their entrepreneurial and business skills and experience. For example, there are different alternatives where inventor/researcher has different roles in the process of transforming the research into innovation (see Fig. 2). However, before choosing any, the intellectual property rights (IPR) aspects should be considered.

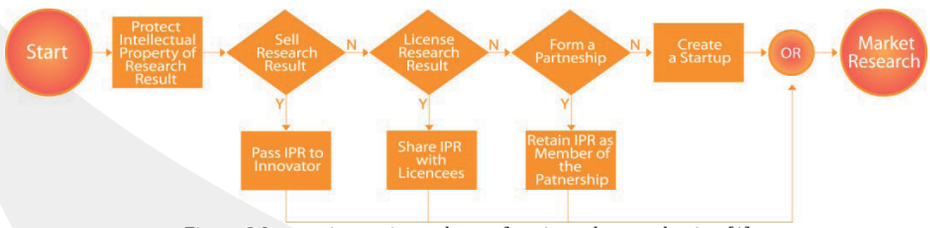

Figure 2 Innovation entity and transforming scheme selection [1]

The "chain-link" model is split into five stages.

2.1 Market research

First stage of the innovation process is market research in order to determine whether there is a need for the innovation on the market and whether the size of the need can justify the investments in the development of an innovation. However, it is not a one-time process, but rather continuous activity that lasts throughout the whole innovation cycle. For implementation of this stage, innovator needs to have marketing skills which is usually not the case so the external expertise is usually sought. The market research results are summarized in the Market Analysis and Plan, containing elements such as target market and its specificities, end-users requirements and expectations regarding the quality and the price, market size, competition, market trends and barriers, competitive advantages and alternative application of intended innovation, feedback from the market, etc. The Plan should be regularly updated.

2.2 Analytical design – technical feasibility

Based on the information previous stage and initial specification of research result, innovator should outline analytical design. The analytical design provides the detailed specification of the intended innovation as an input for the technical feasibility study. It provides the answer whether the research results can be successfully developed into innovation, as well as the potential risks and solutions. Innovator will have the first indications what part of the innovation can be protected in terms of IPR.

Since dealing with the detailed specification of planned innovation, this stage should encompass following issues: state-of-the-art, detailed workplan and structure of innovation project, detailed definition of systems, components and processes needed for the innovation project implementation, conceptual alternatives for the product specification and design, information on production process (in case of product development), risk management, feedback on planned innovation from industry experts, verification of the innovation against the existing IPR rights and determining potential protection of innovation or its parts, potential cooperation with academic/research institutions, preliminary estimation of costs for the entire innovation cycle.

The main outputs of this process should be outlined in the Technical Feasibility Report which should confirm or not that the planned innovation is technically feasible providing the identified technical barriers. The end of this stage is of the main milestones showing the technical and economic feasibility when the decision can be made whether to continue or drop the innovation project.

2.3 Detailed design and test

After the previous stage, the innovator has the clear picture about the feasibility and profitability of planned innovation, so the implementation of the actual innovation process leading to a prototype can be initiated. In this stage, the actual development and testing is carried out and some substantial funding is

required. In order to successfully realize this stage, the innovator needs engineering skills, marketing and cost analysis skills, management skills, etc. which if missing can be outsourced. The main results of the detailed design and test stage is the prototype which needs to be accompanied by Updated Innovation Business Plan that should include the possible market changes. If the prototype is validated, the innovator can enter the production and distribution to the market. If not, prototype needs to be redesigned or the innovation can decide to drop the innovation process.

2.4 Redesign and production

In case that in previous stage, the prototype is not validated and the decision to continue with the innovation project is reached, the project enters the redesign phase. The prototype may not be validated for several reasons such as inability to obtain necessary certification, legal limitation, the achieved innovation does not have the characteristics of planned innovation, changes in the market in terms of insufficient demand, problems with the production requirements, etc.

Any of these reasons may cause innovator to redesign the innovation. In case the redesign is too radical and that the business plan needs to be completely changed, the innovator can decide to abandon the project. If, on the other hand, the prototype is validated and technically and economically feasible, the innovation cycle reaches the new milestone when the full scale production, application or enforcement starts depending whether the innovation is related to a product, process or a method. When planning the "production" phase, several points need to be considered such as production/application facilities, outsourcing opportunities, building industrial alliances, training of staff, quality assurance plan, etc.

2.5 Distribution and marketing

As previously mentioned, marketing activities should be carried out throughout the complete innovation cycle. In the last stage, they are focused on the launching the product, process or a method on the market. Here, an initial promotion of the innovation should be realized in order to attract users and create demand for the innovation in question. This is outlined in the market launch plan, which includes marketing action plan and strategy, feedback from the end-users, training of staff, regular reviews of the project in terms of its profitability, distribution and logistics activities, etc. For elaboration of the market plan, the necessary expertise is most frequently outsourced.

3 INNO platforms for innovation management at WBC Universities

The realisation of innovation process as described above provides some general recommendations and steps for transforming the research results into innovations on the market. With the rapid development of web tools, in recent years there has been a demand to support this process by web solution that would facilitate this process. Following the trends, many companies nowadays use different web and collaborative solutions for managing innovations. However, in the Western Balkan Region, there is a serious lack of application of such solutions for the innovation management in academic sector.

The solution for this problem was brought by WBCInno project (www.wbc-inno.kg.ac.rs) in cooperation with Intranea Solutions company which was one of the partners on the project. The starting idea was to create a collaborative and centralized web supported environment that would facilitate and link different elements of innovation process such as concept documenting, generation and management of ideas, product and service development, marketing activities, and etc. for innovations coming from universities. The result of their effort was five collaborative INNO platforms for innovation management launched at five universities of Western Balkan Region in 2014.

INNO platforms support the entire innovation cycle, from idea management to product and service launch to market. Operationally, they are supported by two applications working under the same platform: Idea Station (for collecting and developing of ideas that can result in new products and services) and Launch Station (for development of these new products and services). Both applications include the decision making mechanism that match the milestones in the innovation process already described above when the results are filtered and decisions on entering the following stage is made.

The innovation process on the INNO platforms starts on the Idea Station with submission of an idea that can be public, shared or private. Depending on the type of the idea, two different workflows are applied: general idea workflow and specific idea workflow.

The general idea workflow (see Fig. 2) is applied in the case of public ideas that are most commonly related to the introduction of innovative aspect in general regarding the education process, working conditions, communication systems, etc. If the idea is specific or business oriented with commercialisation potential, the specific idea workflow is used. In this case the idea owner can limit the visibility idea only to certain Groups (e.g. Student Teams, University staff, Business incubators, Science and Technology Parks, Business organizations, Investors, Business Angels, Venture Forums, etc.).

The submitted idea is further developed within the INNO platform going through several phases (review, scoring, approval, prioritization). If successful, it can be forwarded to the Launch Station, where the project is formed out the submitted idea. Launch Station uses Stage-Gate technology, meaning that after every Stage of the project development process there is a Gate that represents a milestone and decision-making point about the project continuation.
In terms of IPR protection, besides the availability of platforms' contents only to registered users, the contents is additionally protected by Confidentiality Agreement that every new member has to agree to, before registering on the platform. Apart from this, INNO platforms offer additional visibility restriction options that can be set by the idea/project owner.

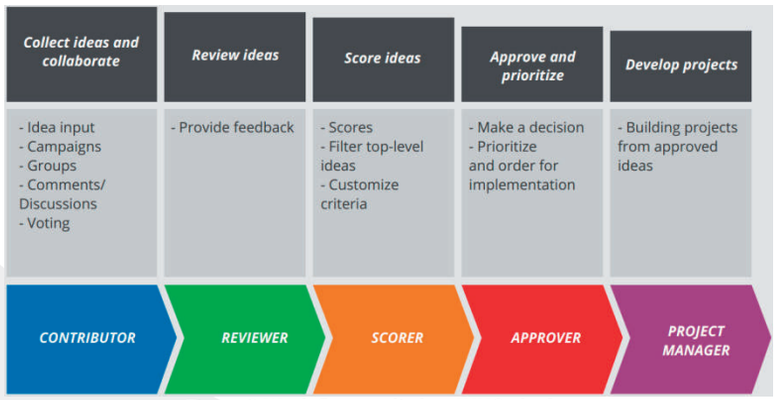

Figure 3 Work flow applied on INNO platforms

Besides the regular innovation management at each university, the INNO platforms were also used for the purpose of collecting ideas within the Competitions for best student ideas which was organized within the WBCInno project at five WBC universities. Organised in groups (teams), the participants collaborated and developed their ideas, going through the innovation process phase by phasing including market research, business plan development, skills development, etc.
The quality of INNO platforms and scope of their use at each university can be measured by reporting system embedded in the each platform, which is an excellent quality monitoring tool. Some of the statistical data related to the use of INNO platforms are given in the Table 1.

Table 1 INNO platforms statistics

	Universities					
Type of Metrics	**Kragujevac**	**Novi Sad**	**Banja Luka**	**Zenica**	**Montenegro**	**Total**
Number of registered members	107	142	38	43	74	404
Number of invited (pending) members	14	1	32	33	90	170
Number of ideas	27	41	8	9	23	108
Number of votes on ideas	165	37	18	21	9	250
Number of documents	346	127	0	0	31	504

4 Conclusion

Innovation management helps organizations to use their creativity to develop new ideas, processes and products. Defined management tools facilitates this process in every aspect by providing the breakdown of activities that more available to adopt and implement.
The innovation culture in Western Balkan Region is an area with a lot of space for improvement, especially when universities and their units are involved in the innovation process. This paper is thus presented in order to give a contribution to the development of this innovation culture, by facilitating it and adjusting it to the needs of university research.

Acknowledgements
This work was supported by EACEA and TEMPUS programme, within WBCInno project (530213-TEMPUS-1-2012-RS-JPHES).

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Stimulating innovations from university through the use of digital fabrication – case study of the SciFabLab at Faculty of Mechanical Engineering, University of Belgrade

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Fabrication laboratory (**FabLab**), first created at MIT-USA, is a digital fabrication workshop equipped with tools that enable students to produce their own prototypes and engage in "learning-by-doing" process. Fablab is a do-it-yourself "DIY" workshop with open-source digital design and manufacturing CNC-machines (3D printers, laser cutters and electronics e.g. Arduino, Raspberry Pi), with a strong focus towards technology transfer options and as such is strongly connected with both the small and medium entreprizes (SMEs) and large industry in a unique ecosystem [1]. There are no such ecosystems yet in Serbia. A project started at the University of Belgrade - Faculty of Mechanical Engineering, already possessing fablab-ready infrastructure [CNC (computer-numerical controlled) machines, lab/workshop space and teaching venue] aims to establish one component of such an ecosystem –a Scientific Fab Lab (**SciFabLab**) as a fablab unit dedicated to scientific research using digital fabrication with special focus on possible industrial applications. SciFabLab acts as a connecting hub between scientists, entrepreneurs and SMEs/large industry enabling efficient technology transfer i.e. putting scientific findings to practice by developing unique technology products. The article will present stages of SciFabLab establishment and conclusions about the ensuing stimulation of innovations and modernization of participating faculties, research centers and universities.

Key words: innovation, digital fabrication, fabrication laboratory, fab lab

1 Fabrication Laboratory - FabLab

A **FabLab** [1, 2], first created at the Massachusetts Institute of Technology (MIT), Boston, USA, is a digital fabrication workshop equipped with tools that allow students to "make almost anything" which is the motto developed by the founder of the Fab Lab concept, Neil Gershenfeld [3,4]. There are over 350 **FabLabs** in 40 countries, open to local inventors, students, scientists, small businesses, and entrepreneurs. FabLab communities are strong in USA, while Europe in general is lagging behind. In Serbia there are currently two fablabs that joined Fab foundation- international FabLab network: Fab Lab Belgrade and Polyhedra Fab Lab, even though both are still in preparatory phases. There is also a first educational FabLab in Serbia being formed as a joint venture of the non-profit organization Fab Initiative run by the authors of this article, Petnica Science Center and Belgrade Metropolitan University, under financial support by the Royal Norwegian Embassy in Belgrade [5].
A case study presented in this article describes the process of establishing a Scientific Fab Lab (**SciFabLab**) as a subunit of the Fab Lab Belgrade. This project is on-going at the University of Belgrade - Faculty of Mechanical Engineering, already possessing FabLab-ready infrastructure [CNC (computer-numerical controlled) machines, lab/workshop space and teaching venue] with the help of the Center of Bioengineering-BioIRC, Kragujevac, Faculty of Engineering, Kragujevac and Faculty of Chemistry, Belgrade.
The main goal of the project is to enable students to use the FabLab equipment for making their own prototypes of the theoretical models from the university courses as well as to provide skills and knowledge to both the students and professors to produce the scale models to be implemented in further STEM education, adaptable for the use both at the high school and university level. Another aim is to establish a facility for manufacturing of the "do-it-yourself" (DYI) instructions for research-grade tools

built from low-cost hardware and open-source software. In a nutshell, the main focus is to establish a place where the good ideas can be realized.

2 Scientific Fab Lab at the University of Belgrade

The engineering approach from theory to its application, i.e. from an idea to realization is the main idea for establishing Scientific Fab Lab at the University of Belgrade, Faculty of Mechanical Engineering (UB FME). Courses in Hydraulic Machinery, i.e. Hydropower Engineering Teaching Module, incorporates, besides fundamental courses, subjects related to the theory, construction, design and testing of the hydraulic machines (pumps, fans, turbines) and turbocompressors. It is an idea to upgrade this approach to the new level - production of the real and operational models. In this way researchers and students will not only do 3D computer models and simulations, but test real models, after internationally relevant standards. They will be able to realize their ideas and test them.

Software for 3D modelling of axial turbomachines is developed. CAD (computer-aided design) model of one axial fan impeller is presented in Fig. 1a, while real model in Fig. 1b. This 3D model was made by casting and polishing afterwards. Complex geometries are now ready to be produced and tested in quite modern way. New CNC (computer numerical controlled) machines, installed at the UB FME, are presented in Fig. 1c-d.

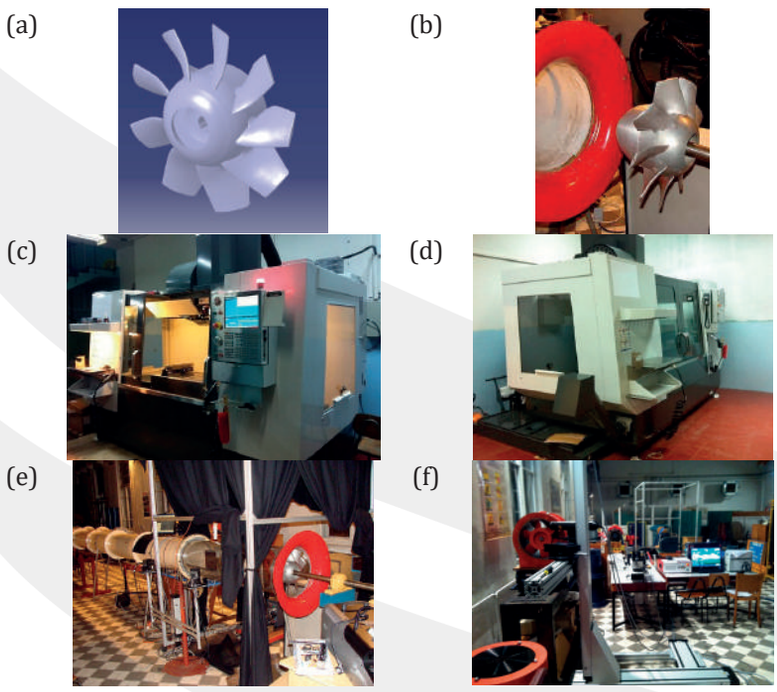

Figure 1(a) CAD model of the axial fan impeller; (b) Axial fan impeller. [2] (c-d) CNC machines at the UB FME: (c) 4-axis; (d) 5-axis.e-f) Test rigs with new experimental equipment at the UB FME: (e) Stereo PIV system; (f) LDA system.

Modern CNC machines, like presented in Fig. 1c-d, provide complete highly automated product design using CAD and computer-aided manufacturing (CAM) programs. These CNC machines use G-code, standardized programming language. They have many functions like milling, drilling and turning and operate in various materials from plastic to steel. First one (Fig. 1c) has 4 axis, i.e. X and Y on the horizontal moving table and Z directed through the rotating spindle, while one rotational is added to the table. Five axis machine has two rotational axis (Fig. 1d). Software for machining simulation is very important. Nowadays the whole machine, modelled accurately, allows simulation software to predict fairly accurately tool and part paths, and check if a production cycle would involve a crash. In the case of 5-axis machining this is strongly recommended.

Afterwards, researchers and students on Master and PhD study levels have also chance to complete their machine tests on one of the test rigs. In Fig. 1 are presented modern experimental techniques for flow study in the technical systems where these machines are usually used. Stereo Particle Image Velocimetry (Stereo PIV) (Fig. 1e) and Laser Doppler Anemometry (LDA) (Fig. 1f) are sophisticated systems for turbulent flow study.

Projects for upgrading the existing test rigs for testing pumps, turbines, hydro-equipment, fans, turbocompressors and etc. would encourage not only researchers and students in this field, but also industry. In addition, it is a plan that Scientific Fab Lab would involve other modern production methods, which would help, for example, production of the radial closed turbomachine impellers.

3 FabLab scale models in STEM education

Contemporary STEM (science, technology, engineering, math) education is based on the problem-based learning projects approach, with the following objectives [7]: to increase the ability of students for performing enquiry-based tasks; to develop students' self-directed skills; to develop students' ability to work and function in groups; to develop students' research and information retrieval skills; to prepare students for their professional life in the future (engagement with complex problem or scenario, that is sufficiently open-ended to allow a variety of responses or solution, etc.)
Problem based learning in engineering education is typically based on the scale models produced by firms with long time experience and reputation in production of education equipment like: Feedback Instruments Limited; Armfield Limiter; G.U.N.T. Gerätebau GmbH; QuanserColsulting Inc. Typically, laboratory models are high quality products that are expensive, with specializd user interface and limited educational potential. The software tools for use with these products are mainly developed with expensive software packages like Matlab/Simulink or LabVIEW. Users get tutorial for using of already developed software with recommended educational methodology.
On the other side, products like: Fischertechnik; NXT LEGO Mindstorms are less expensive and intended for users of younger age. Besides use for science promotion, they are adequate as sophisticated tools for education of youngsters, and are used in university education also. Main advantages are available prices, modular design, flexibility of applications, and are therefore adequate for mass education (the price of one lab workplace as significant indicator). Generally, on the global market there is a lack of contemporary laboratory systems with open architecture having available prices. However, FabLab concepts can support generation of such products which are modular, customizable with acceptable prices. Moreover, scale models can be products of student education through a contemporary paradigm of STEM problem based learning approach.
Student project implementations should use a new approach for synthesis of laboratory models which are based on the following technological trends: FabLab concept of product development (product digital fabrication); Mechatronics approach for product development (Integration based on synergistic effects of electrotechnical, mechanical and software engineering, i.e. integration of different kind computers in products like on Fig. 2).
More precisely, innovative characteristics of student products should be: Open architecture and product modularity; Possibility for mechanical housing components to be produced digitally by user according to FabLab principle using 3D printers and supplied digital code in data file defining 3D printed form; Acceptable prices and educational potential that is based on products fabrication documentation, set of typical software examples and case studies according to standards defined by "project user".
Digital production has the important benefit that the product can be made locally by the user having the digital code in file defining the shape of the object that can be produced by some method of FabLab fabrication.

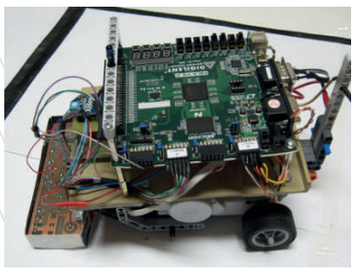

*Figure 2*Illustration of the student project: Integration of Nexys2 FPGA Board in the mobile robot [6]

Planned products and production technology stimulate technological improvements as they directly promote science – STEM and contemporary education which should enable higher level of learning, problem oriented education, using of computer supported technology by students, integral approach to design of devices and systems, understanding of concepts and principles of physical phenomena and systems of engineering.

4 DIY scientific equipment produced in the SciFabLab

FabLab equipment in combination with free and open sharing of detailed design blueprints and accessible development tools, allows the research scientists and, especially, educators to customize existing lab equipment or even build sophisticated lab equipment from scratch for a mere fraction of what commercial alternatives cost [11]. The authors collaborate with two laboratories in USA and Canada that possess expertise in manufacturing of the research-grade tools built from low-cost hardware and open-source software (Backyardbrains and Pelling lab, University of Ottawa). Currently, the first prototypes of the 3D printed pipette are being optimized (Fig 3), while the DIY CO2 incubator/bioreactor for mammalian cell culture is in preparation. The produced DIY wet-lab equipment will be tested and utilized in the Center for Bioengineering-BioIRC and at the Faculty of Chemistry, University of Belgrade.

4.1 Open Labware designs for a biology/chemistry lab

The table shows the sources intended for the DIY tools for biology/chemistry labs to be produced in the SciFabLab

Table 1Open Labware designs, adapted from [11]

Area	Project	Source
Microscopy	Smartphone Microscope	http://www.instructables.com/id/10-Smartphone-to-digital-microscope-conversion
	Raspberry Pi Microscope	http://www.thingiverse.com/thing:385308
Molecular Biology/Chemistry	Thermocycler (PCR)	http://openpcr.org/ http://www.thingiverse.com/thing:151406
	Centrifuge	http://www.thingiverse.com/thing:73910
	Colorimeter	http://www.thingiverse.com/thing:255519
Other	Micropipette	http://www.thingiverse.com/thing:210756
	Syringe pump Vacuum pump	http://www.instructables.com/id/The-simplest-vacuum-pump-in-the-world/

Figure 3Prototype of a 3D printed micropipette produced in the SciFabLab in cooperation with PolyhedraFabLab

5 Conclusion

The Scientific Fab Lab (**SciFabLab**) is being formed at the University of Belgrade - Faculty of Mechanical Engineering in collaboration with the non-profit organization Fab Initiative, Center for Bioengineering-BioIRC-Kragujevac, Faculty of Engineering -Kragujevac, Faculty of Chemistry at University of Belgrade and in close cooperation with the already existing Fab Labs in Belgrade - Polyhedra Fab Lab and Fab Lab Belgrade. In fact, the SciFabLab is intended to operate as the subunit of the Fab Lab Belgrade, dedicated to scientific research using digital fabrication with special focuson possible industrial applications. Currently, the existing infrastructure is being used for the fabrication of the 3D models for the Courses in Hydraulic Machinery at the FMU, for the first prototypes to be used as the scale models in STEM education, and for DIY research-grade tools. The next steps will be focused on integrating the entrepreneurship aspect and enabling students, professors and scientists to start the technology transfer process. This will require establishing a network with the Business Technology Incubator of the Technical Faculties, the Innovation Fund, Serbian Venture Network and other similar organizations. The initial contacts have been already established and the solidifaction and actual new projects are well on the way.

Acknowledgements

The authors are supported as a group by the US Federal Grant SRB100-15-GR-364 and individually IG: ON174028 and III4100, DjČ: TR35046; MM: TR 33022; RP: ON172049

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Approaches in the Development of Research-Driven Business Incubators and Science and Technology Parks in cooperation with universities

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This paper presents six recommended mechanisms for development of research-driven business incubators and science and technology parks in collaboration with universities' research centres and laboratories. Those measures are related to using university resources, both equipment and expertise, logistic support in knowledge transfer activities, involvement of young researchers and students in entrepreneurial and innovative ventures, and so on.

Key words: high-tech innovations, university, enterprise, science and technology park, business incubator

1 Introduction

In today economy, business incubators (BIs) are valuable support structures for new and start-up companies. In Western Balkan (WB) Region, the most of this support is limited to administrative, business consulting and networking services. The research and technology component of incubators is still underdeveloped and as such has been subject of interest in recent years. If an innovative structure such as incubator is to provide research and technology know-how to its tenants, allowing them to be more competitive and to diversify on the market, a strong link with universities needs to be established.
On the other hand, by its definition, science and technology park (STP) is an environment that supports and facilitates university-industry cooperation with the aim to boost technological and knowledge-based economic development of the region. In this case as well, the cooperation with university is essential.
Section 3 of this paper presents six recommended measures that support the establishment and development of research-driven BIs and STPs in the WB Region. These measures were fully described in [3], taking into account the world trends in the development of these structures and the current state in this area in the Region. The publication was elaborated and published within the WBCInno project as the result of work of 16 authors from WBCInno consortium.

2 Development of business incubator and science and technology parks in the world and in the Western Balkan Region

The development and growth of incubators across the world is driven by different factors (development of entrepreneurial culture, appearance of new technologies, more frequent involvement of universities in technology transfer activities, etc.). Early incubator programs appeared for the first time in the late 1950s and early 1960s in the USA, but structures similar to today's incubation programs appeared in late 1970s and early 1980s. Most of those incubators in the late 1990s were run by economic development agencies or local government agencies, in order to boost economic development, while the rest were run by universities and colleges [1].
Silicon Valley in the USA was the first step in creation and development of the STPs in the world. Once known as Stanford University Science Park, it was founded in the early 1950s. After this, another one was founded in France (Sophia Antipolis) in the 1960s and in Japan (Tsukuba Science City) in the early 1970s. Today there are more than 400 STPs worldwide and their number is still growing. [2]
In the WB Region, the development of these innovative structures came rather late. In Serbia the first initiative for the development of BIs in Serbia started through the ENTRANS Programme, funded by the Government of the Kingdom of Norway. With the support of the ENTRANS programme, the first BI in Serbia was established in 2004 in Nis, with 14 incubation units and 4 year incubation period. As result of this and similar initiatives, 23 BIs were established in Serbia, with initiatives to establish additional five.
In Bosnia and Herzegovina, the first institutional approach in development of business incubation appeared in 2005 within the project BIT center Tuzla launched by Municipality of Tuzla, University of

Tuzla and Norwegian SIVA and SINTEF, while the first incubator in Montenegro was in the field of information technologies (IT), founded in 2008 by DDSME and the Capital City of Podgorica. [3]
The available documents related to the BIs and STPs [4] found that in WB region, those innovative structures are mainly funded by municipalities and international programs for support. They most often do not have the research-driven and high-tech innovative component. As leaders and generators of research and innovative activities, universities can contribute by bringing this knowledge- and research-based component to BIs and STPs tenants, allowing them in that way to gain competitive advantage, gain additional profit and reduce the time-to-market.

3 Measures for the development of research-driven BIs and STPs in WB Region

3.1 Using university resources for strengthening of innovation potential

The structure of BIs' tenants in WB Region is such that they are mainly micro enterprises. They do not have necessary resources in-house to develop high-tech innovations. The exception is ICT enterprises dealing with software development whose main resource are people (programmers). For the remainder of BIs/STPs tenants, innovations are mainly related to organisation and marketing. In both cases, pursuing innovations does not require expensive investment in modern equipment, laboratories, product development technologies, etc. However, for those who pursue high-tech innovations, necessary resources can be provided through outsourcing and at this point the role of universities is significant.
WB Region is home to large number of universities well equipped with modern laboratories, research centres, experienced staff, unique equipment and software, etc. Hence, they are the most suitable and most extensive outsourcing opportunity that can provide missing resources and boost the high-tech innovations in BIs/STPs tenants. For example, Serbia is home to 18 universities: 8 public and 10 private universities [5]. In Bosnia and Herzegovina, there are 9 state and 26 private ones (including standalone faculties and high colleges) [6], while in Montenegro there is one public and two private universities [7].
However, many of their resources have not been mapped and in many cases are not visible to BIs and STPs, which is one of the prerequisites for establishing any kind of links. Large efforts in the systematization of available resources at the WB universities were invested within the WBCInno project. Five universities in those three countries conducted the mapping of their innovation and research potential (University of Kragujevac, University of Novi Sad, University of Banja Luka, University of Zenica, University of Montenegro). The results are shown in the form of five catalogues of research and innovation potential for each university [8]. Each Catalogue presents the preview of a university's research units, laboratories, knowledge transfer centres and research groups, with the description of activities, available resources (equipment, software, staff, methodologies, trainings, etc.) and contact details. Mapped units were additionally classified in accordance with Field of Science classification (FoS) and a structure of mapped innovation and research potential was outlined (see Fig. 1)

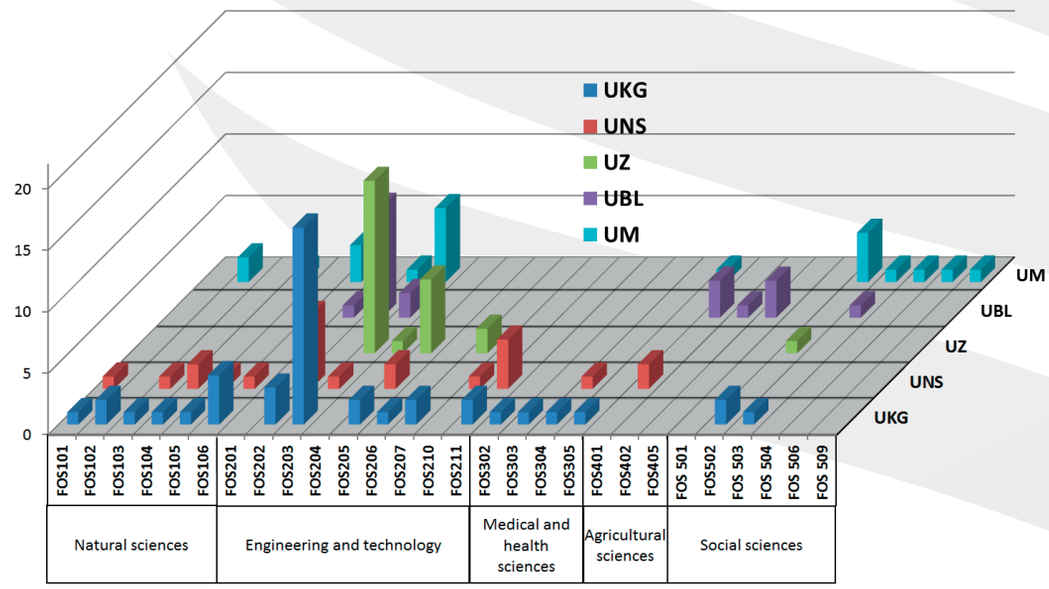

Figure 1 Graphical presentation of structure of mapped entities per university (FoS classification)

Having in mind everything abovementioned, it is clear that there are many opportunities for cooperation and the benefits are mutual. BIs tenants will gain more favourable competitive position on the market, reduce time to market, reduce the cost of product development and consequently gain additional profit. On the other side, through outsourcing contracts universities can provide additional annual income that can be used for maintenance of the equipment and software.

3.2 Providing logistic support by experienced university staff and its knowledge transfer units during the initial development phase of STPs in WBC region

Analysing the current state in the development of STPs in the region the most common case is that investments in those structures were made mostly for buildings, offices, etc. The adequate logistic support for the tenants of STPs (mainly high-tech SMEs) seems to be still missing. The logistic structures such as patent offices, start-up centres, technology transfer offices, etc. should be part of every STP's structure, as recommended in [9]. Providing such a support especially in the early stage of STP development has been a challenge, which can be overcome by engaging university staff who already have experience in these areas, because some of those structures already exists at universities.
This kind of logistics will facilitate the establishing of links between universities and SMEs (STPs' tenants), increase the level and quality of knowledge transfer, and mobility of staff and students between the two sectors.

3.3 Encouraging and motivating students, young researchers and university staff to be involved in entrepreneurial and innovative ventures

University students and researchers are considered to be the leaders and generators of future economic development of a country. Their education, attitudes and motivation to engage in entrepreneurial and innovative ventures can shape the future business environment and its growth.
The current situation in WB Region shows that students, researchers and university staff are not completely ready to enter the market game and take the risks that entrepreneurship carries. However, universities in the Region generate large number of ideas, research results, prototypes, etc. that can be commercialized either through start-ups or spin-offs. Unfortunately, they are locked in the laboratories, research centres, or in the form of laboratory prototypes and concepts. In order to unlock this potential, universities need to provide more efficient institutional support and incentive system for their engagement in such activities.
There are several measures that can help bridge the gap between the potential entrepreneurial force at universities and number of start-ups and spin-offs founded by university students, researchers and staff.
The organisation of various competitions and events has been proved as successful tool in encouraging students and researchers to get involved in entrepreneurial and innovative ventures. Examples throughout the world support this, and there are some successful stories from Competitive Opportunities for Student Entrepreneurs (Rensselaer Polytechnic Institute (RPI), New York) [10] and Villanova Student Entrepreneurship Competition (Villanova University, Pennsylvania) 11] in the USA, The Little Pitch [12] and the Big Pitch (Anglia Ruskin University, Cambridge) [13] in Europe, etc.
In the region, such initiatives are few, and they need to be intensified. One of them was realized within the WBCInno project [14]. Six local Competitions for best student ideas was organized for the first time in 2015 at five WBC universities (University of Kragujevac, University of Novi Sad, University of Zenica, University of Banja Luka, University of Montenegro) with intention to become a yearly event. Apart from this, there is a Competition for best technological innovation in Serbia [15], but it is not specifically targeted to students and researchers, but to innovators in general.
Organisation of such events would encourage university students, researchers and staff to develop their ideas and apply with their business plans to BIs and STPs in order to establish start-ups and spin-offs. There, they would receive necessary entrepreneurial trainings and business guidance, creating in this way a critical mass which would lead to the increase in the quality of BIs and STPs tenants.

3.4 Engaging experienced university teachers/experts for delivery professional specialized trainings to BIs/STPs tenants

While doing a research on BIs and STPs in the Region [3], it was found that most of the trainings offered to tenants were in the area of entrepreneurship, administrative and business management. There was a significant lack of specialized trainings in the technological areas, which are necessary especially if the BIs/STPs tenants are small enterprises dealing with high-tech innovations. These trainings can be commercially provided by teachers and experts from universities, enriching in this way the BIs/STPs range of services provided to their tenants, making them more knowledge-based and research oriented.

3.5 Developing entrepreneurial and practical skills of students through volunteering and practical placement program

Another benefit BIs and STPs can have from universities is through hosting their students in the various types of activities. As an encouragement measures for starting their own companies, BIs/STPs can involve students in the trainings in the area of entrepreneurship and business management that they normally organize for their tenants adjusting their schedule to terms suitable for students. By doing so, they will create the new entrepreneurial force and pool of potential BIs/STPs tenants.
Additionally, the students also can be involved as volunteers or within the practical placement programs in the management structure of both BIs/STPs and their tenants, providing them with a chance to gain some practical skills that would help them develop their future careers.

3.6 Providing additional funding of BIs/STPs and their internationalization through joint project applications and establishment of new partnerships

The fact that most BIs and STPs are mainly focused on provision of entrepreneurial and business services to their tenants is partly limited by the number and structure of their employees and the type of financing. With very limited national resources, additional funding from international programmes in partnership with universities brings many benefits. BIs/STPs participation in international funding schemes could strengthen their human resources and provide additional resources for investment in infrastructure and services.
Apart from this financial component, benefits from networking and collaboration with eminent foreign institutions dealing with knowledge transfer, innovation and research on such projects are unlimited.

4 Conclusions

This paper deals with the aspects and modalities of cooperation between BIs and STPs on one side and universities and their units dealing with innovation and knowledge transfer on the other side. It gives the preview of six most efficient measures to facilitate the development of innovative potential of BIs, STPs and their tenants, improve the services offered by them, encourage the entrepreneurial culture among university staff, researchers and students, etc. The suggested measures will contribute to the transformation of WB BIs and STPs from strictly business oriented into research-driven and knowledge-based innovative structures.

Acknowledgements

This work was supported by EACEA and TEMPUS programme, within WBCInno project (530213-TEMPUS-1-2012-RS-JPHES).

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One View How to Boost Knowledge Transfer from University to Industry in Serbia

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There are several reasons why the cooperation between universities and industry in Serbia is not on higher level. The current situation for receiving state's grants allows a university to obtain significant funds without participation of the industry and this is the main reason why the cooperation between universities and the industry is poor. Legal regulations also have large influence on poor results. Improving cooperation between the university and the industry is a process that can be win-win situation for both the university and the industry using a different approach. In this paper, the new approach for boosting knowledge transfer from the university to the industry in Serbia is provided.

Key words: knowledge transfer, university, industry

1 Introduction

The main purpose of university is to transfer acquired knowledge to students through its processes. Upon completion of their university education, students should apply their acquired and accepted knowledge in the industry. Success of educational processes is also evident from the level of students' valorization of knowledge in the industry. Demand for new knowledge is far greater than the educational system is able to provide. It is a well known fact that knowledge acquisition is a long lasting process. In formal manner, it starts with elementary school and it ends with PhD studies. Changes introduced in the educational system have long term effects. Bologna Declaration is one of the most significant changes introduced to universities in the past years [1]. Taking into consideration that first vocational subjects appear in the third year of studies and that most students choose to complete Master studies as well, it means that it takes at least two years before a former student has the opportunity to apply acquired knowledge in the industrial environment (the term industrial environment covers all kinds of manufacturing systems and service systems).

Two years are a long period and in many professional fields (like computer science, mechatronics, electronics, telecommunications, etc.) significant changes occur and the knowledge becomes "outdated" very fast. This primarily applies to various software tools and hardware configurations. One of the ways to deal with this issue is to get university professors involved with industrial projects, hence make it possible for them to follow the trends in industrial environments and timely introduce necessary changes in the subject matter of their respective subjects [2].

Bearing in mind that the basic activity of university staff is knowledge transfer it is very common that insufficient attention is paid to other duties which are crucial for maintaining the quality of work and those are dealing with science and cooperation with industry. For that reason the government provided regulations for the conditions that university professors have to fulfil in all three segments: education, science and cooperation with industry [3] in order to create high quality structure of population with university degree [4]. Even though the state prescribed legal acts and the criteria for all three segments, different interpretations are present in the practice.

The following lines will provide explanation of rules for election of university professors at University in Novi Sad and their impact to cooperation between the university and industry. After that there will be an explanation of scientific projects financed by Ministry of Education, Science and Technological Development (MESTD). In the end the suggestions aiming the improvement of cooperation between university and industry will be provided.

2 Criteria for election of professors at the University in Novi Sad

Basic document where the criteria for election of professors are described is the Law on High Education [4]. In accordance with this document the University in Novi Sad adopted the Decision on minimal criteria for the election of professors. In this document (Rulebook on the conditions for election teaching staff at the University in Novi Sad) [5, 6], there are defined conditions for every field of science and for election of assistant professors, associate professors and full professors.
In the Rulebook on the conditions for election teaching staff at the University in Novi Sad the conditions which can be defined as the cooperation with industry can be found only when electing associate professors. In Table 1 are provided the conditions in technical and technological fields.

Table 1 Conditions for election of associate professor and full professors which encourage cooperation between university and industry.

	Criteria determined by law	**Near criteria**
Associate professor	Original professional achievement, project, study, patent, original method, new sort etc., management or participation in scientific projects.	Original professional achievement (project, study, patent, original method, new sort etc., management or participation in scientific projects).
Full Professor	Published textbook, monograph or original professional achievement.	Published textbook, monograph or original professional achievement.

The same conditions for election of associate professor and full professor were also interpreted by the National Council for High Education and they are provided in Table 2.

Table 2 Conditions for election of Associate professors and full professors which encourage cooperation between university and industry according to recommendations of National Council for High Education (NCHE)

	Criteria determined by law	**Recommendation of NCHE**
Associate professor	Original professional achievement, project, study, patent, original method, new sort etc., management or participation in scientific projects.	Original professional achievement and participation in scientific projects.
Full Professor	Published textbook, monograph or original professional achievement	Original professional achievement and participation in scientific projects.

Besides the criteria provided in Table 2, the National Council for High Education defined necessary condition for election of university professors and the criterion is: contribution to academic and general community. Within this criterion are defined the elements which also encourage cooperation between university and industry and they are as follows:

- Reputation obtained through invitations for evaluation of performance at public professional meetings;
- Participation in boards, executive bodies and similar functions in accordance with scientific/artistic and professional expertise of faculty and university;
- Providing consulting services to the community;
- Management or participation in extracurricular activities which contribute to reputation and status of faculty and university;
- Participation in important bodies in the community or professional organizations;
- Creative activities which represent professional achievements of teacher and contribute to improvement of university as a teaching community.

The above mentioned conditions are easily validated in case the professor has cooperation with industry. However, National Council did not prescribe them as obligatory and the fulfilment of the criterion: contribution to academic and general community can be fulfilled through participation in scientific projects.
Similar situation is evident from the conditions at the University in Novi Sad. It is clear from Table 1 that the candidate for the position of associate professor may instead of original professional achievement publish a textbook. From all the above mentioned we can draw a strong conclusion that one can be elected to the highest academic rank without any cooperation with the industry.

3 Criteria for allocation of scientific projects

The most contemporary valid criteria for allocation of scientific projects financed by MESTD of Republic of Serbia are defined in the “Act on criteria for the selection, evaluation and financing of research projects in the area of technological development” which was brought in 2009. According to this act the projects

financed from 2010 to 2015 were also elected. The following general criteria for evaluation of suggested projects were defined in the act:

1. Contemporary aspect of the research;
2. Contribution to competitiveness of the product and technologies to improvement and development of Republic of Serbia;
3. Energetic and environmental effects;
4. Participation of the participant in total costs of project realization;
5. Project cost;
6. Competency of project leader and research team;
7. Equipment of research implementer;
8. Possibility to apply the results to multiple users;
9. Evaluation of suggested technical and economical analysis and possibility of investment return;
10. Quality of work performed on projects financed by the Ministry.

In order to valorize the suggested criteria, the MESTD determined the scores or quantitative equivalents of the criteria by a special decision. Ranking of the suggested projects was performed according to them.
All the criteria are well written, but the criterion 4 (Participation of the participant in total costs of project realization) was optional. Due to high pass rate of the proposed projects (close to 90 %), it happened that projects with financial participation of the participants did not perform well financially. How could that happen? Maximum number of points which could be gained for financial participation from industry was 3, where the participant had to take part in covering 20 % of overall project costs. That was limiting the project leaders with the number of participants and the equipment that could be bought. On the other hand, projects without financial participation could have higher cost and larger number of participants. Besides that, due to the long project dates (initially four years which were prolonged to five years) and the market situation the participants were not financially able to finance the projects. In such cases MESTD provided continuation of financing the project regardless of inability to fulfil all the contract provisions. In this manner MESTD provided great support to all the researchers who were in danger to lose the financing, which was not their fault.

4 Propositions for improvement of cooperation between universities and industry

In order to maintain successful cooperation of two partners, interests of both partners have to be met. We will take that the first partner is University and the second Industry and we will see whether there is any interest for mutual cooperation in current situation. If we take a look at the criteria for election of professors at the University in Novi Sad (the criteria is similar for all the state universities in Serbia), in order to be elected in higher ranks it is not obligated for one to have cooperation with the industry. Besides that, project selected for funding by MESTD did not need to have financial participation of partners from the industry since 2005. For that particular reason, criterion 9 of "Act on criteria for the selection, evaluation and financing of research projects in the area of technological development": Evaluation of suggested technical and economical analysis and possibility of investment return had no practical sense because after the completion of project cycle no one asked for any evidence of profit acquired through research results.
On the other hand, industry did not show particular interest in cooperation for the following reasons:

- Scientific papers, not viable technical solutions are mostly offered as the result of cooperation,
- Long duration of projects and
- Unclear financing structure of projects.

Different view provides totally different picture. Namely, cooperating with industry, university researchers may benefit from: doing desired research, achieving profit, advancing educational processes etc. Industry, with relatively small input, benefits from: the possibility to realize research with researchers who are not fully employed in their companies, state support in financing development projects, increase in potential for development, etc.
In order to improve cooperation between universities and industry it is necessary to add to the existing criteria, the following:

1. Before election to the highest university ranks researchers have to prove their knowledge and practical application in industry.
2. Obligatory financial participation of industry in the case of selecting projects of technological development.
3. Evidence of payment made by the industry before the state starts their payments.
4. Obligatory control of project realization by the participants performed by state representatives during the entire course of project.

5. Members of scientific boards who decide on or review the projects can not be participants of any projects.
6. Solution validity check up to three years upon project completion.
7. Researchers in the project participate in profit of project results.
8. All the institutes (state or private) qualify for certain issues of strategic importance for the state that universities can not enrol for.
9. Obligatory promotion of project results.
10. Obligatory participation of at least two scientific institutions from different cities in Serbia in one project proposal.

Suggested approach is not complicated and it does not require a lot of change in the existing criteria defined in the "Act on criteria for the selection, evaluation and financing of research projects in the area of technological development". The most important additions relate to obligatory financial participation of project participants before the financing from the state begins. Such approach is not new and it can be found in many small countries which are well known for their products in the world (Hong Kong, Singapore, Finland). Besides that, majority of projects in H2020 cycle demand financial participation of the participants in the project. Altogether and in this manner the process of market orientation of science in Serbia would be faster.

5 Conclusion

Main goals of university education are to provide the students with: preparation for future employment, preparation to be active members of the society they live in, personal development and maintaining and development of acquired knowledge. In their work, all university teachers have to bear in mind that the main purpose of education is students' application of acquired knowledge and skills and they should personally set an example. Having in mind that it is very common for university teachers to neglect cooperation with the industry, the state prescribed the conditions to encourage such cooperation. In practice it happens that instead of cooperation with industry some other results can be offered and for that reason the cooperation with industry constantly reduces. Such trend is definitely not good and it can have negative consequences to both universities and industry. In this paper, suggestion for addition to the existing criteria has been presented, with the aim to stimulate university teachers for active cooperation with the industry, primarily through conditions for election in higher academic ranks and financing the scientific projects.

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Cooperation between the academic and industrial sectors in the Republic of Serbia - An analysis and proposals for improvement

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After the Industrial Revolution, which led to a rapid expansion of the industrial sector, the development of information technology has caused great changes to all branches of the industrial sector. Many professions have disappeared, while others have been created due to the needs of the market and modern lifestyle. The industrial sector requires a constant influx of workers to fulfil the company's needs. Capacity building is needed for the education of technical staff with appropriate knowledge, who will in turn benefit from job security. It is therefore necessary to adequately monitor market changes in the industrial sector. The Republic of Serbia, a developing country that is facing rapid technological expansion, is plagued by a number of problems including high unemployment and an increase in brain drain, in which the country ranks high globally. These problems affect younger generations, mostly undergraduate students and graduates. Thus, the country ought to adequately bridge the gap between academia and industry. In order to do this, it is imperative to revise the ties between both sectors. The aim of this paper is to highlight this need, as well as analyse and propose solutions for improvement. This will increase the synergy between the academic and industrial sectors, and contribute towards resolving the aforementioned problems.

Key words: academic sector, industrial sector, information technology, unemployment, brain drain, Republic of Serbia.

1 Introduction

The 21st century has been shaped by rapid technological development. This has caused industry to change, so as to keep up with the revolutionary innovations being developed daily. These innovations make work easier, and more profitable. As a result, companies from all over the world are investing in these innovations, with the awareness that it eventually pay off.

These rapid changes are also making their mark on education. Many countries have successfully overcome this transition, although some are still trying to find a satisfactory level for their education. The Republic of Serbia, a developing country on its way into the European Union, is trying to get education and industry back to the successful paths they were on in the middle of 20th century. The global economic crisis that struck in the beginning of this century created bigger problems for an already fragile Serbian economy. This was the trigger for change, and highlighted the crucial need to intervene and help the economic subjects and their correlations. To do so, the country had to keep in touch with worldwide trends and make changes to its main driving force – the working youth and their future. The principal problems are the lack of stable working places for the youth, as well as low incomes, which are reflected in brain drain. However, the country is trying to overcome these problems by investing in industry and the education. Furthermore, the Serbian government is doing its best to keep in touch with the vast Serbian diaspora, by involving them in the new Serbian industrial and educational development. This improves the link between the two sectors, leading to brain gain [1].

As a part of economic recovery in these sectors, leaders adopted several national and regional strategies, including:

- Strategy and Politic of Industry Development of Republic of Serbia from 2011 to 2020
- Education Development Strategy of Republic of Serbia till 2020
- National Youth Strategy
- South East Europe 2020 Strategy (SEE2020)
- Danube Region Strategy [2].

Although the first steps have been made, there is still a lot more to work on. The aim of this paper is to evaluate the current linkage between the educational and industrial sectors of this country, and to propose better solutions that are based on other countries' experiences.

2 Theoretical Background

Technology at the end of the previous century entered the global market with a huge share, which has been increasing in the 21st century. Consequently, world leaders have started funding and supporting bigger and better collaborations between their universities and companies [3]. They are investing in their university-industry relations (UIRs), based on the assumption that a country's innovation level can be increased, which will subsequently influence its economy in a positive way [4].

Research that is conducted by universities can hardly be packed into services or merchandise from which companies can profit [5]. This is especially observed in the textile industry, whereby UIR tends to be very poor. On the other hand, whereby companies require new knowledge for innovation such as in biotechnology, smart materials and information technology, UIR are very close [6], [7], [8].

Some of the UIR relies on start-ups (mostly science-based companies), but the rest rely on many other factors. Studies have shown that research and development intensity, the size of the company, as well as the industrial environment play a huge role when observing which companies use universities as their source of innovation [9], [10]. However, "structural" factors do not solely determine UIR. For example, UK scientists have shown that UIRs in their country, aside from "structural" factors, mostly depend on a company's specific search strategies (and how "open" they are) [9].

The European Union (EU) has recognised the importance of universities as a knowledge source, as well as a source of innovation. The Europe 2020 Strategy and The Lisbon Agreement for Modernisation of Europe's Universities show Europe's dedication to have universities play a central role in economic growth. Besides the usual role of reaching the highest quality of education and transferring it to its students, the new role is to educate scientists and researchers so they can become better "sources of knowledge", and accordingly lead the knowledge economy. Considering the growth of knowledge economy in recent years, this will assure economic growth, as well as the employment of younger people [11]. It is important to note that this knowledge will not be commercialised on its own, as economical and industrial growth are not fortuitous. Thus, government support is needed, in order to establish a well-structured innovative environment [12].

It is important to support the university-industry linkage because it offers solutions to the biggest economic problems of the country: unemployment; slow economic growth and brain drain. The Republic of Serbia is trying to reform its educational system, as well as place universities in a central role. As a part of this reform, it is highly imperative that the educational system hears industrial needs, and shapes the profiles of future employees based on these needs [13].

The Serbian youth represents one of the most sensitive unemployed classes, and that is why investing in the academic-industry linkage is of high importance. Due to the economic crisis, Serbian youth (aged between 15 and 24 years) faced a big drop in employment, and the number of unemployed youth increased. Prior to the crisis, there were twice more employed than unemployed youth, while in 2013, the numbers drastically changed with the number of employed and unemployed youth being tied [2].

According to the Serbia Investment and Export Promotion Agency (SIEPA), Serbia is globally known as the largest exporter of raspberries, but the value of exported software and services is almost twice that of raspberry exportation. In 2013, the Serbian ICT industry was globally ranked at 40th place in terms of the value of exported software, while the total industry was ranked at 79th place [14]. According to the Serbian Business Registers Agency, there were 1,786 active companies registered to perform IT related activities in 2013. Moreover, the whole sector was employing 11,003 people, with a profit of about €62 million. However, the Vojvodina ICT Cluster estimated that this number is part of a much larger ICT working corps of nearly 50,000 ICT professionals [15].

There are roughly 800 professional graduates per year (tertiary-type A) in the IT field. The tertiary-type A education is of strategic importance for capacity development in the ICT industry. ICT education is provided at 35 higher education institutions: 16 are state-owned; 6 are privately owned; and 13 are state-owned higher vocational schools. Additionally, there are 18 cities with ICT higher education institutions, which help to recruit a broad base of ICT students for two study programs (tertiary-type A and type B) and six sub-study programs. In Serbia and throughout Europe, there is a general trend of growing demand for ICT products and services. It is a challenge for Serbian educational institutions to attract more students and provide more professionals for the market [16], [17].

3 Methodology

The methods applied in this paper were the inductive-deductive, statistical, historical, empirical, and proof and disproof methods. Theoretical research and analysis were supported by data from local and international scientific and professional literature. In addition, findings from authors who had explored UIR, information technology, unemployment and brain drain in their publications were utilised. The inductive-deductive method was used to explain the established relationships between the academic and industrial sectors, as well as to discover new ones. The analysis and synthesis methods evaluated complex concepts, judgements and conclusions in their simpler components, and each element was studied separately. This was followed by a method of synthesis that connected the individual parts into a single part. Conclusions were derived by merging the collected materials into one. The historical method aimed to establish the existence of principal developments in observed phenomena within a certain time period. According to the rule, this method included the following phases: collection of historical facts; phase analysis or criticism of sources; and phase exposure or the display of results. Empirical methods were used to collect original, exact numerical data or attributive characters. This led to relevant conclusions, evaluations of the current linkage between the educational and industrial sectors of Serbia, and proposals of better solutions based on other countries' experiences.

4 Discussion

Serbian universities do not significantly cooperate with industry, due to the fact that faculties within the universities have a high degree of freedom that allows them to directly connect with companies. As a result, UIRs in Serbia will be referred to as faculty-industry relations (FIRs).

FIR depends on the field of study. Some faculties tend to have partnerships with well-established companies, which ordinarily leads to the investment of new equipment. This creates better working conditions for the professors and students, thus establishing a vital base for new knowledge creation. Faculty laboratories tend to be well connected to industry, especially in the agricultural sector. This is essential since agriculture is one of Serbia's largest industries. It is important to note that various faculty laboratories represent part of the industry, and are at par with private laboratories in the market. Faculties dealing with knowledge-based sciences are better linked to companies. However, there is a lack of interest by industries in the fields of research and patenting, which could be improved.

The market is a dynamic system that changes through time. Therefore, some professions simply disappear, while new ones appear. In this modern age, technological innovations are chiefly responsible for creating the need for new professions. It is crucial for the industry that faculties identify those professions and design new study programs that provide the appropriate knowledge. This is a major problem for Serbia, which produces a large young working force in professions that National Employment Service is already saturated with. The government should recognise the importance of this need, because the country is still coping with this predicament [18].

In most faculties, work placement is mandatory. A major problem is the lack of information specifically regarding a student's role in that company and its dedication to the students during their temporary work placement [19]. This highlights the need for obligatory feedback surveys at the end of work placement. These results would be beneficial to the teachers, companies, faculties, and most importantly future students.

Industry requires an influx of highly educated young motivated workers. It is worthwhile for companies to get in contact with them while they are in the universities. Good PR is also an important factor at this stage, as well as investing in their future working force. Thus, they should aspire to financially support them by offering stipends and part time jobs.

Currently, companies offer financial aid to students' organisations, particularly for events involving other students. These students are the main target group for these companies. Commonly supported events include: competitions, whereby the best teams may offer several diverse solutions to problems that are worth their attention and possible future investments; academic seminars that provide students with valuable knowledge for the future; summer schools; workshops; and job fairs. Students benefit from these events by acquiring new knowledge and experience, and obtaining certification. Faculties provide logistics for these events. The key elements are the student organisations. Students within these organisations participate voluntarily and work diligently to create and organise the events with minimal resources. This simplifies the participation of companies, students and faculties. Student organisations are common in Serbia, and it is important for them to remain as an essential part of this system [20].

Appropriately tackling the abovementioned problems will give rise to greater youth employment, a healthier economy and reduce the brain drain.

5 Conclusion and Recommendations

The Republic of Serbia is trying to recover its economy and reform its educational system. Since UIRs have a leading role in other countries' economies, it is crucial to analyse and improve FIRs.

Major problems identified were: a lack of tracking the market needs for new proficiencies, as well as recognising redundant ones; a deficiency in FIRs based on patents and innovations; the unavailability of work placement information; an uninformed view of the importance of student organisations; and minimal government support of good FIRs.

By analysing local and worldwide trends in FIRs and UIRs, several proposals have been made. Firstly, the government should encourage this linkage by giving some financial relief for big investments and good partnerships that enhance FIRs. This could be accomplished by lowering the tax for participating companies, thereby encouraging others to form these links and create good synergy.

Secondly, due to the ubiquity of internet accessibility, a website containing company data, work placement opportunities, jobs and stipends should be created. Information would therefore be easily available to all students. Through this, companies and faculties could post news and trending topics. In addition, the aforementioned survey results would be available. A list of company rankings (based on student surveys) would encourage companies to score better by placing more attention on students on work placement. This would eventually lead to good PR. To legitimise the survey, the government should formulate a universal survey.

Thirdly, a mechanism for identifying the professions that the market needs ought to be devised by the government. Round table discussions or company surveys are possible tools for gathering information, and these may be conducted yearly. It is crucial to make these results public (possibly through the aforesaid web solution) for future students to be aware of new possibilities and market demands. Faculties should also apply these results by opening and popularising new study programs among high school graduates.

The government, therefore, has a central role to play in the initiation and monitoring of FIR in Serbia.

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University-industry collaboration: Improving SMEs performances through R&D collaboration

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In today's changing and dynamic market environment, small and medium enterprises (SMEs) need to be able to implement and develop business processes for better demand fulfilment. SMEs especially ones that operate in low performing countries, are facing with number of problems such as access financing sources, capacity building, access to market, etc. Without taking these problems into account, customers have increasingly stringent requirements -shorten the time from idea to final products, lower price of products, higher quality, improved performances, etc. Manufacturing-based SMEs need to be able to meet customer requirements in any moment regardless their current situation within the company. For that reason there is a need for making some changes in the early stages through intensifying research and development phases. Due to limited human and financial resources SMEs do not have own research and development capacities. Therefore, many researchers and business expert solution see in developing university and business sector collaboration. They have realized the strategic role that universities can play, especially in the field of creation and diffusion of knowledge.

Key words: Small and medium enterprises (SMEs), University, R&D capacities, collaboration

1 Introduction

According to various authors [1], [2] a number of changes could be done to improve SMEs business performances. In order to find long-term solution, the major changes need to be done in the early stages of production cycle processes such as planning and designing. Due to SMEs limited resources it is necessary to cooperate with external institutions, especially universities and R&D institutes. Regardless of a strong theoretical background and best practice examples, SMEs are not always ready to cooperate with universities and other research institutions. This paper aims to show the level of readiness of Serbian SMEs to collaborate with R&D institutions along with showing causes of such state. According to these results will be given suggestions how collaboration between SMEs and universities can be improved.

Due to size limitations SMEs have a need of using external networks. The use of external networks is one of the major advantages that SMEs have had when competing against larger firms [3]. Number of domestic and international funds provides support for strengthening collaboration between business sector and R&D institutions in order to create innovative and competitive business environment. Creating an innovative environment in low performing countries that allows development and the production of highly customized products is possible through close collaboration between SMEs and universities.

The purpose of this paper is to examine the collaboration strategies employed by collaborating SMEs and university researchers for initiating and optimizing the process and outcome of R&D collaboration. Most recently these efforts have been explained in terms of a Triple Helix model for research and innovation. The aim of this model is to define and develop new network based on trilateral relation between the government, universities and industry through constant knowledge exchange [4].

2 Literature review

2.1 SMEs performances

The importance of SMEs in economic growth has made them a central element in policy making processes. Small enterprises have a significant contribution in GDP terms and they are important sources of innovation [5].

Most of differences between small and large scales companies are evident but author Floren (2006) states that are many features that distinguish small companies from larger ones such as the absence of complex formal structures, dominance, lack of internal labour markets, environmental uncertainty and a limited customer base [6]. Despite these facts SMEs have very important role in global socio-economic development. Due their limited capacities it is not possible for them to operate as independent entities. The need for cooperation always exists and it is very necessary, especially in the early stages of development.

2.2 SMEs and University R&D collaboration- SMEs and innovation

In some countries and regions, SMEs are the main engine of economic growth. SME sector in particular highlights the problem of harmonizing the business processes with research and development. The SMEs have limited human and financial resources and their organizational capacities are allocated in accordance with this capacity [7]. In most cases they do not have own research laboratories and for that reason it is necessary to develop cooperation with research centres, institutes and laboratories.
SMEs are highly vulnerable in times of globalization, due to limited financial and human resources. They need constantly to cooperate with external institutions in order to achieve business continuity. Author Philbin demonstrates this kind of cooperation through process model for university- industry research (Figure 1).

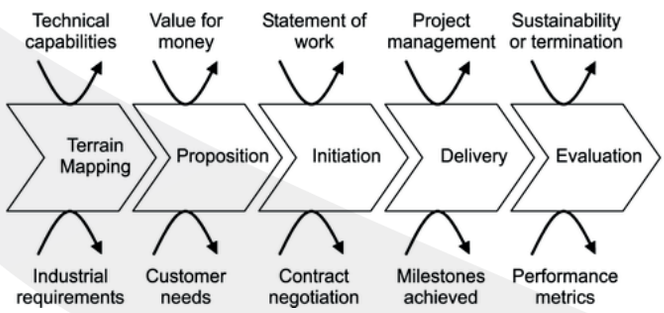

Figure 1 Process model for university-industry research collaboration [8]

This model clearly highlights the importance of social and cultural processes in the viability and success of partnering, which is essential for collaborative research projects [8]. Each collaboration process is specific in its own way but each process is mainly based on this model. Collaboration process begins with mapping and systems analysis and ending with evaluation of results. Apart from these two sides – university and company, in the recent years government becomes very important part of the chain. For that reason Triple Helix model becomes one of the most important interactive models of innovation.

2.3 Triple Helix Model- Government, University and Company

Modern business environment is characterized by globalization of markets and businesses, and technological advances [9], which causes the increase in competitiveness of the SME sector.

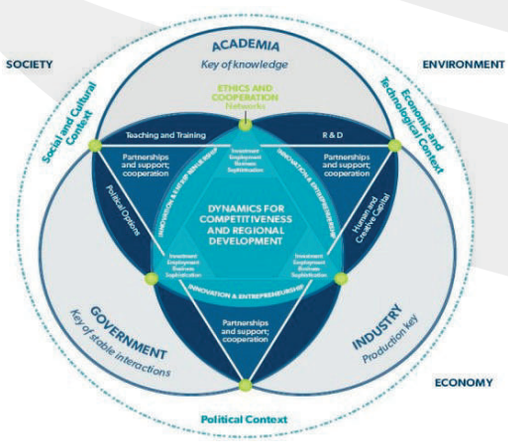

Figure 2. Triple Helix Triangulation Model [10]

The Triple Helix model is based on interactive relationships between the three institutional spheres (university-industry-government) and shows the importance of innovation and entrepreneurship as factors of competitiveness and regional development. The main purpose of the model is to change the paradigm from industrial societies to knowledge based societies [11].
When it comes to Serbia author Kutlaca states that public awareness and public acceptance concerning the necessity and usefulness of innovation infrastructures for economic development in Serbia are rising. Political and financial support is larger every year; the number of people with innovative ideas and solutions is rapidly increasing; and the R&D sector has been more and more integrated with government and business sector [12].

3 Research methodology

This paper has aim to show current state of companies and university R&D collaboration. Overall number of the companies that participated in the research was 102. The main objective of the research was to define and investigate segments that include current state of the companies and their performances. Due to page size limitation it will be shown only one part of research related to the collaboration between companies and R&D institutions. Structure of respondent SMEs is shown in Figure 3.

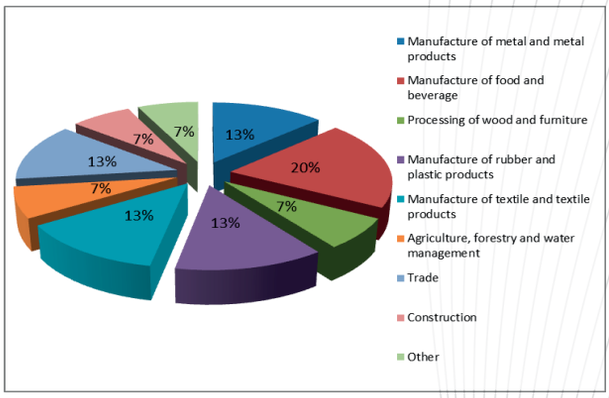

Figure 3 Industry types of respondent SMEs

It can been seen that about 80% of the them are manufactures, which implies existence of high production potential and high added value products as well. One part of the research included examination of level of collaboration between companies and research institutions (Table 1).

Table 1 Statistical data on level of cooperation between companies and R&D institutions

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Level of cooperation between companies and R&D institutions	.289	.074	.371	3.896	.000

Level of cooperation between companies and R&D institutions is evaluated as significant (3.896, Scale from 1 to 5). Serbian SMEs are aware of necessity of collaboration with research institutions but this is still not satisfactory, especially when it comes to quality and intensity of this collaboration.
For some Serbian universities partnering with industry does not come naturally. It took many years to build significant collaboration between those two sectors. When it comes to University of Novi Sad and company's collaboration the situation is a bit different. There are many examples of positive collaboration, especially between universities and organization that support SMEs (clusters, associations, business incubators). Those intermediary organizations play a fundamental role in encouraging, promoting, and facilitating business-to-university linkages and partnerships. University of Novi Sad successfully cooperate with number of clusters and business associations such as: Vojvodina Metal Cluster (Temerin), Vojvodina ICT cluster (Novi Sad), Creative industries cluster of Vojvodina (Novi Sad), Business Incubator (Novi Sad), etc.
University and industry collaboration is very important for both side, and authors state some of the reasons about importance of such collaboration [13]: necessity, reciprocity, efficiency, stability, and legitimacy.

Similar to any other type of inter-organizational relationship, university and industry collaboration has its own benefits for both parties (Table 2).

Table 2 Benefits of company and university collaboration [13]

Kind of benefits	Type of organization	Some examples of benefits
Economic benefits	University	Patents; Additional financial sources to researchers.
	Industry	Improved/new products and services; Cost-effective research than similar in house research; Access public grants.
Institutional benefits	University	Training and employment opportunities for students; Stimulate the development of spin offs; Join publication with industry.
	Industry	Improved innovative ability and capability; Advance new technology, Accelerates commercialization of technologies; Training by experts, hiring of talent graduates.
Social benefits	University	Service to the community; Enhancement of university's reputation.
	Industry	Enhance reputation by becoming more social responsible business.

The collaboration between universities and industry is largely seen as one approach to improve innovation in the economy by facilitating the flow and utilization of technology-related knowledge and experience across sectors [14], [15].

4 Conclusion remarks

Small and medium enterprises represent specific business entities defined and analysed by many authors. In this study SMEs activities are observed from the aspect of project management An effective communication framework can help bridge the gap between outcome and results. The key role in this process has project managers as intermediaries between companies and universities. The project manager should keep groups inside the company and inform university teams about ideas from the company [16].

According to the previous statement it is evident that project management has a crucial role in bridging the gap between research institutions and companies. Implications for further research should be oriented towards project management area in terms of company and university R&D collaboration.

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Fostering Modernization and Innovation at Universities and the Role of English Language Teaching

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Since English has become the lingua franca of modern science, technology and business, the ability to adequately function in that language has become paramount for successful professional and academic development. The paper analyses the changing patterns in English language teaching at the tertiary level aimed at preparing students to participate in the European and international research area by providing the language basis for strengthening the quality of their study and research work. It also suggests that collaboration at the international level and professional development for students and faculty member alike is inseparable from advanced English level skills which enable effective professional communication, successful functioning in international teams and lifelong learning.

Key words: English lingua franca, ESP, EAP, lifelong learning, innovation, modernization

1 Introduction

In the last fifty years English has become the lingua franca of the modern world: the dominant language for communication between people of various language backgrounds in the diverse areas such as: commerce, science, engineering, new technologies, culture, media and entertainment. It is the language that is used not only by a large number of the co-called native speakers, but also by an even larger group of people who use it as their second or foreign language. Kachry [1] even maintains that for every native speaker of English there are now at least four non-native speakers.

One of the consequences of this development is that for a large number of non-native speakers of English adequate command of the language has become prerequisite for professional or academic development, access to relevant and up-to-date information and for professional communication with colleagues and business partners.

These highly demanding tasks require advanced language skills and the aim of this paper is to indicate in what way English language instruction at the tertiary level can aid in developing the language proficiency necessary for the 21st century. It will particularly focus on the areas of language teaching and learning which in a practical, needs-oriented way contribute to the modernization and innovation at our universities. This analysis will be organized around two areas of English language teaching: English for Academic Purposes (EAP) and English for Specific Purposes (ESP).

2 Changing position of English language instruction at the university level

The improved situation with English language teaching in Serbia at the elementary and secondary level (i.e. the introduction of English language as a compulsory school subject from the first year of elementary school) has had an overall positive effect on raising the levels of language competence of university entrants and diminishing the variations in their language abilities. This increased level of English language proficiency opens the opportunities for providing higher level, specific language instruction at the university level which will assist students in their academic work and future professional career. These kind of courses are based around the idea of learners' needs and the specific and apparent reasons for learning the language [2].

University students need to develop the English language skills which will enable them to access vast amounts of information available only in English. This includes course materials written in English which may be suggested by their teachers, the plethora of materials available on the Internet, or the ability to benefit from MOOC platforms, edX or OpenCourseWare. To be able to use all these advantages, students need to develop high level reading and listening skills in English. These language skills are usually included in what is described by the term English for Academic Purposes (EAP).

For those who wish to continue their academic career at the master or doctoral level EAP becomes even more important as it enables them to have access to the latest developments in their field, communicate with fellow researchers from other countries and present the results of their work to the international academic community. In this way it becomes crucial for their academic advancement.
Good English language skills are equally important for those students who enter the workforce after graduation. Their professional career entails the requirements to understand various technical documentation, reports and instruction manuals in English and to communicate with their colleagues from different language backgrounds. Modern fast-paced world imposes the demands of lifelong learning and frequently involves specialization in particular areas of work and, in order to be successful in this, future professionals need to rely on their knowledge of English. A course which is based around these specific needs, is described as English for Specific Purposes (ESP) course.
It is clear, therefore, that, in order to complement the general English courses offered in elementary and secondary schools, and to successfully address the demands of modern university education, the courses offered at the university level should incorporate elements of English for Academic Purposes and English for Specific Purposes. The types of students who can potentially benefit from such courses are presented in Table 1. It should be noted at this point that the line between EAP and ESP is not always strictly defined and that the lists presented here are by no means exhaustive.

Table 1 Examples of typical audiences for EAP and ESP university courses.

EAP based course	**ESP based course**
top undergraduate students	all undergraduate students
Master and PhD level students	graduate students
exchange students	members of multi-national teams
participants in mobility programs	professionals on specialization courses
young researchers	administrative staff (involved in international projects)
junior faculty members	

The role that this kind of instruction plays in the overall modernization of universities, developing university innovation potential and strengthening research capabilities is illustrated in the following section.

3 EAP and ESP as aids in modernization and innovation processes

The increased modernization of the West Balkan universities and development of their research and innovation capabilities clearly relies on having the adequate knowledge base. According to [3] the percentage of scientific publications in English has shown a continual increase from 66% in the 1980s to about 90% at the end of the 20th century. In that respect, providing support in the form of language courses which incorporate EAP and ESP can be instrumental for students, young researchers and faculty members. They would need to advance their second language *reading skills* to enable them to read analytically in English, critically evaluate their literature and transfer this knowledge to their areas of expertise. From the language point of view this involves good command of English grammar and knowledge of the specific vocabulary as well as the instruction in the use of reading strategies of skimming, scanning, summarizing, predicting and the like [4].
In addition, students, particularly master and PhD students and young researchers need to acquire good *writing skills*. This will improve the quality of their work and especially the presentation of their research results which will positively influence young researchers' integration into European and international research area. Writing instruction would also be beneficial for members of the university administrative staff who need to communicate at the international level, participants in international projects, members of multi-national teams and the like. This kind of instruction needs to focus on the properties of different genres: Master thesis, Ph. D. dissertations, research articles, formal letters, project applications, reports, documents etc. [5]. In addition to advanced language skills and genre awareness it should also stress the potential cultural differences in this field [6].
Communication and exchange of ideas at the international level also require good *oral communication skills.* They need to be developed both as "transactional talk", communication which has the primary aim of transferring information and as "interactional talk" which is used in social interaction [7]. Instruction in this area should focus on developing good presentation skills: from correct pronunciation and intonation to structural organization of presentations, metadiscourse, use of visual elements, etc. These

are vital for successful academic presentations, dissemination of research results and adequate presentation of innovative or creative ideas. At the same time students on exchange programs, members of multi-national teams and other staff which is included in international projects would need to develop such oral capabilities which would enable them to speak with confidence and fluency in formal and informal situations.

Reading skills:	**Writing skills:**
• research and find relevant information in English • analyse and synthetize information • read, understand and critically evaluate relevant literature in English	• write appropriately in different genres and styles • summarize, paraphrase, take notes in English • quote, write a bibliography in English
Listening skills:	**Speaking skills:**
• develop listening and note-taking skills in English • deduce the meaning of unfamiliar words • recognize speaker's attitude and implications	• present their research and their own creative ideas • participate in group discussions • express agreement or disagreement, ask for clarification, negotiate, etc.

Figure 1. Language skills developed in EAP / ESP university course which contribute to developing modernization and innovation potential at universities

The overview of main skills which EAP and ESP instruction develops in the four language areas: reading, writing, listening and speaking is presented in Figure 1. These kinds of skills help students and young academics to expand their knowledge base, explore their research potentials and successfully integrate into wider academic community. For young professionals, these capabilities provide means for exploring new creative solutions and developing their entrepreneurial skills in cooperation with people from various language backgrounds.

4 Conclusion

In order to facilitate the processes of innovation and modernization at the West Balkan universities English language courses at the tertiary level should include elements of English for Academic Purposes and English for Specific Purposes. This can help students to upgrade the previously acquired language skills and acquire new ones. Knowledge of English language is not an aim in itself but a tool which aids students, young researchers and high-achieving professionals in gaining information, integrating into European and international research area and developing their own innovative potentials.

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Innovation in the role of economic development

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The strategic goal of the Republic of Serbia is the creation of the economy based on knowledge. Innovation and new technology are areas in which Serbia has a large potential for new investment and intensive economic development, and is increasing the competitiveness of products and industries. For the developing countries and countries in transition innovation and intellectual property have added value through attracting foreign investments. It requires, first of all, support of the government, fostering researcher programs focused the commercial application of knowledge and technology and establishment and strengthening of cooperation between science and industry. Serbia has a great innovation potential, but needs a lot of program and support for creating framework conditions to increase dialogue, exchange and mobility among public/private research centres and to promote the development and application of ideas and knowledge in order to favour sustainable growth of the industrial sector. The Chamber of Commerce and Industry of Serbia has one of the most important roles in this process. Through direct transfer of innovations and new technologies it contributes to the improvement of technological development of the country, provides business stability of a company and safety for investing of foreign investors.

Key words: knowledge, innovation, industry, transfer technology

1 Introduction

In the analysis of the competitiveness of countries, the so-called global competitiveness index of the World Economic Forum (WEF), which includes the economic competitiveness of a country as a whole, the ranking of 141 countries - Serbia is ranked 94th place in 2014. Experts from all around the world indicate better technological readiness of Serbia in relation to the data from 2013, which is a significant shift. In addition, the global experts point out that there are still opportunities for the development of innovations in Serbia especially according to the quality of scientific research institutions and point to the growth in this criteria (1).

In the area of innovation perform in 2014 from research and innovation inputs, through business innovation activities up to innovation outputs and economic effects, which reflects a balanced national research and innovation system the top innovation leaders in a global context are the US, Japan and South Korea. The innovation leaders in the EU are Sweden, Denmark, Germany and Finland, followed by the innovation followers has continuously the smallest variance in their performance across all eight innovation dimensions. These innovation leaders are also mostly on top and clearly above the EU average, Figure 1. Also this year Switzerland confirms its position as the overall innovation leader by continuously outperforming all EU member states and by being the best performer in as many indicators. Iceland is one of the innovation followers with an above EU-average performance, and Serbia is moderate innovators-below that of the EU average, but above Romania and Bulgaria (2).

According to the report of the Global Innovation Index published by the World Intellectual Property Organization (WIPO) and INSEAD organization, in cooperation with partners Knowledge Partners Alcatel-Lucent, Booz & Company and the Confederation of Indian Industry (CII) two years ago, Serbia is ranked highly seventh place on the effectiveness of the implementation of innovation and assessed as a country that has a high potential in this sector, while last year the second largest number of scientific and technical articles (3).

Moreover, lot of indicators show that Serbia have innovation potential, but it has to establish the National innovation system for supporting implementation of innovation into industry. The Chamber of Commerce and Industry of Serbia (CCIS) as one of the main creators of the National Innovation System makes a substantial contribution to the market valorisation of innovations. The CCIS has systemically defined the support for the development of innovative society and the creation of a modern knowledge-based economy starting from the fact that innovations are the basis for the competitiveness of any economy. Legal regulations in Serbia in the field of innovative activities and intellectual property are harmonized with the EU legislation thereby creating the conditions for the development of industrially applicable ideas and attracting foreign investors (4).

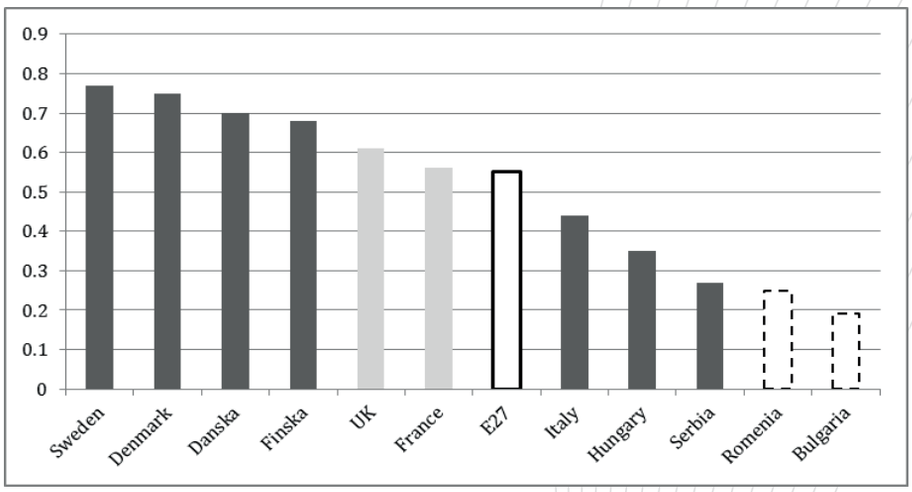

Figure 1 Innovation Union Scoreboard 2014 (Source: EU IUS report, 2014)

2 Innovation potential of Serbia

The Ministry of Education, Science and Technological Development of the Republic of Serbia is responsible for the National Innovation System. The indicators for innovation, Serbia's potential in high-quality technology and technological processes and innovations from universities, institutes and other scientific research organizations, the development of production and research centres, innovative companies, inventors of organizations and individuals, is very significant (5). However, few of these results have been applied in the economy. There is a big gap between science and economy. According to the Law on Innovation, we have the Register of innovations subject in Serbia, Figure 2. Also, allocations for I&R in Serbia are quite low and do not exceed 0.4% of GDP. The problem is that this tendency is displayed for a long time.

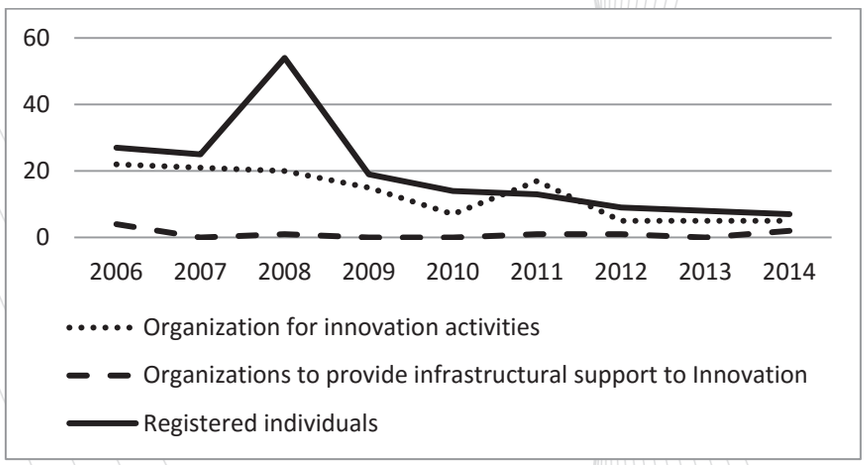

Figure 2 Innovation registered entities in Serbia (Source: Ministry of Education, Science and Technological Development of Republic of Serbia, 2015)

In addition, according to the data from the Figure 3, we can conclude that a very small number of patents are coming from institutes and universities (6). In transition countries, such as Serbia, the Intellectual

Property Law has one additional characteristic function which, from the point of view of the current economic policy, is sometimes in the foreground. It is in the role of attracting foreign investment. Effective legal protection of intellectual property rights undoubtedly encourages overseas companies to bring manufacturing into the country, and services based on new technologies, well-known trademarks, service marks, and creative industries (4).

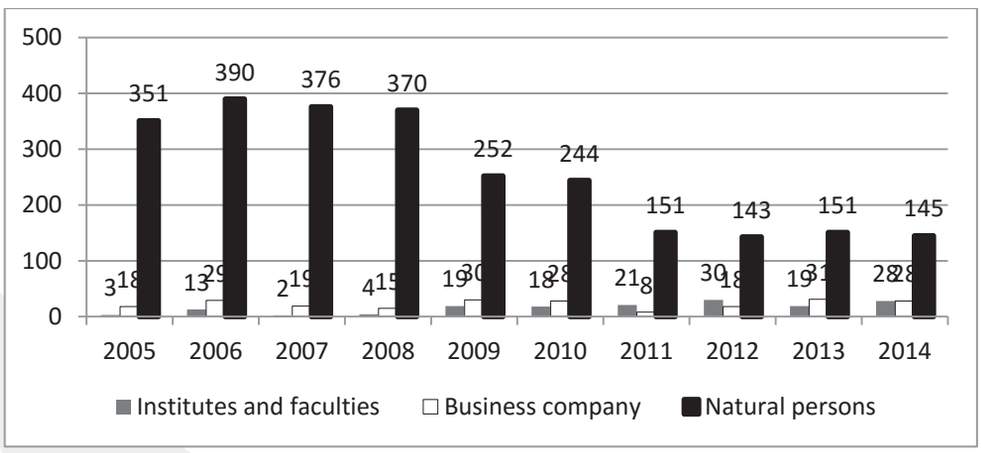

Figure 3 Shares in filing patent applications (Source: Intellectual Property Office of RS, 2015)

3 Role of CCIS in National Innovation System

The CCIS is a national association of Serbian businessmen that put their 150 year tradition and experience, knowledge and expertise into function of increasing the competitiveness of Serbian economy on domestic and international level. Recognizing the importance of innovation, knowledge and education for launching the economic development, active participation in policy and strategy for scientific and technological development, innovation and intellectual property business the CCIS has positioned itself as one of the most important actors of the national innovation system. Formation of a national innovation system involves a complex package of stimulus legal and institutional conditions for the creation of new intellectual property, their transfer and use in the economy. The CCIS organizes, initiates and supports all forms of innovation and creativity that contributes to improving the level of technological development of the country, and the creation of modern Serbian economy based on knowledge. First of all, its protects and represents the interests of all creators, whether from the academic, scientific, business or inventive community, and for the inclusion of creative potential in solving concrete problems of development of the economy. It Initiates, makes proposals, participates in the provision of system conditions for the creation, development and implementation of innovations and new technologies, and creation of environment for the promotion of industrial and applicable ideas to attract foreign investors (4).

Through direct transfer of innovations and new technologies it contributes to the improvement of technological development of the country, the CCIS provides business stability of a company and safety for investing of foreign investors. Under this we have supported and affirmed a lot of innovations. According to the national "the Best technological innovation competition" that has been successfully organised by the Ministry of Education, Science and Technological Development, the Chamber of Commerce and Industry of Serbia, the Faculty of Technical Sciences, Novi Sad, the Intellectual Property Office and the Radio Television of Serbia for eleven years (7). So far, this competition has involved over 7,000 participants and over 80 high-tech companies have been established creating products with added value and improving the competitiveness of the Serbian economy.

In the CCIS we have established the Office for the support to young researchers and innovators in Serbia in the area of agriculture under the project "Network of Young Innovators in the Agro-food Sector (NOBLE Ideas Network)" which is financed by the EU funds. In cooperation with 12 partners from seven countries the Chamber of Commerce and Industry of Serbia has been implementing project whose objective is to contribute to the development of agricultural and food sector through innovations. The Office provides free of charge services in the area of innovation management, financing innovations and intellectual property, with the aim to prepare innovation projects for implementation in the economy both on domestic and international level.

In order to exploit the innovative solutions the CCIS has developed the technology innovation database, in cooperation with the Ministry of Education, Science and Technological Development of the Republic of Serbia, in order to support market evaluation of innovative solutions (8). The CCIS has developed a model for the implementation of new technology and innovation in the economy and for direct transfer of knowledge and technology (9). The CCIS provides support to the development and implementation of high technologies through the establishment of high-tech firms. We believe that one of Serbia's opportunity it to increase competitiveness in the formation and development of high-tech firms. There are low-tech industries, but there is low use of technology in certain industries. The development and implementation of new technologies and implementation of intellectual capital in the creation of new products with high added value is the net potential that Serbia has to exploit. Its position and competitiveness in the international arena should be built through the acceptance of theoretical principles of macroeconomics and experience of successful small yet efficient economy based on knowledge.

Awareness of the importance of knowledge for the prosperity of a society is at a very low level in all communities. In addition to the classical, fundamental and applied knowledge necessary to find time to study modern knowledge that is important for the development of an innovative society. One example of linking education and economic aspirations of the country is fostering an innovative and entrepreneurial spirit that's supposed to be present to a greater extent, in order to appear later in the world of work (10). An important part of the role of the CCIS is education. For innovative society we need innovative industry. Our industry on the second level based on the effective not innovation. Modern CCIS will provide dual system of education and give the possibility for better connection under NIS (8). Business education in order to improve knowledge and skills of employees and managers, build capacities and strengthen domestic economy.

Also important segment of activities concerns the work of tribunals and foreign trade arbitrations in the CCIS, as well as fostering good business practice and business code of conduct. Furthermore, the CCIS is the member of the Eurochambres, the Association of Balkan Chambers (ABC), it is the part of the Adriatic-Ionian and Black Sea Initiative and has signed over 70 bilateral agreements with partner organisations in the world. In the last ten years, the CCIS has participated in the implementation of a large number of international projects financed from the EU funds, bilateral and donor support programs and according to this possibility increase market for transfer technology and innovation.

4 Conclusion

For the industry based on knowledge we need operational National innovation system, improved cooperation between science and industry as a partnership in innovation and technology projects, increase of R & D share in the GDP, greater allocations, support to commercial application of research, and support to technology transfer and improvement of the model for the transfer of knowledge and technologies in the industry.

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Competition for the best students idea, based on experience of the University of Novi Sad

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This paper summarizes information and impressions from the Competition for the Best Students Idea held in Novi Sad as first stage of the competition within WBCInno TEMPUS project. Importance of competitions based on the level of an idea was considered. Competition organisation, aims, structure, courses and platform were discussed in detail.
Experience of the University of Novi Sad, competition stages and levels, number of students and ideas / teams through the competition process are also described in this paper. Evaluation process, types of evaluation stages and evaluation criteria are explained in detail. Winners of the competition and their ideas are presented.

Key words: students, competition, idea, entrepreneurship spirit

1 Introduction

There are many students' competitions, typically in area of natural sciences, engineering, arts, literature, sport, expert study subjects, etc., but very few of them are at the level of an Idea or entrepreneurship. Without ideas, there is no progress, change does not happen, much of human development stops. However, ideas cannot go anywhere unless they are realised and carried out in action. Moreover, without the initial idea anything cannot be done [1].
Small and medium enterprises (SMEs) are the backbone of European economy. SMEs employ 2 in every 3 employees and produce 58 cents in every euro of value added[1] [2]. Therefore, the significance of development of entrepreneurial spirit in student population is essential for increasing number of SME's in the future. Furthermore, not only number of SME's is important, their value added and employment rates are crucial for European economy [3].
Idea of forming a Competition for the Best Students Idea was to educate students about importance of SME's in the present and future economy, to prompt theirs entrepreneurship spirit and to give them basic knowledge about Business model development and validation, Finance and Elevator Pitch. This idea came from the WBCInno TEMPUS project [4].

2 Competition for the Best Students Idea

2.1 Competition organisations

Competition was organised by WBCInno TEMPUS project members. The five universities from the WBC Region, members of the project (the University of Kragujevac, the University of Novi Sad, the University of Banja Luka, the University of Zenica, the University of Montenegro) conducted the competition.

2.2 Competition aims

This Competition aims to:

- promote entrepreneurship culture among students and academic staff on Universities in the Region of Western Balkan Countries (WBC),
- facilitate exploitation of their produced results through commercialization and transfer to innovations on market for economic-social benefits in the WBC Region,
- serve the purpose of pre-incubation for business incubators partners on WBCInno project,
- reduce risk for new ventures, by providing necessary knowledge for starting innovative business,
- encourage students and university staff to establish spin-offs and start-ups,

[1] net contribution of the company to the economy

- encourage creativity among students and help them to develop business ideas,
- increase the number of university spinouts and students start-ups [6].

The competition for best student idea is designed primarily to students at all levels of their studies (BSc, MSc and PhD) from five WBC universities participating in WBCInno who can apply individually or as teams of most four members.

2.3 Competition structure

Competition was divided in two main stages: ① local stage at the five universities (members of the project) and ② final competition stage in Belgrade. Local competition stages will ensure two winning teams from each university for the final competition stage.

Local competitions had three levels: 1) idea submission and trainings, 2) working on the ideas making business model of them 3) final pitch presentation.

2.4 Competition courses

Four trainings were prepared as students' education and preparation for making of the business model, elevator pitch and final competition:

1) Business model development (Canvas [7]) – to learn more about first steps in development of business models for their ideas. After the introductory motivational part about developing an idea into business opportunity, students will learn more about the Canvas method, and some practical steps in its application on ideas submitted within the Competition. Moreover, participants of the training will develop their ideas into a business plan using the Canvas method. The aim of the training is to bring their ideas to the quality and successful business plan from several iterations by using all segments of Canvas methods.
2) Business model validation – included several topics such as validation of business models, mapping of customers' profiles and target groups, interviewing the customers, minimum viable product, etc. At the end of the training, the trainees will adapted their business models canvas using new inputs and guidelines they obtained during this training.
3) Finance for start-ups – to learn more about the sources and modalities of financing for start-up companies, balance sheet and income statement, as well as the cash flows.
4) Elevator pitch – to learn to demonstrated several techniques of good presentation practice and instruction for theirs application on the Competition for the best students ideas.

2.5 Competition platform

All ideas and business models submission processes and elevation processes on initial and first two levels were conducted through the INNO platform. This platform was specially designed as a central place for input and development of ideas, launching and tracking projects, as well as cooperation of individuals and teams at the university. Student team registration is also made through the INNO platform.

3 Experiences from competition in Novi Sad

3.1 Competition levels for the first stage of the competition in Novi Sad

Competition for the Best Students Idea was open for application during two months. Promotional banner can be seen in Figure 1.

For the Competition for the best Students Idea at the University of Novi Sad had 31 students' ideas / teams and 104 students (42 % of them were women) applied. After initial selection, were idea submission form was evaluated, 25 students' ideas / teams and 81 students entered the second level of the competition. These students passed through the four trainings described in the previous subchapter. After completing the trainings they had to improve their ideas in accordance to the Business Model Canvas. Students also had team mentoring with trainers.

Figure 1 Promotional banner

Business model adjustments are made on the INNO platform by students, while mentors were able just to see the changes, not made it themselves. Students' activity and number of sessions on the INNO platform was the highest in the period of the competition (Figure 3). That is the proof of students' engagement, commitment and learning process in this competition.

Figure 2 Screen shot of the INNO platform

Afterwards business model evaluation from the three evaluators, 16 best ideas / teams and 52 students passed evaluation criteria (evaluation criteria is shown in Figure 4).

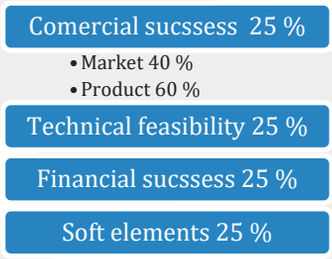

Figure 3 Evaluation criteria categories with percentage of contribution

The best 10 ideas continued to the third level of the first stage of the competition. These students had team mentoring from trainers and Business Incubator Novi Sad staff. Four mentoring hours were spent on practicing Pitch presentation exercises for the final level of the competition and answering on individual questions.

Local finale, third level of the first stage was organised as a public Pitch presentation session in front of five jury members. Jury was consisted form the university professors, members of the WBCInno project but also external university professors with the expertise in the area of entrepreneurship, students' start-ups and spin-offs. All teams had 7 minutes for pitch presentation; jury had 3 minutes for asking questions (including answers) and 1 minute for evaluation.

3.2 Competition winners in the first stage of the competition in the Novi Sad

Form 10 teams which enter the final level of the competition, three teams quit competition before pitch presentation and seven teams presented their ideas in front of the jury, public and media. First place at the competition won four PhD students; team "Creative Lab" with the idea of establishment the mini brewery (Figure 5a). Second place belonged to first year BSc students; team "Studenti GRID-a" with the idea of making "Virtual waiter" an android application for mobile orders in restaurants and cafes (Figure 5b). Third place won the team "Smart Gym" with an android application for the help with exercise and nutrition in the gym (Figure 5c). First two teams are qualified for the second stage of the competition in Belgrade.

(a) First place
team "Creative Lab"

(b) Second place
team "Studenti GRID-a"

(c) Third place
"Smart Gym"

Figure 4 Novi Sad first stage winners: (a) first place, (b) second place and (c) third place (Source: Business Incubator Novi Sad)

3.3 Competition prices for local finale in Novi Sad

Prices for the three best Novi Sad ideas / teams were:

- for the first place: 500 EUR, trip to Graz, incubation for six months in the Business incubator Novi Sad
- for the second place: 400 EUR, trip to Graz
- for the third place: 300 EUR.

These prices were provided from WBCInno project, the University of Novi Sad, the Business Incubator Novi Sad and three sponsors: Pan Computers, Novi Sad [8]; Ibis Instruments, Belgrade [9] and CAM Engineering, Novi Sad [10].

4 Conclusion

Promotion of entrepreneurship culture among students and academic staff, commercialization and transfer to innovations of their produced results is becoming of the great importance for the economy for countries in the transition and economic development.

Reducing risk for new ventures, by providing necessary knowledge for starting innovative business reduces failure among start-up and spin-off companies. Encourage creativity among students and help them to develop their business ideas follows a good practice example for economy recovery and development.

Competition based on Ideas on which students work by modifying, improving and expanding them into business models thru courses in Development and Validation of Business Model, Finance of Start-ups and Pitch presentation is a manner for students to approach entrepreneurship. This was an opportunity for students to dare, learn and attempt the transformation of theirs idea to the business.

Prises, competition in general, are just an additional motivation for students to enter in the world of business.

The University of Novi Sad will continue to organise this competition since it had a great impact among students, university stuff and society.

Acknowledgements

This work was supported by TEMPUS programme, within WBCInno project (530213-TEMPUS-1-2012-RS-JPHES).

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SESSION 2: Modernization of education, research and knowledge transfer processes

Characteristics of cognitive - innovative function of the education system in Serbia[1]

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Cognitive – innovative and professional functions of education represent the most important social functions of education. Cognitive – innovative function is reflected in the young generation's ability to generate new knowledge. The previously acquired knowledge represents the basis for broadening new knowledge, but the extent to which the acquired knowledge will have influence on improving new knowledge depends on the way the previous knowledge has been gained. The knowledge, which has been acquired through critical thinking and understanding, becomes the part of students' intellectual potential and represents a stimulating basis for further development of intellectual and creative abilities.
Key words: knowledge, education, creative thinking, intellectual capital.

Key words: knowledge, education, creativity, intellectual capital

1 Social functions of education

Education system in a modern society, that is, in the knowledge society is a significant factor which completely shapes the modern society from economic, social, cultural and democratic aspects at both national and global levels. Significant social importance of education in modern society requires great responsibility of the society for development of education system, considering the far-reaching social functions of education system, because the attitude to education represents the criterion of social responsibility towards the basis of society's economic, cultural and social development.
Main functions of education system are professional, social integration, self-consciousness, cognitive-innovative, and meritocratic functions. Professional function is reflected in acquiring and gaining the existing knowledge in certain fields which enables young generation to successfully perform acquired social roles. This function of education did not exist in the past because knowledge was not considered to be a significant factor for performance and development of economic and social activities. Professional function was developed simultaneously with continuous growth of economic and social importance of knowledge as a fundamental factor affecting economic and social development. Even today, there are considerable differences between developed and less developed countries in the level of development and efficiency of professional education function. However, more and more countries in the world accept the importance of education as a factor affecting the development and they tend to make professional function the fundamental function for education and development of society by organizing the education system efficiently and applying professional knowledge from the developed countries. Cognitive-innovative function of education is reflected in the development of young generation's abilities to generate new knowledge. Although professional and cognitive-innovative functions are interrelated and conditioned from the aspect of development, cognitive-innovative function, besides socially and economically stimulating criteria for development, has personal, internalistic and scientific preconditions for successful development. When scientific knowledge reaches certain level of development, it also reaches higher degree of autonomy with respect to social system and it starts its development based on the needs and principles of development. Science becomes a relatively independent system with respect to the social system. Meritocratic function of education system is reflected in adequate assessment of acquired knowledge, ability and selection of young generation based on the gained knowledge. Meritocratic function of education system has its social dimension which is reflected in providing the most successful person in the education process with the most important social roles, highest rewards, power, respect and considerable prestige. Unlike meritocratic function of education system which is typically realized successfully, the social dimension of meritocratic

[1] This paper is the result of work on the projects: 'Transformation of Social Identity of Serbia in crisis and influences on European integration' (179052) and Smart Electricity Distribution Grids Baded on Distribution Management System and Distributed Generation (42004) financed by Ministry of Education, Science and Technological Development of the Republic of Serbia

function which is reflected in providing the most successful person in education process with the most important social roles is, according to a large number of authors, not realized successfully even in the systems of developed countries[10,3].

Self-conscious knowledge is made of the most complete and comprehensive knowledge of the essence and basic principles of existence and development of human being, society and nature and their interrelationship. The term self-consciousness in science is often described as the attitude towards the world. The initial stimulus for developing self-consciousness comes from a deep rooted need of individuals and social groups to realize and understand the essence of the world and their place in this world. The need for spiritual identity is the basis for self-consciousness. Who we are, where we are from, and what we aim at, are all the questions of people's existence. The ultimate aim of science is development of grand unification theory that can explain the Universe [2,6], but for now, even with greater integration of knowledge from different scientific disciplines (technical, social) and dramatic expansion of natural-technical knowledge, this aim remains an ideal which is to be achieved by future generations.

The function of social integration is reflected in acquiring knowledge and experience which enable young generations to completely integrate into social community and fully participate in main processes of social life of a community. Unlike the past times, when a family played a crucial role in the process of socialization and transfer of local cultural values to young generations, thus giving them a complete local integration, modern education system promotes national, that is, global integration. Elementary, that is, functional literacy represents the simplest form of people's integration into the social community. According to one comparative research on functional literacy (which is divided into five levels) conducted by the Organization for economic cooperation and development (1996), it was discovered that a large number of adults in Western countries were below the third level of functional literacy that was considered as a threshold of integration into the modern society [4].

2 Cognitive-innovative function

Cognitive-innovative function and professional function represent the most significant functions of education system. The most important 'creator' of new knowledge in a modern society is intelligence. The period of generating new knowledge based on practical experience belongs to the past. All successful inventions in modern society were developed as a result of organized and systematic scientific-technical intelligence. According to Peter Drucker, basic features of modern scientific inventions are complexity and complementarity, that is, reliance on the knowledge from different scientific disciplines. [1]

Cognitive-innovative function of education is achieved through development of creative learning and creative learning is a type of learning which is focused on critical reconsideration of the existing knowledge from the aspect of new cognitive perspectives so that the existing knowledge could be demonstrated, applied, broadened or completely denied from the aspect of new cognitive functions. The acquired latest knowledge is the most significant prerequisite for generating new knowledge. However, considering knowledge relativity, we should bear in mind that by focusing the education system on acquiring new knowledge without critical attitude to the gained knowledge can limit creative abilities of young generations, and it is difficult to generate new knowledge without creative attitude to the gained knowledge. Jean Piaget emphasizes that "something that a scientist keeps from his early age is not a collection of original ideas, because the processes of formulating hypotheses are present in both cases, but a constructive ability; one of us even went further by saying that an ingenious physicist is a person who preserved creativity inherent to childhood instead of losing it at school" [7].

The acquired knowledge represents the basis for generating new knowledge, but the extent to which the acquired knowledge will have influence on the generation of new knowledge depends on the way the new knowledge is gained. Knowledge is considered as knowledge when it is acquired with understanding. When knowledge is acquired with understanding, it becomes a constituent part of students' intellectual potential and can stimulate further development of intellectual and creative abilities. Unfortunately, standard practice in education system of less developed countries in particular is the focus on mechanical memorization of the taught content and adequate reproduction of that content. Creative abilities are not constant; they develop or get suppressed by education system. If a student is not obliged to constantly develop his/her creative abilities during education, then these abilities, unless they are completely lost, will be limited and replaced by acquired knowledge which a student does not see as internal part of his/her personality. There are rare individuals who have intellectual and personal power to doubt the acquired knowledge and start critical reconsideration of the acquired knowledge and then acquire new knowledge based on the new bases. The largest number of students and pupils accepts the existing knowledge as the absolute truth.

If, from cognitive and innovative aspects, the success of education system is measured by the number of received Nobel prizes for science, the number of patents, scientific productions, impact factors, ranking of

universities as cognitive, educational parameters which are partially conditioned by education system, it can be concluded that the most successful education systems are those of the USA, Great Britain, Germany and France, and they are followed by some smaller European countries (Switzerland, Sweden, The Netherlands, Austria, Denmark) which do not have such considerable scientific potential. The previously mentioned is a confirmation that smaller countries with well-organized education system can also achieve surprising cognitive results and this represents an education path which is to be followed by small economically underdeveloped countries such as Serbia.

By comparing Serbia with developed European countries based on the above mentioned cognitive – innovative categories it can be noticed that Serbia is far behind those countries and reasons for that are in the fact that Serbia is neither market nor society of knowledge, and in the fact that neither economy, nor country, nor other activities are based on knowledge and they do not require knowledge as the basis for development but rather political power which has led to anti-intellectualization of the social system. Knowledge has not become a systemic need and it has lost social importance and value over the time. This has also shaped both teachers and students' opinions that knowledge has lost value. Degradation of cognitive-innovative function is additionally emphasized by private faculties, which have enabled those who are not capable or ready to finish state faculties to obtain diplomas without knowledge and obtain important social and public positions with the help of the state. In Serbia, 218.000 students attended state faculties and 23.600 attended private faculties (nine times fewer students in private faculties), and in 2011, 29.628 students graduated from state faculties and 8.362 graduated from private faculties (just three times fewer students in private faculties). Expansion of PhD degrees in Serbia occurs simultaneously with the process of privatization of faculties and implementation of Bologna Process principle. In Serbia, 16.860 students has obtained doctorate degree since 1905 when the University was founded and more than a half (9000) of doctorate degrees were obtained in the period from 2005 to 2014 (1275 PhDs obtained their degrees in 2011/2012) (Data were collected from National Council for Scientific and Technological Development).

3 Culture of learning and success of students at schools in Serbia

Learning is a theoretical process of identification of facts, logical integration of those facts into logical structures, and causes for creation of logical structures. Learning is a specific form of work which requires a large number of intellectual activities which are undertaken at the same time such as memorization of facts, logical integration of facts into a complete logical structure, discovery of invisible deterministic structures and their connection with already gained knowledge and interpretation of already acquired knowledge. Learning as a theoretically complex process is, in practice, most often based on reproductive learning (completely or partially) which formally adequately interprets the contents and creative learning that integrates facts into logical structures and reconsiders them based on the already acquired knowledge by generating new knowledge. The process of learning is learnt, and predominant way of learning in one society depends primarily on the people's attitude to knowledge, educational practice and culture of learning.

In the societies which are based on knowledge, the knowledge appears as internal need of the society for development, and when knowledge becomes the internal need of a society it imposes the main goal, both for education system and participants, which is acquiring of the existing knowledge for the purpose of further development, and this is what creative learning is. Unlike the knowledge societies, in less developed and underdeveloped countries, knowledge represents general social need, need for acquiring knowledge for the purpose of earning reputation and professional status prestige because material and social privileges are given based on diplomas and not based on knowledge. This attitude to knowledge causes reproductive system of acquiring knowledge in education system to be dominant aim and practice. According to Merton, the basic principle of cognitive-innovative work is organized skepticism and trustworthiness which means that profound knowledge should be gained not as holy truth but as a mean for discovering new truth. We should learn from brilliant scientists not in the way to imitate them but to surpass their knowledge [5]. Naturally, a final social framework for dominance of reproductive, that is, creative form of learning should be established in cognitive-innovative society. In the societies in which knowledge represents internal systemic need for development, creative form of learning becomes necessity and dominant practice over the time.

Majority of students in our schools do not think of knowledge as internal need but as a general value and mean for achieving grades which serve for obtaining diplomas, and diplomas are important for finding jobs. This makes students insufficiently systematic and dedicated to learning. In our society, knowledge has lost meritocratic function in the selection of staff based on their cognitive abilities and this has contributed to the fact that educational practice has also lost meritocratic function in time, thus creating one sub-culture with the majority of students in which getting the pass grade with little studying has

become an important value. According to the results obtained from the research[2] conducted in 2012 in Vojvodina it was noticed that based on our sample comprising 1226 students who finished high school, 5.3 % of them studied regularly every day and 22.2 % mostly studied daily, which means that less than one third of students regularly studied every day. More than two thirds of students studied every day just before oral examination [9]. These data show that cramming in high schools is the most popular way of studying and that this type of studying is developed and transferred from high schools to faculties as well. Cramming, as a dominant way of studying at our schools, is proven by average number of hours spent on studying every day. More than half of students (54.9 %) study daily for one hour or less, one third of students (31.4 %) study for two hours, 9.3 % of them study for three hours and 4.4 % of students study for four hours a day. If we analyze the relation between the way of studying and success at school, the data show that cramming is the most efficient way of studying in our schools. If we take, as an example, excellent students in the second grade of a three-year school, that is, third grade of a four-year school, it can be noticed that the largest number of students (59.9 %) studies every day only before examinations and considerably smaller number of students (32.1 %) study mostly every day, and only 8.9 % study regularly every day regardless of examinations. The same percentage is expressed among very good students, but cramming is more dominant (77.6 %) [9].

It seems that the grading system in our schools stimulates or aims at cramming as the most adequate form of learning because the largest number of excellent students in the first grade of high school and eighth and fourth grades of primary school crammed. About 60.6 % of excellent students in the first grade of high school were cramming, and in the eighth grade 68.0 % of excellent students crammed, and in the fourth grade, there were 70.2 % of excellent students. Cramming and the grading system are correlated. The dominant way of grading at schools is assessing students' abilities to mechanically reproduce partially learnt content and this type of grading is supported by cramming which enables memorization of data that are easily forgettable after intense learning for a short period. The data, showing the effects of time necessary for learning on the success, indicate that the largest number of excellent students in the second grade of three-year high school, that is, third grade of four-year school (48.35) study for two hours, that is, one hour (39.5 %), and considerably smaller number of students study for three hours (15.0 %), and four hours (5.2 %). [9]

Studying is not a pleasure for the majority of students because only 6.1 % of students say that they are very happy to study and 28.6 % of them say that they are mostly happy, which means that one third of students get pleasure from studying. Students' attitude to studying seems to be correlated with teaching practice, that is, teaching culture and culture of studying in our schools are mutually conditioned.. High percentage of students in all above-mentioned categories who are not satisfied with teachers' lectures indicates that lectures are not qualitative and adjusted to meet the needs of both excellent and very good students as well as good and students who did not achieve good results.

4 Conclusion

The results are showing that learning culture in our system of primary and secondary education is focused on reproduction of existing knowlegde rather than on creative learning. This learning culture is transfered to the system of higher education and this is an obstacle for successful development of cognitive-inovative potential and educational capital.

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Study program Computer Graphics - Engineering Animation and their relation with modern Serbian CG Industry

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In December 2010 Computer Graphics - Engineering Animation study program got certified at the Faculty of Technical Sciences in Novi Sad. The first generation of students enrolled in 2011 and this generation is now about to finish their 4th year and to graduate with the engineering degree in Computer Graphics.
During the 3rd and 4th year of their studies our students made connections with many companies in Novi Sad and in Belgrade which are rising in this industry. Some of them are Eipix, 3Lateral, ProVeritas, Mad Head Games, Crater Studio etc.
This paper gives an overview of our study program and its connection with the companies listed above.

Key words: computer graphics, education, visualization, animation, gaming industry

1 Introduction

Study programme: Computer Graphics - Engineering Animation (CGEAni) started in October 2011 when companies working in computer animations and computer games development were rare [1], [2]. In this paper we will analyze companies from the closer environment, mostly from the cities of Novi Sad and Belgrade, working in this field. We will show the areas of interest and operation of these firms. Also, we will list the subjects for all four years of our Undergraduate Academic Studies CGEAni [3], [4]. The programme also has Master Academic Studies which last a year, and Doctoral Academic Studies, which last three years, but this paper will not talk about these two levels of studies. The oldest generation of students finishes fourth year of Undergraduate Academic Studies in June 2015 and in the paper we will analyze the current state in our Study Programme and the state in the industry.

Our intention is to present the CGEAni Studies Syllabus and the activities of private companies so as to analyze and show the usability of knowledge of our students on the actual market, especially in these companies. We did not create our CGEAni program according to needs of these companies, because most of these Companies did not exist when we started. Instead, we just followed the current trends in CGEAni field and now we have an opportunity to analyze the situation, assess the actual state of affairs and see the possibilities for employment of our students, graduate Engineers in Computer Graphics field, in these and other companies.

2 Computer Graphics - Engineering Animation Studies

The CGEAni study programme at the Faculty of Technical Sciences is an interdisciplinary programme combining electrical engineering and computer science on the one hand and mathematics on the other [1], [5], [6]. The programme is designed to enable high quality education in interdisciplinary visualizations and in applying Computer Graphics in interdisciplinary researches in different fields: in medicine, in visualization in technical and engineering disciplines, especially in mechanical engineering, industrial engineering, civil engineering, architecture, traffic engineering; wherever the visual presentation can play an important part in the solution of the problem. Computer Graphics can be used for educational interdisciplinary presentations; as well as for visualization purposes as it is the ideal means to teach any discipline that could use visual presentation.

The CGEAni study programme for Undergraduate Academic Studies consists of 40 subjects [1] with nine elective subjects (Table 1). We can say that the programme is created to provide two basic educational

modules for our students: the first one is creating 3D computer animations and the second one deals with all programming techniques which refer to image, i.e. for image creating or analyzing.

Table 1 Undergraduate Academic Studies / Engineering Animation [1], [5], [6]

No	Course	Semester
	First Year	
1	Algebra	I
2	Physics	I
3	Free Hand Drawing	I
4	Spatial Shape Design	I
5	*Elective Course 1* Foreign Language 1	I
6	Geometry and Visualization of 3D Space	II
7	Programming and Programming Languages	II
8	Drawing for Animation and Visual Effects [7]	II
9	Mathematical Analysis	II
	Second Year	
10	3D Modeling	III
11	Computer Graphics	III
12	Computer Image Processing in Engineering Animation	III
13	Perspective	III
14	*Elective Course 2*: Mathematical Shape Modeling for Computer Animation *or* Discrete and Combinatorial Methods for Computer Graphics	III
15	*Elective Course 3*: Classical Animation *or* Mechanics	III
16	Character Animation	IV
17	Mathematics for Engineering Graphics	IV
18	Video in Engineering Animation	IV
19	Acoustics and Audio Engineering in Multimedia	IV
20	*Elective Course 4* Foreign Language 2	IV
	Third Year	
21	Fundamentals of Engineering Animation	V
22	Advanced Display Technologies	V
23	Storyboard	V
24	*Elective Course 5*: Fundamentals of Information Systems and Software Engineering *or* WEB design *or* Selected Chapters in Kinematics	V
25	*Elective Course 6*: Fundamentals of Information Systems and Software Engineering *or* WEB design	VI
26	Aesthetics of Visual Communications	VI
27	Engineering Animation and Other Media	VI
28	Digital Image Processing	VI
29	Special Visual Effects	VI
30	Sociology of Technique	VI
	Fourth Year	
31	Interactive Engineering Graphics	VII
32	Human-Computer Interaction	VII
33	Colors and Light	VII
34	*Elective Course 7*: Image Based Modeling *or* Industrial Robotics *or* Composing Digital Images	VII
35	*Elective Course 8*: Geometry of Discrete Space *or* Formal Mathematical Models	VII
36	Advanced Engineering animation	VIII
37	Application of Engineering animation	VIII
38	*Elective Course 9*: 3D Digitalization Methods *or* Introduction to Virtual Reality Technology	VIII
39	Professional Practice	VIII
40	Bachelor Thesis	VIII

3 Companies of interest in the neighbouring area

We will present a short list of companies which work in the field which is similar to those for which we prepare our students. These companies are in our neighbourhood, primarily in the cities of Novi Sad and Belgrade. These are Eipix, 3Lateral, Mad Head Games and ProVeritas from Novi Sad, and Crater Studio from Belgrade. These are private companies which employ a total of approximately 400 people.

Eipix

Eipix Entertainment is an independent game developer, established in 2005. From 2011 the company has been rebranded and under the new slogan "Creating worlds" it is focused on developing HOPA (Hidden Object Puzzle Adventure) games [8], and is now also involved in Free to Play games as an exclusive partner of North American company Big Fish Games [9].
Eipix is located in several cities in Serbia and the headquarters are in Novi Sad, and they have about 300 employees. The emphasis is on the design of games, on 2D and 3D design, arts, animation, film, sound design, all of these for different platforms.

3Lateral Studio

3Lateral Studio is built around passion for creating characters and creatures. It gathers most diverse people since this is an industry that has to marry seemingly incompatible skills - rebellious artistry and disciplined engineering practices [8]. The company has about 20 employees. They deal with character concept, character modeling, character rigging, face rigging, 3D scanning and simulation.

Mad Head Games

Mad Head Games is an award-winning, growing development studio from Serbia. Founded in July 2011 by a group of experienced developers and friends passionate for making games [11].
Today, Mad Head Games creates hit casual games and establishes game franchises by bringing their love for good art and intriguing game-play into record-breaking hidden object adventure games, published around the world by Big Fish Games [9]. The company has about 50 employees.

ProVeritas company

ProVeritas company was founded in 2014. Based on the multidisciplinary, experience, innovation, knowledge and talent, ProVeritas wants to position itself among the world's leading companies for visualization, virtual and augmented reality training of complex industrial systems and processes. The company has about 10 employees [12].

Crater Studio

Crater Studio was established in 2005, the company is one of the first in Serbia dealing with the field of visual effects and animation i.e. VFX industry [13]. The company has about 40 employees.

The companies listed here engage in production of animation, compositing and film, VFX, visualization, virtual reality and augmented reality. They also deal with 2D and 3D games creating and other areas combining the activities listed above.

4 Discussion

In October 2011 the first generation of students was enrolled in the Computer Graphics - Engineering Animation study programme. This year, in 2015, they are finishing their Undergraduate Academic Studies with the degree of graduate engineers in Computer Graphics field. The CGEAni study program enrols sixty students each year. From the first generation, 34 students have completed the 4th year of study but so far nobody has graduated. Some of these students (approximately 10 students) have already found employment, and the majority have been offered jobs at the companies in which they completed their professional practice. Namely, at the end of the 4th year students have professional practice for a period of a two weeks which they complete at the companies listed here but also in other smaller companies that we have not mentioned here.
In order to illustrate the influence of our students' education on their practical work at professional practice we will cite the opinion of one of the top students from the first generation:
"After four years of study at Computer Graphics programme, looking back and summing up all the impressions, I could conclude that I was pleasantly surprised by the amount of accumulated knowledge acquired during the studies. As a 2D/3D artist and animator who has been working in the industry for four years I face with new challenges and problems every day. Theoretical knowledge gained on courses such as Free Hand Drawing, Classical Animation, Fundamentals of Engineering Animation, Video in Engineering Animation, Advanced Display Technologies, Interactive Engineering Graphics and others, helps me to successfully handle all the problems and produce a higher quality product.

The most use full ability that I have gained by attending Computer Graphics studies is actually the ability to adapt quickly to problems and to use the knowledge I have gained to solve the problems I haven't met before. In addition to 3D modeling and animation at the university we learned a lot about programming. We learned about object-oriented programming *(C++, Java)* as well as the use of a variety of graphics libraries such as *OpenGL, OpenCV* and *VTK.* We are also learned about writing graphic shaders by using GLSL language for shaders programming. The acquired programming skills help me in communicating with fellow developers, and for writing and adapting tools that help me in my everyday work."

5 Conclusion

Over the last ten years several companies have been established in Novi Sad and Belgrade whose areas of work correspond to study programme Computer Graphics - Engineering Animation. In the paper we showed five companies from the neighbouring area which employ about 400 people.

A rough comparison of the subjects from our study programme and the areas of activities of the listed companies indicates that our programme does a good job in teaching our students and preparing them for the field which is new in our country.

We are aware that in the next period attention should be given to correcting the deficiencies we have noticed in our CGEAni studies. From our experience it can be said that for creating a new subject at the University level it takes at least three iterations, i.e. three student generations. This means that we can expect to have very good quality subjects six years after starting with the first generation of students.

Also, the next accreditation of our study programme, scheduled for 2017, will offer the possibilities to enrich our CGEAni studies with the latest developments in the field. At the same time, the professional development of our teaching staff and their advancement to higher academic positions will provide new possibilities and greater flexibility in everyday work.

In addition, we are aware that our CGEAni studies should not be limited only to the companies mentioned here. We expect that new employment opportunities will be created in the future which presently do not yet exist in Serbia. Because of this, new firms will emerge and these companies will demand from us new knowledge for their employees.

Our predictions are that in the near future (1-2 years) creating 3D animated short films [14] will start at Serbian market. After that, in the next five years, conditions will be formed for forming a consortium which will be capable of animated film creating. Another new challenge will be designing games which are more complex than HOPA or Free to Play games.

We expect to see a very dynamic and interesting period from the aspect of using 3D visualisation in various fields and for various purposes.

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Lifelong Learning Courses on Material and Energy Flow Management

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Energy efficiency is the trend in Europe, which Serbia should follow as efficiently as possible. Knowledge transfer (through lifelong learning courses, LLL) and joint operations between Serbian and European partners is the best way for Serbia to adopt advanced solutions and increase the efficiency of the industry as well as all other sectors. At The Faculty of Technology, Novi Sad, a new dual degree master program in material and energy flow management is accredited in cooperation with German partner, the Trier University of Applied Sciences, Environmental Campus Birkenfeld. Beside the main objective of project to adopt EU's experience on material and energy flow management another goal of project is creation of lifelong learning training courses on material and energy flow management. The main reason for this is to introduce the representatives from industry and public services to the main concepts of sustainable development realised through material and energy flow management. In contact with regional industry representatives it was pointed out that beside energy efficiency one of the main problems is reduction of waste flows to decrease environmental issues and create added values. Members of various industry sectors (mainly food industry) showed interest in presented LLL courses.

Key words: lifelong learning, material and energy flow management

1 Introduction

Lifelong learning incorporates the entire spectrum of formal, non-formal and informal education. It includes active participation in civil society, personal fulfilment and social inclusion as well as aspects related to employment. Principles which reinforce lifelong learning and affect its successful implementation emphasize the focus on the learner, the importance of equal opportunities and the quality and relevance of learning opportunities. Rapid progress in other regions of the world shows the importance of innovative, advanced and quality education and training as a key factor of economic competitiveness. As Europe's response to the economic challenge Lisbon strategy was adopted [1].

In 2012 Serbia adopted "Strategy for the development of education in Serbia by 2020 year". Adult education, as an integral part of the entire educational system and manifestation of the concept of lifelong learning, has the following functions: to respond to the needs of the labour market and individuals for new knowledge and skills; improve employment opportunities; facilitate professional mobility and flexibility of the working age population; increase the value of human capital and the possibility of sustainable socio-economic development of the country and its integration into the global economy; contribute to poverty reduction, increase inclusion and intergenerational solidarity and quality of life, development of democracy, intercultural and tolerance [2]. In the frame of higher education lifelong learning has special place. As a special form of their activities within educational areas, higher education institutions will organize and implement the lifelong education following a general technological progress, the development of the area and the needs of the labour market, and lifelong learning to adapt ECTS system and it will include elements relating to non-formal education [2].

Improving energy efficiency is one of the key elements of the energy policy of the Republic of Serbia, due to the fact that its increase contributes to the security of energy supply, increasing the competitiveness of industry and increasing the standard of living, as well as to contribute to the reduction of import dependence and reducing the negative effects of the energy sector on the environment.

The circumstances that occur in surrounding area of the Republic of Serbia, especially in the European Union, clearly show that the country needs a very deliberate and organized system of the education in the area of energy efficiency and sustainable development as one of the key conditions for the development of the Republic of Serbia towards a society based on knowledge capable to provide good employment of the population. These circumstances indicate that, otherwise, Serbia could remain on the European

periphery, poorly competitive, little attractive for investment in sectors that generate higher new value, exposed to further emigration of talented and creative people.

2 Lifelong Learning Courses on Material and Energy Flow Management

At the Faculty of Technology, Novi Sad, a new dual degree master program in material and energy flow management is accredited in cooperation with German partner, the Trier University of Applied Sciences, Environmental Campus Birkenfeld [3]. The development of dual master degree is steered through Tempus project (TEMPUS IV – 6th call), under title "International joint master programme on material and energy flow management" (Project acronym: MEM). Beside the main objective of project to adopt EU's experience on material and energy flow management another goal of project is creation of lifelong learning training courses on material and energy flow management [4].

The content of the "Strategy for the development of education in Serbia by 2020 year", which consists of a series of elements, highlights the openness of the education system i.e. educational system must be oriented towards the outside world, i.e. the education system is seen as an open and in totality with all its interactions with the surroundings [2].

Apart from this openness to businesses as part of the surroundings, it is important to point out some of the basics on which strategy is formulated, above all the further development of the production systems in the Republic of Serbia that must be based on knowledge, entrepreneurship of the educated population, own and transferred technological innovation without adverse impacts on the environment, the market economy and international cooperation (business, technical and other). It means that the educational system of the Republic of Serbia has the task of timely, high quality and efficient education of the Serbia's population in accordance with the expressed or identified developmental commitments towards sustainability. It follows that the educational system takes on the role key development factor, as it is well educated population of the Republic of Serbia as a real resource for the proper use of natural resources and other inherited the Republic of Serbia, as well as to develop new, especially those that will be based on the advancement of science [5].

The cooperation of companies, the state and the academic sector in the areas of factories of the future, energy efficiency and renewable energy sources, development of agriculture, i.e. technology platforms for the production of food, is crucial in order to develop new technologies and for effective technology transfer and their incorporation in the production systems of the Republic of Serbia. With this goal in mind at the Faculty of Technology Novi Sad three lifelong learning courses are developed.

During meeting with industry professionals and public services employees the new dual master program and possible lifelong learning courses were presented. The major benefits of the international dual program were presented as well as the structure of the program. After presentation, questionnaires were distributed to the participants at work in industry to get an indication of needs and preferences of Serbian industry sector.

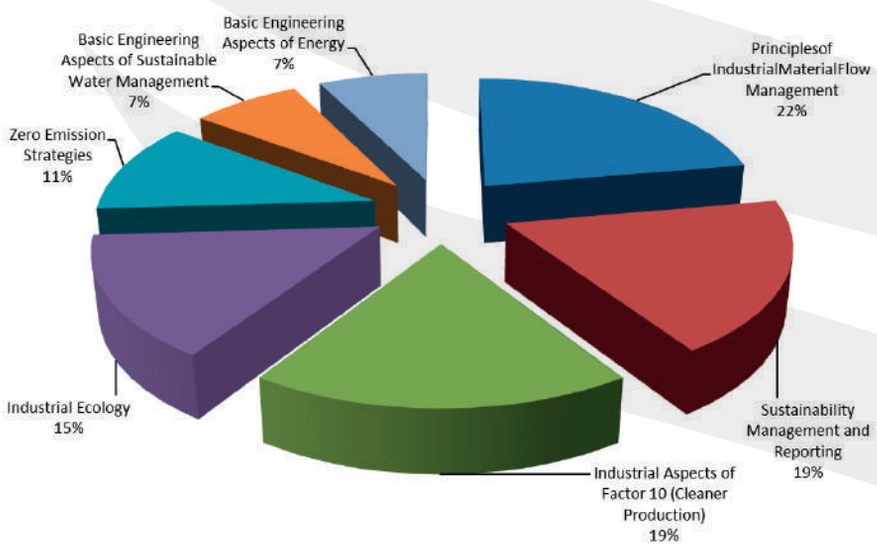

Figure 1 topics of interest for Serbian industry professionals related to Material and Energy Flow Management.

Based on the results of the questionnaire formulated for industry professionals following lifelong learning courses were proposed:

- Course 1:
  Ecosystem Management
  Industrial Material Flow Management
- Course 2:
  Ecosystem Management
  Industrial Ecology and Zero Emission
- Course 3:
  Ecosystem Management
  Engineering Principles of Sustainable Water and Energy Management

During discussion, it was pointed out that energy consumption in industry sector in Serbia is very high, especially compared to the situation in Germany, due to low energy efficiency. Another problem defined during the discussion was the problem of waste flows and its exploitation as raw material for biogas production or in any other way to reduce the environmental issues related to the production as well as for possibilities to create added value. Members of various sector of industry (mainly food industry) showed an interest in presented lifelong learning courses as well as planned master studies [4].

3 Course content

All three developed lifelong learning courses have similar concept. The first part of the courses consists of short introduction to ecosystem management. It is a new approach to sustainability. Ecosystem management represents a holistic approach to an environmental protection. Ecosystems provide a full array of goods and services upon which people depend for their livelihood and well-being. Human well-being ultimately depends on the health of the ecosystems which envelope and sustains humans. People exploit ecosystems for the food, water, and timber needed for everyday living. People depend on ecosystem processes to regulate natural cycles and keep diseases at bay as well as they rely on them for recreation, instruction and mental and spiritual enrichment. Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fibre, and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth [6].
The second part of the courses is related to the topics that industry professionals were interested in. The topics are: industrial ecology and zero emission; and engineering principles of sustainable water and energy management and industrial material flow management. During this part of the course attendees will be introduced to defining and understanding the flows of energy and materials and their relation to global balances and definitions of sustainability. It includes energy sources, energy and material flows, thermal-dynamic, geo-chemical, biological, sociological concepts of sustainability. During the course analytical techniques and concepts for goal setting with respect to energy and material sustainability will be defined. These concepts include ecological footprint, the Natural Step, Factor 4 / Factor 10 and other assessment tools.
In the course 2 industrial ecology strategy of forming industrial ecosystems or by-product exchange networks among co-located plants will be analysed. The Zero Emissions concept represents a shift from the traditional industrial model in which wastes are considered the standard to integrated systems in which everything has its values for other consumers. It promotes an industrial transformation whereby businesses imitate the sustainable cycles found in nature and where society minimizes the load it imposes on the natural resource base and learns to do more with that the earth produces. The elimination of waste represents the ultimate solution to pollution problems that threaten ecosystems at global, national and local levels. In addition, full use of raw materials, accompanied by a shift towards renewable sources, means that utilization of the earth's resources can be brought back to sustainable levels [7].
Engineering principles of sustainable water and energy management program enables attendees interested in a cross-disciplinary chemical, civil and environmental engineering education to widen their knowledge that focuses on integrating basic scientific principles, engineered processes, and systems analyses to address diverse challenges related to society's growing energy needs and their interconnection with water and the environment.

4 Conclusion

Lifelong learning courses on material and energy flow management are in accordance with modern scientific developments and comparable to similar programmes at foreign institutions of higher education. Development of lifelong learning courses programme on material and energy flow management is result of MEM (Tempus project number: 544364-TEMPUS-1-2013-1-DE-TEMPUS-JPHES) in cooperation with EU partners from Slovenia, Belgium, Hungary and Germany. During retraining sessions held in EU partner countries Serbian partners were informed about host universities experience in creation of multidisciplinary courses. The aim of the lifelong learning courses on material and energy flow management is to encourage economically-efficient and environmentally-sound use of material and energy in companies, administrations and entire regions.

Acknowledgements

Authors wish to thank Tempus project, "International joint master programme on material and energy flow management" for financial support.

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Fab labs as platforms for implementation of the knowledge triangle – case study of the educational Fab lab Petnica

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Fab labs (fabrication laboratories) are open high-tech workshops where individuals have the opportunity to develop and produce custom-made products that are not accessible by conventional industrial scale technologies [1]. All the fab lab activities are targeted towards solving the real-life problems. In this regard, fab labs can be used as platforms for connecting research, education and entrepreneurship/innovation (components of the knowledge triangle) into an efficient ecosystem consisting of high schools/universities/research institutions, startups/SMEs/large industry and fab labs as hubs that integrate all the ecosystem elements [2]. In this way, a fab lab is a crossover between a business incubator and a science & technology park that enables the closing of the so –called "innovation divide" i.e. a gap between the latest research knowledge and real life practice [3]. The article presents formation of the educational Fab lab Petnica that aims to provide high school students and teachers in the STEM (science, technology, engineering, math) field in Serbia with knowledge, tools, inspiration and connections to start implementing digital fabrication and STEM entrepreneurship principles in practice. Authors also consider the future connections of the Fab lab Petnica with the higher education facilities (universities) and research institutions, as well as with the business accelerators and venture forums.

Key words: knowledge triangle, research, education, business, entrepreneurship, fab lab, innovation

1 General context

There is a high need for better STEM education success in South East Europe countries, including Serbia, that all have mean performance below Organisation for Economic co-operation and Development's (OECD) average in overall science, as per results of the PISA test 2012 [4]. Two thirds of schools in Serbia do not possess science labs nor science clubs and cannot perform scientific experiments with students [5]. Lack of experimental work leads to low motivation for STEM subjects in students. Youth unemployment is another critical issue for Serbia (Youth Unemployment Rate 2013 = 49.4%) [6]. Young people in general tend to hesitate to start their own business. Youth entrepreneurs face specific challenges including lack of experience and contacts to the business as well as lack of equipment for product development [7].

The article describes how the Fab Lab Petnica will be used to teach young people and their teachers in Serbia, how to adopt hands-on approach for STEM subjects with small amount of money, by starting their own science clubs with low-cost fablab-made equipment, and how these activities can be used to foster entrepreneurial thinking and kickstart setting up of the new business by the young people in Serbia. We also describe how we envision Fab Lab Petnica to act as a hub that provides not only knowledge and inspiration but also tools and industry connections necessary for product development and product launching.

The general mindset among young people in Serbia is that if you are successful you should try to develop academic career or to be part of large teams in international cooperation. It is very rare to find the entrepreneurial ideas in this population. This is the result of few decades of education in the socialism. Although the new generations are influenced with the news about the success of young entrepreneurs abroad, they do not think about starting their own business. The problem is that there is no entrepreneurship philosophy in our families, in our schools, at the faculties. On the other hand the idea of entrepreneurship exists as the need for the economic development, and there is a lot of potential for building the understanding of it.

2 Petnica Science Center

Petnica Science Center (PSC) is the biggest and the oldest independent nonprofit organization for extracurricular, informal science education in South Eastern Europe. Since 1982 Petnica has organized more than 3000 programs (seminars, workshops, research camps…) for nearly 50,000 students and science teachers in 15 disciplines of science, technology and humanities: Astronomy, Physics, Electronic, Computing, Mathematics, Biology, Molecular Biomedicine, Chemistry, Geology, Geography, Archaeology, History, Linguistics, and Psychology. Majority of programs are designed for secondary-school students although there are a lot of programs for primary-school students, university students and science teachers. Attendants of regular Petnica programs are coming from all countries of former Yugoslavia.
PSC has functional and complex facilities in the village Petnica near Valjevo in west Serbia (Figure 1(a)). There are fully equipped boarding facilities (160-bed Dormitory plus Restaurant), various types of classrooms, laboratories, a big and multifunctional library with a carefully designed Teaching Resource Centre, etc. All laboratories are well-equipped thanks to the support of Serbian Government and European Investment Bank of almost 3 million euros in 2011.

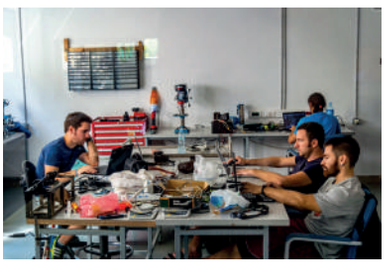
(a)  (b) 

Figure 1 (a) Petnica science center - air view; (b) Fab Lab Petnica - in the making.

Students and teachers who participate at some of PSC's programs have access to a rich Library (40,000 books and journals, and computer database with thousands of electronic journals and books), Teacher Resource Centre with specific training capacities. There are also about 75 computers dispersed through PSC's facilities, which are accessible 24-hours a day, and laboratories and professional workshops of different types and functions. PSC is member of National Academic Internet Network.
For many years the PSC has carefully collected various types of useful teaching equipment, especially research-grade equipment that could be used for students' individual projects and research activities. Therefore, we can say that some of the PSC's labs are equipped much better than the majority of Serbian schools, but we must be aware that the level of equipment in Serbian schools are far from EU standards. One of the main PSC's activities last years was focused on education of teachers and gifted kids for starting the open labs. After establishing collaboration with the non-profit organization Fab Initiative, the activities focused on formation of the Fab Lab Petnica (Figure 1(b)) and subsequent formation of the mini Fab labs in the schools where the students and teachers come from.

3 Petnica and Fab lab

Fab Lab Petnica is the joint project between Petnica Science Center, Fab Initiative (FabIn) and Belgrade Metropolitan University (BMU). The goal of the Fab Lab Petnica formation is to connect the experience with the STEM education at the PSC, the wide network of schools and scientific institutions in Serbia and SEE region that PSC has, and knowledge of the Fab Lab that FabIn has experience with, while also including the eLearning options that BMU offers.
The project will establish educational FabLab Petnica and use it to provide high school students and teachers in the STEM (science, technology, engineering, math) field in Serbia with knowledge, tools, inspiration and connections to start implementing both the FabLab@School [8] concept and STEM entrepreneurship principles in practice e.g. by forming their own science clubs back in their schools.
Teachers and students will gain know-how and ability to continue forming their own science clubs, obtaining their own low-cost equipment. Science clubs are very good opportunity for motivated kids to have additional scientific education based on the hands-on approach. It is very important to encourage all motivated teachers to start with their own science clubs. The FabLab@School concept entails using fablabs in STEM education.
The World Bank recommends fablabs both as a very efficient way for supporting STEM education and also for commercialization of research at higher education institutes and local industry sustainable development and entrepreneurship [9]. We intend to use FabLab Petnica as the World bank recommends, both as a platform for hands-on STEM education through FabLab@School and as a channel to introduce

high school students and teachers to basics of STEM entrepreneurship, product development and technology transfer (commercialization of scientific discoveries).
The 1-year project comprises: setting up the Fablab Petnica; specific 3-day courses on digital fabrication for students and for teachers and jointly for both to work in collaboration; introductory 1-day courses for the students in on-going seminars; online course on eLearning system - the content of the seminars will be adapted for the effective usage on the eLearning system, and will be published on the BMU eLearning system.
Students will learn how to design and create objects using fablab equipment (3D printers, laser cutter, milling machine), how to use electronic devices such as Arduino, Raspberry Pi, microcontrollers supplied by MikroElektronika and open-source robotics kits to make their own machine prototypes, and how to make simple software for such machines.
The course for teachers will be a hands-on practicum in evaluating, designing and building technology-enabled curricula, tools, and learning environments. Teachers will learn how to set up a science club and wet lab using low-cost fablab-made equipment and teaching aids.
A special focus of the course will be to reinvent the "offline" side of online learning: in other words, designing hands-on toolkits, equipment and low-cost wet labs that could be used in conjunction with online course we will prepare, in order to bring the well-known benefits of hands-on learning to the online learning world. The online courses will insure that students and teachers will have access to training material that they can reuse themselves, or show it to new members in their schools' science clubs. We also focus on low-cost, appropriate technologies, making sure the teachers are able to implement what they learned when they return to their schools.
For all the courses, PSC senior associates from wide network of scientific institutions will be involved as the lecturers and the mentors and we will also have invited speakers, from the large networks associated to all 3 partners - to cover a range of topics:

- Experts in 3D design and digital fabrication: from various architecture- and 3D design studios, from FabLab Belgrade; Fablab Croatia; Faculty of Digital Arts, BMU;
- Mechanical engineers - experts in additive manufacture (3D printing) methods: from Faculty of Mechanical Engineering Belgrade, Faculty of Engineering in Kragujevac and Kraljevo and following research centers: Center for Bioengineering - BioIRC,; Center for Information Technologies that works on rapid prototyping:;
- Experts on open-source, robotics and DIY science: from Slovenian Poligon-maker lab, Fablab Belgrade, Polyhedra FabLab; Experts on Arduino and Raspberry Pi: 012lab.com/education.

The course for both teachers and students will cover the basics of entrepreneurship in the fablab context and show examples of the products made in the fablabs. We also intend to organize live encounters of teachers and students with Serbian entrepreneurs and companies that use fablab equipment to make products: Voxellab (voxellab.rs); Polyhedra (polyhedra.co); Teleskin, associated with Faculty of Mechanical engineering, Belgrade - www.teleskin.org/about.html.
The 1-day intro-courses will be custom-designed for participants in other on-going programs in Petnica – e.g. for students in Biology/Biomedicine programs, the course will focus on implementation of fablab machines for making e.g. 3D model of a DNA molecule, on making 3D printed model of e.g. bone that was previously scanned on a 3D scanner; for students in Chemistry – students make 3D models of atoms, large molecules, to be used to learn about changes in e.g. protein function by changing geometry etc.
At the end of each course, moderators will discuss with participants how the course helped them to devise plans for including DF in STEM lectures, for making their own mini fablabs/science clubs in schools, if they have ideas for their own projects in their science clubs, if they envisage using FabLab Petnica for making potential prototypes, for starting a startup around the business idea related to the technology developed in the FabLab Petnica etc.
Fab lab Petnica is not just an open lab for all interested people in Serbia who wish to do their own projects. It is an educational fab lab with the main goal to develop small labs all over the Serbia and to build the entrepreneurship way of thinking among young population [10].
Primary target groups are motivated, gifted high school students and their teachers from all parts of Serbia. By targeting motivated kids, this project is helping young people with the best potential for (self) development. However, it is very important to work with their teachers in parallel, to improve their local surrounding and also to reach the secondary target group - the other students from the participating schools, who will benefit from the science clubs formed by the students and teachers who participated in our courses. With this program all participating schools will have an opportunity to develop school scientific clubs based on Fablab@school concept and basics of STEM entrepreneurship. Students and teachers participating in the Project will have enough knowledge and experience to work on their own for these science clubs in their schools. Such Fablab@school science clubs will be the new opportunity for all

other students from these schools to learn something new about digital fabrication and STEM entrepreneurship.
The covering aspect of the Fab Lab Petnica is the network of described Fab Lab-oriented institutions and individuals. All scientific institutes, faculties, schools, companies interested in Fab Lab initiative will have the resource center at the Fab lab Petnica. All individuals motivated to do digital fabrication projects will be connected through Fab Lab Petnica.

4 Conclusions

We envision these fablab-related networks to help in introducing the entrepreneurship philosophy to the motivated youth trough additional extracurricular education. Globally, fablabs are very efficient in closing the innovation divide and establishing efficient and working knowledge triangle. Fab Lab Petnica is the attempt to bring such global trends into the Serbian education, science and technology ecosystem and effectively bind it to the industry.

Acknowledgements

Authors lead the project "Fab Lab Petnica - formation and incorporation with on going programs" financially supported by The Royal Norwegian Embassy in Belgrade (Grant No: SRB-15/0022).

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Needs for Research, Innovation and Cooperation in the field of Disaster Risk Management and Fire Safety Engineering in WBC

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Climate change, fast urbanization and new technologies, in interaction with irresponsible human activities, cause the need for multidisciplinary and interdisciplinary engineering competences, knowledge and skills. Considering these, available recourses and knowledge based technology in WBC are insufficient and unsustainable at regional level without modernizing and further development of research and education.
In order to assess the vulnerability and improve the resilience of the region to hazards, it is necessary to develop interoperable university research centres and provide the required number of experts, that is to modernize and develop higher education at the regional institutions in the field of the Disaster Risk Management and Fire Safety Engineering.
Resilient societies are based on knowledge and training, as well as preparedness. Building synchronized regional capacities in research and higher education in Disaster Risk Management and Fire Safety Engineering, according to regional needs and contemporary trends, is a first step towards building resiliency of our region.

Key words: higher education, disaster risk reduction, fire safety, vulnerability, resilience

1 Introduction

Western Balkan Region (WBR) is exposed to a variety of natural hazards, including storms, droughts, floods, earthquakes and landslides as well as wildfires and building fires. Areas within the Balkans are hot spots for mortality risk and/or risk of economic losses. In general, the natural disasters are unpredictable events. But, they occur according to a specific frequency and are located in specific areas. However, in many occasions, especially in the case of floods in Balkans, the statistics regarding the possibility of occurring and the intensity of the event have failed. The consequences of disasters and fires in different groups of society may reach serious levels. The levels of vulnerability have significantly risen with the increase of the number of population and with transition tendencies of migration (concentration of population in main urban areas, which are exposed to high risk of natural disasters and fires).
Disaster risk management and Fire Safety (DRM & FSE) are disciplines require measuring risk to take into accounts not only the expected physical damage, victims, and economic equivalent loss, but also social, organizational, and institutional factors. The difficulty in achieving effective disaster and fire risk management has been, in part, the result of the lack of a comprehensive conceptual framework to facilitate a multidisciplinary evaluation and intervention. Unwanted fire is a destructive force that causes many deaths and huge property loss every year. It could be prevented in a way to reduce the probability of occurrence, but it is impossible to prevent all major fires. Given that some fires will always occur, but there are many strategies for reducing their impact. Fire safety science is rapidly expanding and requires the integration of many different fields of science and engineering. In addition, the lack of specialist in DRM & FSE area in WBR has condition the high dependence on international support in national projects and programs addressing these issues. The technical aspects of disaster risk management and fire safety, as well as the economic aspects of the area have been poorly covered at HEI's study programs in WBR.
In order to improve the resilience of the region to hazards, it is necessary to provide the required number of experts, that is to modernize and develop higher education at the regional higher education institutions in the field of the Disaster Risk Management and Fire Safety Engineering, in cooperation with the universities from EU countries that have well developed curricula at all three education levels [1].

2 WBR common needs for improvement in DRM & FSE research and education

The building of disaster resilient societies, or those able to absorb the impact and bounce back in a timely manner from any disturbance, is seen today as a desirable target to make our societies safer while contributing to their sustainability (United Nations, 2012). DECISION No 1313/2013/EU on a Union Civil Protection Mechanism [2], in view of the significant increase in the numbers and severity of natural and man-made disasters in recent years and in a situation where future disasters will be more extreme and more complex with far-reaching and longer-term consequences as a result, in particular, of climate change and the potential interaction between several natural and technological hazards, an integrated approach to disaster management is increasingly important. Therefore, prevention is of key importance for protection against disasters and requires further action as called for in the Council Conclusions of 30 November 2009 [3], and in the European Parliament Resolution of 21 September 2010 on the Commission's Communication entitled a "Community approach on the prevention of natural and manmade disasters" [4]. To fulfil the prevention objectives and carry out prevention actions, improving the knowledge base on disaster risks and facilitate the sharing of knowledge, best practices and information, was defined as the first ranged action to take.

The same goal is promoted in multiple EU documents, e.g.: *European and Mediterranean Major Hazards Agreement* (EUR-OPA) [5], Medium Term Plan set Using Knowledge to Reduce Vulnerability as the main long-term objective to reinforce the role of laboratory of ideas and of platform for communication and exchange of scientific and technical information on hazards and vulnerability, and to identify possible solutions to improve the resilience of societies to potential disasters. Resilient Europe and European cooperation in education and training ('ET 2020') [6]; in order to ensure a long-term economic growth perspective, the region is looking for ways to change its development path towards more value added, moving away from low-cost labour to other sources of competitiveness. Smart growth needs to be fostered in the framework of "knowledge - based economy" – an economy founded on the production, distribution and use of knowledge and information (SEE 2020 Strategy) [7]. There is also *Supporting growth and jobs* – an agenda for the modernization of Europe's higher education systems (COM (2011) 567 final) [8].

Education and training lie at the heart of the EU's Europe 2020 strategy to exit the recession and establish the foundations for future knowledge-based growth and social cohesion. The Europe 2020 headline target - to reduce the rate of early school leavers to less than 10% and to increase the share of 30-34 years old is having completed tertiary or equivalent education to at least 40%. EU Principles for Innovative Doctoral Training [9] are also important to be implemented in Doctoral Study Programme Curricula.

Common regional needs to improve the resilience of the region to hazards are recognized. The first of all is a need for human resources – experts, who are competent to operate in prevention, reaction and recovery phases of the catastrophic events and solve engineering problems in the field of Disaster Risk Management and Fire Safety Engineering. The second is a need to ensure competitive experts who are able to create a sustainable financial plan for disaster preparedness and preventive measures, according to regional economy recourses. According to official WBC HEIs records available there is no similar study program in WBC HEIs, with the exception of existing academic (UNS) and professional (VTSNS) master programs which need to be modernized. Number of graduates is not sufficient for regional/national needs. The overall broader objective to be contributed is to build the sustainable educational foundation in DRM&FSE field in WBC and ensure national professional resources and regional capacity for resilient society.

3 WBR common objectives and goals in DRM & FSE research and education

All above listed are common needs, objectives and goals both for EU and WBR, considering the on-going European integration process in the Balkans. Wider and specific objectives are also ought to be in compliance with WBR countries national higher education strategies and action plans, as well as national strategies in the field of fire protection and emergency situation.

The subject area Disaster Risk Management and Fire Safety Engineering refers to Multidisciplinary / Interdisciplinary priority amongst the national / regional priorities of a WBR Countries, with Engineering and engineering trades as dominant academic discipline, and other disciplines which should be addressed by programme curricula are Environmental protection, Architecture and Construction, Civil Protection, Fire Science, Climatology, Hydrology, Seismology and Economy.

Specific subject curriculum should be dedicated to the vulnerable social groups' safety (disable people, hospitalised persons, poor people living in slums, the homeless, elderly people and children). EU law and technical standards should also be the topic of specific subject curriculums.

Acquired knowledge in the field of Disaster Risk Management and Fire Safety Engineering provide the base for building a resilient society.
The innovative contribution rests in European dimension of Disaster Risk Management and Fire Safety Engineering (DRM&FSE) programs with respect to international co-operation of the WBR countries. The new study programs are to be proposed in the Balkan region.
These programs should foster the assessment of transversal skills. The implementation of interdisciplinary study programs DRM&FSE in the field of Technical Sciences, created in a way that enables continuation of the studies for a number of different profiles of engineering professions, also enables continuation of the studies of active professional experts. Also, support the production and adoption of Open Educational Resources in diverse European languages would result with study programs which will be available in WBC HEIs in EN and regional languages. Glossary of DRM&FSE key words and terms and On-line Library would support cooperation.
Educational ICT based laboratories should be created in WBC HEIs with interoperability capabilities and On-line library providing international and regional case-study and research publications. That insures common regional problem approach and knowledge compatibility also in accordance to contemporary trends in field of DRM&FSE.
Modernisation, accessibility and internationalisation of the higher education field in the WBR Countries should be supported through the innovative DRM&FSE master and doctoral study programs in WBC HEIs which will provide experts with recognizable competences and profiles of professionals at the labour market and EQF, capable to meet various requirements of regional needs.
Interdisciplinary, multi-language and ICT based education approach insures regional cooperation, allows the exchange of knowledge and the mobility of students, teachers and workers, and strengthens national and regional capacities in EU integrations.

4 WBR common goals and aims

The common goal is to create effective, contemporary and sustainable Study Programs in the field of Disaster Risk Management and Fire Safety Engineering.
Due to differences in legislatives and educational structures the first step towards joint educational program is implementation of the same, standardized and regionally fitted Master Program. To supplement Master Academy DRM&FS Engineering Program and with aim to develop all required competences for labour market, two horizontal educational branches are planned to be implemented at the same time: Protection Engineering professional master program and Economic and Financial Resilience professional master module. All these together with an implemented PhD Program complete the cycle of education in the field of DRM&FSE.

5 Conclusion

There is one Disaster Risk Management and Fire Safety Engineering MSc program (UNS), and no similar program even in neighbouring European countries. The current situation in higher education in this field is not self-sustainable, because there is no PhD program to ensure HEIs teaching staff and it does not meet the national needs for qualified personnel and, in particular, does not meet the regional needs.
European cooperation is needed for assistance in program modernization, development and implementation, through knowledge sharing, experience transfer, particularly in developing similar programs and modules and assistance in defining needs for program content and teaching methods improvement and modern ICT use in the education process coinciding with higher education development in the EU.
National, regional and local funds are directed and limited to HEIs' day-to-day functioning activities, and are already being used in these purposes. This implies the need for extensive funding directed to curricula development through international cooperation within a larger consortium at a European level.
Issues related disaster and fire risk management, and risk modelling are of particular importance, as they form the basis of a comprehensive understanding of cost and benefits of adequate national or international programs aiming at reducing the risk of disasters and fires. Strengthen regional cooperation in education and research will also support capability in regional cooperation and interoperability in hazardous events.

Acknowledgements

The work reported in this paper is a part of the investigation within the research project „Improvement of processes and methods of academic education and research in computer science and automation“

supported by the Department of Computing and Control Engineering, Faculty of Technical Sciences in Novi Sad. This support is gratefully acknowledged.

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Development of scientific research activity through normative activity of University of Kragujevac bodies

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Through various forms of normative activity, the University of Kragujevac provides and improves processes of research, innovation and knowledge transfer. The aim of this activity is to develop efficient systems for application of scientific research results, through various forms of knowledge transfer between the University of Kragujevac and businesses and institutions who have the need for innovative production, professional training, and further education of their own labor power. By its normative activity, the University of Kragujevac also provides cooperation with other universities and international organizations, in order to improve the quality and competences for the scientific research work. In this sense, through this work, legal mechanisms and organizational structure of the University of Kragujevac that ensure the development of scientific research will be presented.

Key words: University of Kragujevac, scientific research activity, normative activity.

1 Introduction

The University of Kragujevac, founded by the Republic of Serbia, is an independent higher education institution, consisting of 12 faculties and an University Library. Faculties within the University of Kragujevac are settled in 6 cities of Central Serbia Region: Kragujevac, Čačak, Kraljevo, Jagodina, Užice and Vrnjačka Banja. The University educates about 20 000 students from the territory which includes more than 5 000 000 inhabitants, thereby it acquired the status of one of the main levers of development in this area.

The University of Kragujevac integrates the functions of all faculties and organizational units in its structure, carrying out a unified policy, aimed at continuous improvement of the overall activities of higher education, particularly scientific research, innovation and knowledge transfer with industry and institutions that have the need for innovation and technical improvements.

Scientific-research activity at the University is realized at the level of the University and faculties in its composure, through fundamental, basic, integrated and interdisciplinary, development research and research from program of technological development in the field of natural and mathematical, technological, socio-humanistic and medical sciences, on which, in addition to 1,100 teachers and associates of the University, over 600 researchers are engaged.

2 Normative activity as a precondition for the development of scientific research

In order for the University, following the Bologna principles in higher education, to improve and harmonize the educational process and research work of its teachers and researchers with European higher education standards, its organs, the Rector with his management team of Vice-Rectors, Senate and Council, started the development of mechanisms, established by the applicable legislation Republic of Serbia, through normative activity of bodies, in accordance with their responsibilities, which would initially ensure:

- logistic support to scientific research potential of teachers and researchers,
- linking research and achieved results of scientific research with the needs of the economy and the public sector,
- respond to the needs of the market not only in research but also education regarding appropriate profiles and their further development,

- ensure the transfer of knowledge as a common good with maximum protection of intellectual property and
- mobility and exchange of teachers, researchers and talented students, especially those who are directly or indirectly involved in scientific research.

In order to achieve these objectives, the competent authorities of the University arranged and organized a system which will ensure the development of the University in this direction. This was done in accordance with the jurisdiction prescribed by the Law, University Statute and lower legal acts, such as decisions, regulations, instructions and other documents, using the experiences of other universities in the country and the world, as well as those that resulted as liabilities from international projects whose holder or partner was the University, through Statute amendment, making of appropriate decisions, regulations, directives and other legal acts.

The various forms of the University of Kragujevac normative activities, through the establishment of special organizational forms, but also through the adoption of guidelines for their use, regulations on their organization, mode of operation and responsibility, and in particular the Regulation on the manner and procedure of realization of international projects managed or coordinated by the University of Kragujevac, which the University Senate passed in September 2010 and which arranged that all the equipment, purchased during the implementation of projects whose holder or partner is the University, is physically stationed at faculties whose teachers were coordinators or contact person of the projects, for equipping laboratories, institutes and other normative regulated forms of research and knowledge transfer, and is made available to all teachers, assistants, researchers and students of the University, in order to gain new scientific knowledge, scientific research and innovation.

In this sense, the University of Kragujevac in the last few years founded the following centers, committees and offices at the University of Kragujevac: University Center for Career Development and Student Counselling, Collaborative Training Center, Lifelong Learning Center, Knowledge Transfer Center, International Projects Office, Business Support Office, Board for managing the activities of the International Projects Office, Board for Entrepreneurship, Center for Scientific Research of SASA and University of Kragujevac and Repository of the University Library. The University regulated their organization, operation and other issues important for their functioning, for the effective application of scientific research results, all in order to develop the economy and society.

The University Center for Career Development and Student Counseling was formed as an organizational unit within the University of Kragujevac Department for Education and Student Affairs in 2007, with the initiative of Crown Prince Alexander Foundation for Culture and Education and with the support of the University of Kragujevac.

The Center was founded with the goal to help students prepare for the job market after graduation, to connect them with business community and support them in acquiring those skills and knowledge that are now necessary in the labour market.

Apart from the fact that the Centre is mainly directed to development of student services, it also provides internships and mobility for teachers and researches, in order for them to gain new knowledge and ways and conditions of its exploitation, through exchange with other universities. Namely, the Center provides an introduction to different manners of scientific research at other universities in the world, especially in countries of the European Union, the way of their connections with industry and the public sector, way of delivering and charging services in the field of scientific research and gaining experience that, through the normative forms of organization, can be transferred to the University of Kragujevac, as examples of good practice.

The Collaborative Training Center of the University of Kragujevac is one of the centers from CTC network founded in Western Balkans Region, within the Tempus project WBC-VMnet, in June 2010, as an organizational unit of the University. Considering the importance and necessity of cooperation between the University and enterprises, the main strategic objective of the Centre that the University wanted to achieve with its establishment is coordination and improvement of cooperation and enabling the transfer of knowledge and technology.

The mission of the Centre is to develop efficient and effective mechanisms for cooperation between the University and enterprises, through the implementation of projects, professional training for companies and for the unemployed, through industrial scholarship programs (Industrial Fellowship Programme).

Center coordinates a network of CTC centers in the WBC region (Kragujevac, Banja Luka, Podgorica, Rijeka), VMnet network with over 1,400 members, VRPM network (Virtual Rapid Prototyping and Manufacturing) of 74 researchers from 20 countries.

The Lifelong Learning Center of the University of Kragujevac was established in June 2010 within the framework of the TEMPUS project "Development of Lifelong Learning Framework in Serbia", the project holder was University of Kragujevac.

Lifelong Learning Center works on creating the organizational and institutional conditions for the inclusion of the University of Kragujevac in the field of Lifelong Learning as well as on networking of the Centre with other university centers for lifelong learning in Serbia.
Since lifelong learning is one of the priorities in the knowledge society and knowledge-based economy, the University, with the establishment of this Centre, showed the necessity for opening education to the general population, in order to respond to the challenges arising from the globalization process in the most appropriate manner.
Among other things, the Centre has the task to accomplish partnerships between all relevant stakeholders: the state and its authorities, enterprises, local communities, educational institutions.
The Knowledge Transfer Center was established in November 2012 within the realization of TEMPUS project KNOWTS "National Platform for knowledge triangle in Serbia", in order to enable, facilitate and coordinate the transfer of knowledge and technology at the University of Kragujevac, as well as to analyze and evaluate the technical and commercial opportunities for innovation, but also to provide the necessary assistance to researchers in intellectual property protection for their inventions, to organize training in this field, to enable networking and internationalization of research results through the establishment of a database.
The main objectives and tasks are: improving opportunities for efficient and effective application of scientific research results of the University in order to develop the economy and society, fostering knowledge transfer between the University and industry, supporting the placement of new technologies and innovations, linking relevant entities, establishing networks and collaboration for more intense technology transfer, developing knowledge and skills in the protection and exploitation of patents and other forms of intellectual property in the process of technology transfer, raising awareness on intellectual property and increase the capacity of technology transfer at the University, providing general information on intellectual property, expertise and support in the development of technological and economic feasibility studies, as well as evaluating the value and overall potential in the use of patents, helping create new innovation centers, incubators, business and technology parks established by the University and by the faculties of the University.
The International Projects Office, was established by the Council in October 2010. The main objective of the Office is to raise the level of quality of scientific research activities at the University and the level of engagement of the total resources for the implementation of projects at the University through various types of activities such as: the organization of Info days dedicated to open calls and new possibilities for applying for funds from HORIZONT 2020, Erasmus +, IPA and other programs , organization of trainings dedicated to seeking partners, writing and submission of project applications, providing adequate help in the preparation of project applications, keeping track of projects implemented at the University, providing administrative and technical assistance in the implementation of projects, providing technical assistance in preparing documents that accompany the implementation of projects , establishment and development of cooperation with higher education institutions in the world and in international university networks and associations.
The Board for managing the activities of the International Projects Office was established by the Council in order to create conditions for the modernization and improvement of scientific research and the existing teaching resources and computer equipment through participation and implementation of projects, thus creating conditions for the introduction of new technologies and raising the level of training of teaching staff, associates, researchers and students of University of Kragujevac.
The University of Kragujevac Business Support Office was established within the TEMPUS project WBCInno, according to the decision of the University Council in April 2014, with the aim to make available research and innovative potential of the University to the business environment and to support the development of the ideas of researchers and students.
The Office is providing unique access to university knowledge and resources that are offered to the business environment, development and maintenance of a platform for innovation management, collection, presentation and promotion of university research and innovation resources on an on-line web catalog, encouraging researchers on students creative thinking and the development of ideas, providing logistical support for the development of business incubators and science-technology parks in Western Balkans, as well as preparation of specific reports and statistical data analysis for decision-making in the management structure of the University.
The Board for entrepreneurship of the University of Kragujevac was formed by the Council in order to create a favorable market environment and to encourage investments, through the development and cooperation of science and economy in realization of international projects and projects of national and regional character, creation of the human resource database through education of staff with corresponding profile and their training through a system of practice, commercialization of results of

scientific, research and artistic work, in accordance with the law, and by improving economic and overall potentials of Kragujevac and Šumadija.

The Center for Scientific Research of SASA and University of Kragujevac was founded to perform activities in the field of science, research and innovation, founded by Serbian Academy of Sciences and Arts and the University of Kragujevac, who jointly manage its affairs. The Centre was established in May 1991, and in 2010 the Founding Act was amended and harmonized with the new legislation, aimed at encouraging and developing of scientific, educational and cultural activities of the wider area of Central Serbia, which gravitates to University.

The Centre was established without legal entity status, and its core business is realized through work on scientific research projects, especially research in the sciences that are not studied at the University of Kragujevac, as well as through multidisciplinary research, but also through the organization of conferences, forums, lectures, promotions and other scientific and cultural events. The Centre has an especially important place in publishing activity, within which publishes scientific journals such as MACH, but also professional monographs, proceedings, and other types of publications in which publishes the most significant papers that are of importance for the development of science, culture and art.

The Repository of the University Library in Kragujevac was founded by the Senate with the Decision on establishing the registry and database in electronic, or digital form, in June 2012, thus established the basis of all doctoral dissertations defended at the University since its establishment, in order to have an easier, more accessible and transparent access to scientific basis of knowledge, with which the Senate accepted and joined the signatories of the Berlin Declaration on open access to knowledge in the field of natural sciences and humanities. Repository was established at the University Library, as part of a global network of knowledge and, with special Instruction issued by the University Senate, the conditions and manner of use that protect copyrights were regulated. The mission of establishing a Repository is the dissemination of knowledge through the timely availability of information relevant to the wider scientific community, but also the promotion of achievements in the development of scientific thought of teachers and researchers of the University of Kragujevac.

3 Conclusion

The University of Kragujevac, through various forms of presented normative activities in the last 6 years, provided and improved processes of research, innovation and knowledge transfer, provided basic protection of intellectual property and copyright, thus created a solid legal basis and legal framework with pre-established rules. In short, the result of this normative activity is that faculties of the University are engaged as coordinators or as partners in 132 projects funded by the Ministry of Education, Science and Technological Development of Republic of Serbia, while in international projects, faculties are engaged as partners or co-ordinators in total of 16 projects. The total number of teachers and associates who participate in national projects is 521, while 44 are engaged in international projects. In order to connect with the economy a great number of contracts is realized, out of which the most important are those for the purposes of FAS Kragujevac, but also for a large number of companies across the Cooperative Training Center, as well as for the needs of institutions and NES in cooperation with the OSCE through Lifelong Learning Centre.

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Acknowledgements: This work was supported by EACEA and TEMPUS programme, within WBCInno project (530213-TEMPUS-1-2012-RS-JPHES).

Application of the principles European Charter and Code for Researchers at the University of East Sarajevo

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This paper describes the application of the principles the European Charter and Code for Researchers (C&C) and their impact on the university's research management and on the University strategy development 2015-2020.
The application of principles C&C has caused the creation of detailed analysis of the University of East Sarajevo on the basis 40 different items, within the 4 sections. The analysis contained filling an electronic questionnaire, its completion by over 300 researchers at the University, as well as its processing. Then, within the following 4 sections per 40 parameters the specific internal analysis is made, in which is evaluated legislation, existing practice at the university, but also the different practices are predicted about what is required to be implemented in order to C&C becomes fully implemented at the University of East Sarajevo. In accordance with the processed questionnaire and internal analysis the action plan for the implementation of the principles C&C is made. Defined action plan is a key input in the finalization of the human resources strategy for researchers that will not be created as a separate document but as an integral part of the overall strategy of the University.

Key words: European Charter and Code for Researchers, European Research Area, Internal analysis, Action Plan, Strategy of Human Resources

1 Introduction

C&C has the main aim to ensure equal rights for researchers, to improve quality of scientific researches and working conditions for all researchers as well as to ensure transparent and objective work and mobility of scientific researchers [1]. Its application at the university is the prerequisite for the entrance into European research area. The application of principles C&C implied the creation of detailed analysis of the University of East Sarajevo on the basis 40 different items grouped into 4 different sections: Ethical and professional aspects, Recruitment, Working conditions and social security, and Training. The analysis was divided in filling an electronic questionnaire, its completion by over 300 researchers at the University, as well as its processing. For each of 40 parameters the specific internal analysis is made. In that analysis national and institutional legislation is evaluated, existing practice at the University, as well as different practices needed for fully implementation C&C. This final analysis was the base for creation the action plan for the implementation of the principles C&C. The key activities defined in this action plan are divided per chapters of the Charter and Code: Ethical and professional aspects, Recruitment, Working conditions and social security, and Training. For each activity the executors and terms of completion tasks are defined. Described action plan represents the main input for the completion of the human resources strategy for researchers.

2 The Approach and Working Methodology

In 2005, the European Commission adopted the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (C&C). These documents aim to provide the same rights and obligations of researchers and organizations in which they work, and the C&C suggests equality for all researchers in Europe during the recruitment process and increasing of the transparency of the recruitment. The University of East Sarajevo decided to accept the principles of C&C, and the Rector of the University of East Sarajevo, signed the Declaration of accession to the C&C on February 7, 2013.
The implementation process regarding C&C at the University of East Sarajevo began in mid-2013 when a working group was established. The working group began preparations for conducting internal analysis

and creation of the action plan. The preparations for the next step that the University should take - conducting surveys among researchers - lasted more than six months. Vice-Rector for Science, Research, Development and Investments presented a plan regarding the implementation of mentioned activities at the meeting of the University Senate. At the meeting of the Committee for Quality Assurance held on December 20, 2013 the original questionnaire with forty questions was analyzed and sent for further analysis and adaptation to a simpler survey form. On June 10, 2014, the survey was sent to all Deans of the University 17 organizational units accompanied with a formal letter with derived electronic survey link (Lime Survey). They were supposed to organize, with the help of their logistics services, filling out of the survey. Researchers are supposed to state their opinion on each of the principles through simplified electronic questionnaire containing forty statements related to the forty principles of C&C. The survey was filled out by more than 300 employees at the University of East Sarajevo, which created a critical group of the responses providing statistically significant results. The working group analyzed the results of the survey and prepared a report on the results which was presented at the Rector's Collegium of the University of East Sarajevo.

In the period between 2013-2015, in order to ensure a more open and transparent process, all relevant bodies at the University were informed about the implementation process of C&C and about the content and results of the internal analysis. In May 2015 the work of the Offices for Science, Research, Development and Investments and International Cooperation and Quality Assurance was intensified leading to the drafting of the final version of the internal analysis and action plan, and thus the entire project entered its final phase. The internal analysis is made partially of the results of the electronic questionnaire and mostly of the analysis of the relevant legislation and institutional rules and practices. This provides possibility to define the necessary actions required for the full implementation of C&C, taking into account all principles or claims of the C&C. In June 2015, based on the internal analysis, conditions for the development of the Action Plan were created. The activities of the Action plan will be incorporated in the Development Strategy of the University with a special section focusing on human resources and researchers. Specifically, the proposed strategic goal 2 applies throughout its scope to the implementation of the principles of the C&C. Results of this research will be used for the preparation of the University strategic documents related not only to human resources, but also to the overall Development strategy of the University.

2.1 Results of on-line research study

Total of 312 or 56.41% of the total number of full-time teachers and associates at the University participated in the survey, which was finally accepted by the Commission as a representative number of responses, or as the number by which an internal analysis could be made.

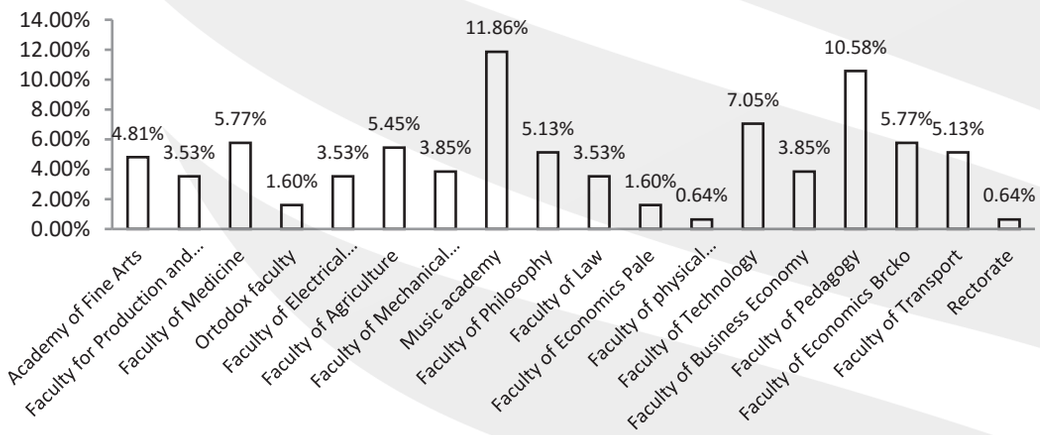

Figure 1 Percentage of the total number of responses per organizational units of University

The following table 1 shows the University questionnaire based on the original C&C questionnaire which was completed by the university teachers and staff (only part of the chapter 1 due to the volume of all questionnaire). It also illustrates the mean score and standard deviation for each question or statement.

Table 1 Presentation of the answers to the questions or statements of the University questionnaire with the mean scores and standard deviation (part of the 1st chapter)

Chapter CC	Statement CC	The statement - Questionnaire	mean score ($\overline{X}$)	standard deviation (σ)
Ethical and professional aspects (3,97)	1	Researchers, during performance of their research work, have complete freedom of thinking, expression and application of appropriate methods for accessing research problem.	4,36	0,83
	2	The researchers adhere to ethical principles and practices, as well as standards that are appropriate for their discipline and that are in compliance with various national / entity and institutional codes of ethics.	4,17	0,89
	3	The researchers perform the original research, while respecting the intellectual property of other researches.	3,87	1,06
	4	Researchers are familiar with the strategic goals governing their research environment, funding mechanisms, and the manner of reporting on the progress of their research effort to the relevant authorities at the home institution /or financier.	3,63	1,12

The following figure 2 shows an excerpt from an electronic questionnaire in the Serbian language that was used during the survey process.

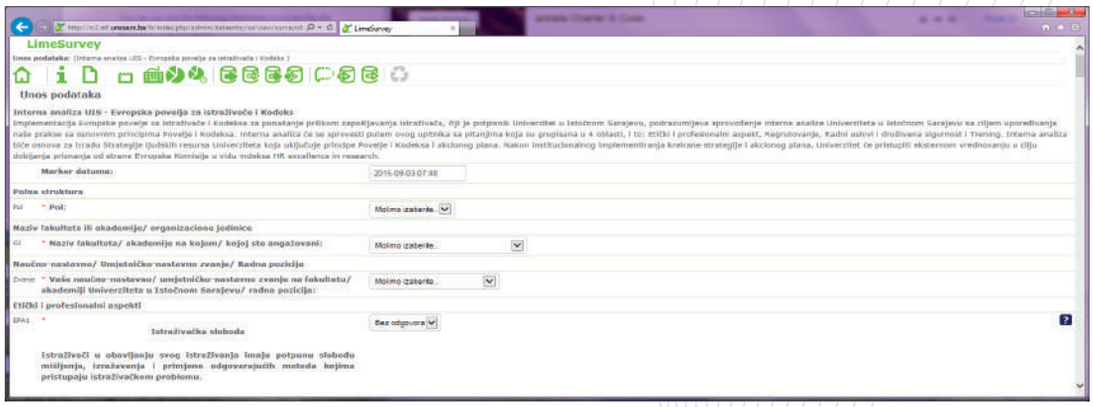

Figure 2 Excerpt from the on line questionnaire which is used during survey process in the Serbian language

2.2 Internal analysis

For each described attitude of C&C the relevant legislation, different laws, regulations and procedures have been studied in detail. Also, existing institutional policies and practices, and answers from the questionnaires with particular orientation to the number of negative responses have been considered. In this way it is suggested precisely what to particular attention should be paid to. Based on these three elements, necessary actions which would lead to implementation and complete fulfillment of all attitudes from the C&C have been written. Then, in accordance with the necessary actions, responsibilities for completion of each attitude and the timeframe when they would be implemented have been specified.
The internal analysis, together with the results of an online survey, with special emphasis on the institutional rules and practices, was a key input in the development of the Action Plan that will be an integral part of the Development Strategy of the University of East Sarajevo.

Table 2 Part of the internal analysis of C&C questionnaire (6. Accountability)

6. Accountability

Relevant legislation (permitting or impeding the implementation of this principle)	Existing Institutional rules and/or practices	Actions required	When/Who
- Labour Act of RS - The Law on Scientific Research Activities and Technological Development of RS, Articles 107 and 108	- University Statute - Code of Professional Ethics of UES	- Introduce a Regulation on the responsibility of coordinators and researchers on projects implemented at the University.	- University Senate The end of 2015 – 2016

2.3 Action plan

The Action Plan for implementation of the principles of C&C is a document stemming from the internal analysis and results of the online survey. It contains the key activities that need to be incorporated in the Development Strategy of the University. Considering that the Development Strategy of the University

would be made on the principles of the Balanced Scorecard, herewith, the defined actions in the Development strategy will represent programs or initiatives that will be analyzed in detail, in a separate unified document for the whole University, in terms of the necessary costs, resources, and indicators execution time.

The proposed Action Plan is a combination of the possibilities of the University, implementation of the necessary actions to improve science and research, and artistic activities, opinions of key users, and implementation of the principles of the C&C. A number of principles of the C&C have been already incorporated in the integrated functioning of the University. The other necessary actions, defined through this Action Plan, will represent an upgrade and improvement of research and artistic aspects, which will contribute to the establishment of current non-existent matters.

Key activities defined in this Action Plan are divided into sections from C&C, namely: ethical and professional aspects, recruitment/employment, working conditions and social security, and training. Executors and implementation deadlines are defined for each activity.

Defined Action Plan is a key input in the finalization of the human resources strategy for research that will not be developed as a separate document but as an integral part of the overall Development strategy of the University, and it will be described in detail in the strategic goal 2.

The following table shows only part of the Action Plan because of its volume.

Table 3 Part of the C&C Action plan

C&C Principles	Actions required	Who	When
1. Research freedom	Introduction of statement signing during employment process with handing out the Code of Professional Ethics and European Charter and Code (to all employees)	Secretary General Legal services Office for Science, Research, Development and Investments WEB team	The beginning of academic 2016/17
2. Ethical principles	Analysis of the situation regarding compliance with the Code of Professional Ethics and the relevant legislation through surveys	Office for Science, Research, Development and Investments Quality Assurance Office	The beginning of academic 2016/17 (then set up a system once every three years)
3.Professional responsibility	Creating information packages and newsletters for teachers and researchers containing information on relevant legislation and institutional rules related to scientific research and arts, rights and obligations arising from employment	Legal service Office for Science, Research, Development and Investments The Commission specifically formed for the purpose of fulfilling the task (it must consist of 60% vice-deans for science and research)	The beginning of academic 2016/17
	Introduce a Regulation on the protection of copyright and responsibility at the University level and made it available to public	The Commission specifically formed for the purpose of fulfilling the task University Senate Ethical Committee WEB team	September - October 2017
	Provide access to leading journals and online databases. Continuously strengthen awareness of the importance of professional ethics and unacceptability of any form of plagiarism and forgery	Vice-rector for Science, Research, Development and Investments WEB team	Continuously

3 Conclusions

This research shows the reaction of the University of East Sarajevo on demands which are placed in the direction of participation to the European Research Area. The most of the demands are filled taking into consideration a new development strategy of the University. The detailed analysis showed that there is possibility to consider all important aspects of research function of University, and determine the future steps of University developments with the aim of in the direction of raising research at a higher level.

Applications of the principles C&C has contributed to the development of a detailed analysis of the research and researchers at the University, establish a set of activities that need to be implemented in order to enter into the European Research Area, and proposed the creation of a human resources strategy for researchers within the University's development strategy.

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The role of qualitative research methods in the post-transition countries

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Qualitative research has receiving immense attention in the social sciences in recent decades. Qualitative studies in social research have been exploited, for example, to study perceptions and narratives of various cultural groups for certain social phenomena; opinions and experiences of vulnerable groups for certain sensitive topics in different geographical communities. Despite many produced texts and a significant body of research on qualitative methods in the Western World, less attention has been paid about the qualitative research in post-transition countries in South-East Europe (SEE). This paper aims at to open up discussion by suggesting that there is a need of to introduce qualitative research in social sciences in the post-transition countries in SEE. It draws upon experience of conducting qualitative research with young social scientists in order to suggest some new insights in qualitative research in which social scientists might get critical thinking about qualitative research.

Key words: qualitative research, methods, post-transition countries.

1 Introduction

Qualitative research has become increasingly common in social sciences in recent decades. Research studies have used this method to get insights to various cultural narratives [1,2] to understand opinions and experiences of different sensitive groups, which are not easily approached by the state officials and most of them are geographically distanced. The Western Universities have paid enormous attention to the qualitative methods in their social, economic and medical departments, in parallel with numerous quantitative studies carried out in the same time [1,3]. The number of produced qualitative papers in the online research data is improving, last decades and it could be noticed that many studies shed a light on this research method in the developing countries [4]. Therefore, this paper proposes that there is a need of to introduce qualitative research in social sciences in the post-transition countries in the SEE.

Scholars arguing about the importance of qualitative research in social and related sciences have raised a number methodological tools that are significant in the research process: focus group discussions, in-depth interviews, observations, story narratives, photo analysis etc [1,2]. All these qualitative research tools have been applied to research studies on many occasions as single methods or in combination [5,6]. Qualitative research is often used in various social researches for very different goals and purposes Traditionally, the qualitative research tool of focus group discussion is used in political action as participants want to raise social change in certain communities [3]. In cultural geography, qualitative research is used, for example, in understanding the market economy in developing countries [3]; understanding the contemporary historical debates [7]; and evaluating attitudes among drug users, HIV patients; persons with nutritional disorders [8].

However, scholars admit that there is no unified way of using qualitative research [9, 10, 11, 12]. Each discipline like health research or social science research has its own approach towards carrying out qualitative research. For the social science approach, the theoretical aspects and generating knowledge for building a theory is very significant. With the theory aspects the researchers would like to set, predict and interpret events or phenomena of interest [13, 14]. Theory is relevant to understand certain variables and context where the problem is present and giving a concept for guiding the research [5].

2 Qualitative research in post-transition countries

Post-transition countries from the (SEE) have faced enormous changes in its educational and empirical research after the collapse of socialism. Within the independence the education system in the post-transition countries had to face challenges of demand for interactive teaching, improving the quality, linking with the practice, insufficient finances, and lack of continuous education. Since 2007, European standards in the educational system in many ex-communist countries were introduced, moving the

education system away from the international isolation [15]. At the same time, increased enrolment of students and lack of funding led to a decline in the quality of higher education. As part of the education reforms many additional departments have been established, introducing the demand for new profiles and knowledge.

Within the many departments of social research the use of qualitative methods is always on the margins. The predominantly used method in the post-transition countries is quantitative empirical research. This method has a focus on the descriptive statistics, applying very basic quantitative analysis. Further, in some cases these countries are lacking in accurate and organized data administration on both a local and national level. Yet, often, the academic use of the statistical analysis is more than needed, since the prevailing research is from the international scholars and organizations.

Qualitative research in the educational system of post-transition countries is disregarded. For instance, at the Medical Faculty in Skopje this research method has been not introduced yet. In a similar approach, many departments in the social research sphere, e.g. social work, qualitative methods and their approaches have little presence in the curricula. In guiding their master and PhD students very often the supervisors and mentors are confused with the meaning of the qualitative research and its application in academia. For example, from my experience, reading an academic thesis with mixed methods (qualitative and quantitative), elaboration and depiction of qualitative research results were interpreted in numbers without explaining what are the main emerging themes in the data analysing [16].

The practice of using qualitative research in the academic field in the post-transition countries is rare. Furthermore, it is important to note that these educational organisations have not received adequate knowledge and training in developing and applying this method in their curricula. On the other hand, in many informal talks with the professional staff of the universities it has been observed that the knowledge and support about the qualitative methods is very low. Qualitative research has been criticized by the national scholars as shallow and not fully interpreting the data produced. Likewise, the scholars in post-transition countries use qualitative research in diverse and experimental ways yet chose not to concentrate their efforts on reflecting upon these issues in details in their writing [16, 17].

I would like to propose that – although qualitative research has become one of the research methods in recent decades, employed by social scientists and other scholars – there is a need for it to be implemented and developed in-depth in the post-transition countries where the researchers can critically and creatively think and use this method. This will involve moving beyond the quantitative methods and presenting just the numbers, to finding the link with what is behind these numbers [1]. The reflections in this paper stem from qualitative research about the health care professionals who are dealing with sensitive issues in Macedonia. This project employed focus groups and interviews along with non-participant observation to discuss what are professionals' experiences with the disadvantaged groups during their everyday work. Drawing upon my experiences of moderating 8 focus groups and 32 interviews, I have faced with many challenges in using the qualitative research with the scholars from the SEE and this made me to think critically about using this method in future.

3 Concluding remarks

In conclusion, this paper reflects that there is a need to open discussion about the use of qualitative research method in academia in the post-transition countries. Apart from occasionally applying the qualitative methods, especially the focus groups discussions by the international scholars and organizations in the post-transition countries, there is a lack of critical reflection regarding practicing qualitative research in the academic curricula. In a series of recent reviews of qualitative research in post-transition countries in the SEE, qualitative research methods have not been referenced in the academic texts [18]. Scholars from the SEE post-transition countries use the qualitative research in a range of some creative and innovative ways as evidenced from informal talks with the colleagues; however, these issues have not reflected in their papers and writings, and I have used this paper to suggest that is time to move beyond quantitative methods and creative use of qualitative methods.

Using my experience of PhD study for the health care professionals in Macedonia, I have highlighted a number of issues on which the qualitative research could be used. Within the social science literature on qualitative research [1,2], much attention is given to the social scientists and using interviews and focus group discussion as crucial in qualitative research, also, in the ethnography the observation method plays an important role. However, in this paper, I have suggested that scholars in this region could contribute to critical reflection on qualitative research, on many complex issues in various contexts. This may include analysing the perceptions and opinions as to why the qualitative methods have been neglected in the post-transition countries academia; concerns about many political issues that embrace these post-transition countries; concern on different scales in the health education and governance; behavioural economy. Consideration of qualitative methods in these countries could have multiple influences in

various contexts, as well as in the critical thinking development by the scholars through using qualitative methods.

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SESSION 3: Policy, IPR, applied research, projects

The role of the Provincial Secretariat for Science and Technological Development in the progress of science and innovativeness within AP Vojvodina

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Fields of science and innovation are essential for the country's development. The subject of this paper is analysis of the specific regional government's tools for the development of science and innovation in the Autonomous Province of Vojvodina (APV). The Provincial Secretariat for Science and Technological Development (PSSTD) supports a wide range of activities that lead to the progress of science and innovativeness within APV. Support of international cooperation is among its priorities. With the aim of achieving the most successful incorporation of the scientific institutions from APV into European research area, PSSTD has developed unique instruments such as support schemes for the application to international projects as well as for the support of already accepted on going internationally funded projects. These forms of support do not exist at the republic level and represent an additional incentive for the development of this area in APV.

Key words: science, innovation, policy, policy instrument

1 Introduction

Knowledge is the currency of the new economy. A world-leading research and innovation capacity, built on a strong public science base, is critical to achieving lasting economic recovery and to securing Europe's position in the emerging global order. This is why the European Research Area (ERA) is at the heart of the Europe 2020 strategy and its Innovation Union (IU) policy flagship and why the European Council has called for ERA to be completed by 2014[1]. The overall aim of ERA is closer coordination of national and European policies, the organization of increased joint efforts including funding mechanisms and greater European cohesion in research [2]. Due to the EU integration processes incorporation in the ERA is one of the policy priorities in AP Vojvodina.

2 Science and research policy in the Autonomous Province of Vojvodina

The main national research policy actor in Serbia is the Ministry of Education, Science and Technological Development [3]. It carries out public administration activities related to: the system, development and promotion of scientific and research activities for the purposes of scientific, technological and economic development; defining and implementing the policies and strategies of scientific and technological development and the programmes of scientific, technological and development research and innovation policies; fostering the transfer of know-how to the economy and developing and improving the innovation system in the Republic of Serbia.

According to the Law establishing particular competencies of the Autonomous Province jurisdiction in the field of research and development is at the level of the Republic.

The Provincial Secretariat for Science and Technological Development (PSSTD) is the main science and research policy actor at the regional level, i.e. at the territory of AP Vojvodina. According to the Provincial Assembly Decision on the Provincial administration PSSTD, in accordance with the law that defines these areas and the Statute, perform the tasks of the provincial administration in the field of science, technological development and higher education and student standard[4].

3 Policy instruments of the PSSTD for the development of science and innovation in APV

Although the jurisdiction of the AP Vojvodina in the field of science and technological development is very limited, the Provincial Government pays a great attention to the progress in that area. Even though the PSSTD has no legislative power it undertakes many activities with the aim of the progress of science

and innovativeness within the province. Activities of the PSSTD in 2014, as in the past ten years, were focused on the further encouragement of the development of science and technology in the AP Vojvodina and their approximation to the European standards [5]. Secretariat implements its activities operationally, under the Rulebooks and by announcement of the public calls for each activity. The most important activities of the PSSTD are: projects significant for science and technological development of AP Vojvodina ; short-term projects of special interest to the sustainable development in the AP Vojvodina; organization of scientific and professional events; participation in the scientific events, professional development and staying abroad of the highly accomplished scientists, researchers and students; plant for the application of new technologies in AP Vojvodina; jobs for researchers-returnees from abroad and activities of international cooperation.

Support of international cooperation of the scientific institutions from AP Vojvodina in order to facilitate their significant involvement in international research area is at the top of its priorities. The international aspect permeates almost all activities of the PSSTD. In 2005 began the co-funding of so called interregional projects with neighbouring countries and institutions in these countries. The requirement for these projects was to establish joint teams of foreign and domestic partners and to formalize their cooperation. The most direct support to the international and inter-regional cooperation takes place through co-financing current activities of international cooperation institutions from Vojvodina. This support began in 2005, when 45 activities have been co-financed, and in 2014 it rise to even 194 activities. The approved projects included more than 45 mainly European countries, and some projects are done in cooperation with more than ten countries. The projects are working in cooperation with 951 institutions abroad. The same year begins the co-financing of the on-going activities of international cooperation realized by the scientific-research institutions from AP Vojvodina. With the aim of bolstering a more effective participation of research institutions from AP Vojvodina in the European research programs, Secretariat started in 2007 to support financially the proposals of the international projects complying with the EU programs. The priority was given to the applications for the FP7 and SEE-ERA.NET programs. The support has been dedicated for the technical preparation and contacts with potential partners for realization of the applications for international projects. The support was given exclusively to the project proposals that were submitted or prepared in the cooperation with at least one of the EU member states [5].

These forms of support do not exist at the republic level and represent an additional incentive for the development of science, technology and innovativeness in APV.

3.1 Co-financing of on-going activities of international cooperation

The direct support to the international cooperation of the scientific-research institutions from the province is the scheme for co-financing of on-going activities of international cooperation. The Secretariat is co-finance those international cooperation activities that are supported through international funds as well as bilateral and multilateral project activities that are implemented on the basis of inter-state and inter-institutional protocols of cooperation and whose realization is in progress at the time of filing the application.

Application may submit scientific-research organizations from AP Vojvodina, and exceptionally other institutions dealing with scientific research and by a special decision. For the realization of co-financing activities of international cooperation PSSTD announces a public call. The amount of funds for co-financing in the current year shall be determined on the basis of the total available funds in the budget of the Secretariat for this purpose, the number of accepted activities and the established character of approved activities. Funds are approved for the following purposes: travel costs, costs of stay and education expenses and the cost of the presentation of the results achieved by the participants and contributors to the activities of international cooperation. Monitoring of the implementation of international cooperation activities are carried out on the basis of reports, which are regulated by a contract between the Secretariat and the institutions that realizes the activity of international cooperation.

Table 1 Review of support to the on-going activities of international cooperation from 2005 to 2014 (by the type of cooperation).

Project type/year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	TOTAL
FP 5	1	1	1	1							**4**
FP6	4	10	10	7	3	1					**35**
FP7				7	11	16	14	19	22	15	**104**
INTERREG	1	2	6	2							**11**
TEMPUS	16	13	15	9	7	12	17	26	19	23	**157**
COST	2	6	10	10	15	20	26	34	50	63	**236**
IPA						4	17	22	23	9	**75**

EUREKA	2	2	2	4	5	6	9	5	4	1	**40**
CEEPUS	6	8	8	13	17	17	19	18	23	27	**156**
WUS	3	2	2		1	1					**9**
DAAD	1	1	-	1	2	2	3	1	2	2	**15**
Stability Pact	1	1	1	1	1	1	1				**7**
CIP								1	1	1	**3**
IAEA								1	2	1	**4**
ERASMUS								1	2	3	**6**
SCOPES						2	2	2	1	5	**12**
SEE.ERA-NET			1			1	2				**4**
CBC					1						**1**
SEE TC Programm					2	2	4	4	3	1	**16**
Multilateral activities	8	8	8	9	10	11	16	20	19	25	**134**
Bilateral activities		15	19	17	14	22	15	19	18	17	**156**
NATO Programme							1	1	1	1	**4**
US EPA							1	1	1		**3**
TOTAL:	**45**	**69**	**83**	**81**	**89**	**118**	**147**	**176**	**191**	**194**	**1193**
Approved funds (in EUR):	**126.000**	**153.000**	**173.000**	**204.514**	**261.340**	**240.372**	**343.274**	**374.911**	**421.474**	**418.783**	**2.717.119**

From the above data it can be seen that the majority of co-financed projects were from the COST program (236), followed by TEMPUS (157), CEEPUS and bilateral activities (156 each), multilateral activities (134), FP7 (104) and IPA (75). Other types of activities are represented in significantly less number.

As for the institutions involved, significantly largest share of the participation of the scientific-research institutions from the AP Vojvodina in international projects is of the Faculty of Technical Sciences (439), followed by the Faculty of Natural Science (215), Faculty of Agriculture (109) and Faculty of Technology (91). The University of Novi Sad is the holder or participant in 80 activities and its participation over the years is steadily increasing. It is also important the fact that independent research institutes from AP Vojvodina have well-developed international cooperation and to participate in a number of projects. Scientific Institute of Food technologies is leading with 65 co-financed activities, and it is followed by the Institute for Lowland Forestry and Environment with 41 and the Scientific Veterinary Institute with 32 co-financed activities.

PSSTD invested 2.717.119 EUR through this form of support, and the scientific-research institutions from the AP Vojvodina brought grants in the amount of 23.730.120 EUR which is about 10 times more than PSSTD invested.

3.2 Co-financing of the preparation of the project proposals for international cooperation

The Secretariat co-finance those proposals for international cooperation activities which are submitted to international institutions and funds, as well as those that are submitted on open calls for bilateral and multilateral cooperation. Priority will be given up for the program Horizon 2020. Application may submit scientific-research organizations from AP Vojvodina, and exceptionally other institutions dealing with scientific research and by a special decision.

For the realization of co-financing activities of international cooperation Secretariat announces a public call.

Table 2 Review of support to the proposals of international cooperation from 2007 to 2014 (by the type of cooperation)

Project type/year	2007	2008	2009	2010	2011	2012	2013	2014	Total
Horizon 2020								18	**18**
FP7	39	13	17	14	13	13	7	1	**117**
EUREKA			1	1	1				**3**
TEMPUS			1	7	7	6	12		**33**
SEE.ERA-NET	28			4				2	**34**
EU Neighborhood Program	1								**1**
DAAD		1			1	1	2		**5**
COST		1	1	1		3	11	10	**27**
WUS			1	1					**2**
SEE Prog.		6		1		6			**13**
NATO				2					**2**
IPA				5	10	12	6		**33**

Multilaeral coop.								5	**5**
Bilateral coop.				3	16	13	13	8	**53**
SCOPES			1				2	3	**5**
US EPA					1	1			**2**
Erasmus Mundus					1	1	1		**3**
CEEPUS							1		**1**
ERA-CAPS							1		**1**
BMBF Prog.								1	**1**
CEI								1	**1**
START Danube Region								1	**1**
Danube Region Strategies								1	**1**
Feloww prog. for research in Japan								1	**1**
Visegrad fund								2	**2**
Creative Europe								1	**1**
Total:	**68**	**21**	**22**	**39**	**50**	**56**	**56**	**55**	**367**
Approved funds (in EUR):	**34.406**	**14.038**	**13.439**	**26.005**	**29.403**	**30.619**	**21.316**	**57.534**	**226.760**

It could be seen that most scientific-research institutions has submitted proposals for FP7 program (117), followed by SEE.ERA-NET (34), bilateral cooperation (53) and IPA (33). It is also important the fact that 18 applications for the program Horizon 2020 were submitted in 2014. That shows that from the very beginning of this programme the institutions from AP Vojvodina are very active to participate.

As for institutions, the situation is similar as with on-going activities, the largest number of applications comes from the Faculty of Technical Sciences (104), followed by followed by the Faculty of Natural Science (89), Faculty of Technology (66) and Faculty of Agriculture (52). Concerning the applications from scientific-research institutes, the most active was the Institute for Lowland Forestry and Environment with 9 and the Scientific Institute of Food technologies with 8 applications.

4 Conclusions

With the aim of achieving the most successful incorporation of the scientific institutions from AP Vojvodina into European research area, Government of the AP Vojvodina has developed unique instruments for the support of international cooperation of scientific-research institutions. These instruments, realized by the Provincial Secretariat for Science and Technological Development, are the schemes for the application to international projects as well as for the support of already accepted on-going internationally funded projects. These forms of support do not exist at the republic level and represent an additional incentive for the development of science, technology and innovativeness in AP Vojvodina. These support schemes are implemented successfully since 2005. It is supported over 1.000 international projects from different programs through them. Number of supported projects and funds for these purposes are increasing every year, and the number of institutions requesting support increase every year too. All this indicates the need to continue and even expand of such forms of support to the international cooperation of scientific research institutions in order to accelerate the progress of science and innovativeness within AP Vojvodina. In order to assess the real impact and sustainability of these instruments in the previous period the next step should be the evaluation of their performance.

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Innovation policy, development, dynamic, role and impacts

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There is general opinion that innovative policy is used to incite and foster research activities and innovative solutions. There are several issues related to innovative policy which gave broader view on significance of innovation policy. The motive for establishing innovative policy caused differences in dynamic of its development and, consequently, role and impacts of innovative policy to research activities are different. While innovative policy is mainly related to universities and research centres, in this article is presented, as well, how innovative policy has been affected their research activities and what are impacts at creation of innovative environment.

Key words: innovation policy, innovative solutions, research and development

1 Introduction

This paper examines the impact of innovation policy at research activities at universities and research centres as measure for incite and foster these activities. Technological innovation is widely recognized as a key determinant of economic and industrial progress. Patents as well as other forms of intellectual property protection play essential role in encouraging innovation in many technological fields. The main role of innovation policy is to promote importance of innovation and its impact on technological and economic progress.

While the process of developing a new and innovative technological solution and bringing it to the market is a long, costly and risky process, getting the appropriate remuneration is very important way of completing this process. The innovation policy should contain and predict all elements relevant for getting the main goal of innovative activities. This paper examines this aspect as well as the previous one.

The significance of innovation policy is mainly presented through giving support for innovators by providing measures for appropriate financial resources, than by facilitating or removing regulatory, institutional or competitive obstacles for innovation processes and by strengthening the knowledge base through promotion and investment in education and research activities.

The process of development innovation policy has many obstacles. Some of them are how to recognize the appropriate field where are the strongest needs for researches, how strong are capacities of researchers, are there technical possibilities for innovative activities as well as many others issues that have to be included during the process of development of innovation policy. A key success factor for develop successful innovation policy is to integrate a vision for innovation into long-term development strategies. Such a vision allows to the holder of innovation policy to define priorities and implement them by process of development.

The rest of the paper is organized as follows: after the Introduction, Section 2 describes the position of innovation policy in developed and developing countries. Section 3 presents short description of development process of innovation policy in Research Centre for ICT at University of Montenegro, Faculty of Electrical Engineering. Finally some conclusion remarks are given in Section 4 of the paper.

2 Position of innovation policy in developed and developing countries

Aiming to follow successful practices at universities and research centres from well developed countries, which are recognized adoption of innovation policy as one of key factors for their innovation activities and implementation the innovations at the market, the universities and research centres from developing countries are trying to adopt the same approach. Innovation has always played a decisive role in the economic and social development of countries: it is the main source of economic growth, it helps improve productivity, it is the foundation of competitiveness, and it improves welfare.

While the universities and research centres from world leading countries have been using positive aspects of the adapted innovation policy, the universities and research centres from developing countries

only recently recognized the importance of these acts and their impact, at the end, on the economic development of the countries. Patents and other forms of intellectual property rights play an essential role in the economic "ecosystem" of discovery. Hundreds of start-up firms, often backed by venture capital, have been launched and a robust innovation market has emerged [1]. The value of these development-stage firms is largely determined by their proprietary technologies. As a result, the strength of intellectual property protection plays a key role in funding and partnership opportunities for such firms. Universities also play a key role in the research ecosystem because they conduct basic research activities supported by commercial investments in research or research supported by grants, which encourage technology transfer from universities to the market [2].

All potential types and sources of innovation should be considered and addressed by innovation policy, not only science- and research-driven innovation. The key changes in societies and economies are mostly brought by technological advances deriving from science and research efforts. Other types of innovation which including those in the economically advanced economies, derive from sources other than research and development, such are the innovation in the cultural and creative industries, innovations in logistics, service delivery, and supply chains, yet have a considerable impact as the origin of new industries, jobs, and income [2]. The important point in understanding the development of any new industry requires a complex set of activities and competencies that go far beyond technology or research activities. The good example for that is the wine industry which requires technological competency in the production process but also management competency and investment in complementary activities for tourism and export [2].

The World Bank suggests in [2] that innovation policies in developing countries, not only at universities and research centres but on governmental level, should take into account their specific features and several points need to be emphasized:

- Technology strategy – low- and middle-income countries should emphasize adapting global knowledge to local needs, while the research centres structure should focus on adaptive research in close contact with local needs and users.
- Institutions – in these countries there is a need for at least minimal policies and mechanisms for supporting innovation.
- Legal framework – it is essential to have a solid infrastructure for norms, standards and quality control to ensure proper commercialization of products at the market.
- Policy focus – specific needs and assets.
- Agents of change – using global connections for leveraging change in the domestic context where foreign actors can influence change and help reverse the institutional and behavioural inertia that affects domestic activity.
- Reform approach – acting on specific sites and stimulating broader reforms via success stories.
- Cultural and behavioural characteristics – respecting cultural and behavioural specificities and the idea that "one size fits all" is now widely rejected, but beyond that there is a need to understand specific motivations and behaviour as people innovate, create new things, adapt their institutions, and manage their businesses.

3 Example of development and adoption process of innovation policy in Research Centre for ICT at University of Montenegro

The Research Centre for ICT (Info-Communication Technologies) is established at University of Montenegro, Faculty of Electrical Engineering within the FP7 Fore-Mont project [3]. The main goal of the Centre is to create a platform for achieving state of the art research related with advanced innovative solutions for info-communication networks and e-services engineering. Furthermore, bringing an innovative dimension in its research activities, the objective of the Centre will be focused on building a sustainable strategy, knowledge, and infrastructure to be able to support the development of e-Society for Montenegro, but as well, as the leading regional centre to offer this range of materials and skills, for all South-Eastern Europe area. One of the Centre's main activities is to develop and adopt innovation policy for the Centre as well as for the Faculty.

As a result of intensive research activities the Centre and the Faculty is recognized as the leading research and innovative institution in Montenegro. This fact recommended the Faculty, together with its partners, to become the leader of the first Centre of Excellence in Bioinformatics (BIO-ICT) in Montenegro [4].

The Faculty of Electrical Engineering, University of Montenegro, is currently working on development of its Intellectual property strategy plan to increase its innovation capacity. So far the Faculty did not obtain any protection of intellectual property rights for its results and applied solutions. Establishing sufficient intellectual property policy and developing procedure and measures for protection intellectual property

from researches activities at the Faculty is the first goal of the Centre and further goal is to bring it at University level.
Since the Faculty neither The Research Centre for ICT or Centre for Excellence in BIO-ICT are not legal entities and all their activities are realized through University, that put them in special position related to other governmental institutions as well as to the market. The issues which should be decided under those circumstances related to innovation policy are who will be holder of innovation policy, how will be allowed to implement it and how will monitoring the results of this policy.
According to current law related to this topic the Faculty, together with the Research Centre for ICT and the Centre for Excellence in BIO-ICT, can be founder of start-up, according internal University's regulation with special position in University's system and start-up can be organized around the innovative products, patents or around intellectual services, which is only one segment of innovation policy. But there is not regulated who can be holder of intellectual property rights and how costs of protection can be covered, which is also very important to be regulated.
In this moment, according the above mentioned suggestions of World Bank related to development and adoption of innovation policy, we can detect positive activities in field of technology strategy (recognition of local needs), policy focus (shaping specific needs and assets), agents of change (use of connections with professionals from developed countries). There are still many obstacles related to the institutions (governmental mechanisms for supporting innovations are not established), legal framework (lack of encouraging norms and standards), and reform approach as well as to cultural and behavioural characteristics.
Ahead of us still is a long way to overcome all above mentioned obstacles in process of developing and adoption of suitable innovation policy that will be inceptive for further research activities at the Centres and Faculty and will lead, at the end, to the visible and applicable innovative results.

4 Conclusions

The significance of the suitable innovation policy in order to make innovative research results more visible and applicable in practice is indisputable. Many universities and research centres in developing countries are facing with the lack of appropriate strategy because of various reasons. However, recently they put great effort to overcame this problem and use the all possibilities to improve environment in their institutions.
The institutions as well as researchers personally use all available means, such as projects, professional and personal contacts, to recognise appropriate solution for their institution bearing in mind their goals and specific circumstances.

Acknowledgements

This paper has been supported by REGPOT project Fostering innovation based research for e-Montenegro (Fo*r*e-Mont) and the Ministry of Science of Montenegro and the HERIC project through the BIO-ICT Centre of Excellence (Contract No. 01-1001).

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Project Success in International Development Projects

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The overall intent of this study is to learn about project success in International Development sector.
The purpose of this paper is to give insights into empirical relationship between project management (PM) efforts in using available PM tools in different phases of International Development Projects life cycle, and project success, within education sector.

Key words: international development, project management, project success

1 Introduction

European Union, whose mechanisms will be examined in this paper, represents the union of countries connected with shared development strategies and growth mechanisms. Projects have shown to be vital instruments and vehicles for international development assistance [1].
Nevertheless, effectiveness and efficiency of International Development aid in recipient countries have often been debating topic in project management journals [2]–[5].
International Development (ID) projects aim at improving living conditions in under-developed countries by recovering their infrastructure, education, agriculture or health systems [6]. Hermano and others state that in 2007, low human development (HDI) countries received official development assistance approaching almost 15% of their Gross National Income [7].
Despite its importance for developing countries, literature on ID projects is rather scarce, and additional research on this topic is recommended by authors [6], [8], [9].

2 International Development Projects

International Development Projects (ID projects) aim at reducing poverty, protect human rights, assist victims of natural disasters and those caused by human activities, construct and improve physical and social infrastructure, improve various aspects of quality of life, build capacities of individuals and institutions etc. These objectives are not as tangible then those in commercial projects, hence, their results are less visible and harder for measuring [10].
ID projects share some of the characteristics with standard projects: limited scope, uniqueness, multidisciplinary and temporary nature, life cycle phases, delivering goods and services and using specific project management tools and techniques [8].
The main *difference* between standard and ID projects is non-profit nature of ID projects, intangibility of their ultimate objectives and complex web of stakeholders. Due to peculiarities of ID projects, their management also needs to be adjusted, as well as applied project management tools and techniques.
ID projects are characterised with the complex web of stakeholders. Khang and Moe [11] suggested that ID projects have at least three stakeholders: the funding agency, the implementing unit and the target beneficiaries, while standard projects usually have two main stakeholders - the client, who finance the project and benefit from it, and the contractor, who get paid by the client to implement a project and deliver expected results [8]. Furthermore, Ika states that ID projects have asymmetrical distribution of power and the supremacy of rather bureaucratic rules and procedures [9], [12]. Ika states that problems in ID can be put in three main categories: (1) structural/ contextual problems, (2) institutional/sustainability problems, and (3) managerial/organizational problems [8]. Complex environment causes problems that may be political, economic, physical/geographic, socio-cultural, historic, demographic and environmental.
In the seventies, Baum introduced powerful tool for the management of International Projects, based on *Project Life Cycle* [13]. This approach was in recent decades hugely accepted by development agencies, mostly for its solid structure and techniques that allow more efficient organization of work and better focus on the project goals [14].

Baum's Life Cycle has following phases (Figure 1):

1. Identification
2. Preparation
3. Appraisal
4. Negotiation
5. Implementation
6. Supervision and Evaluation.

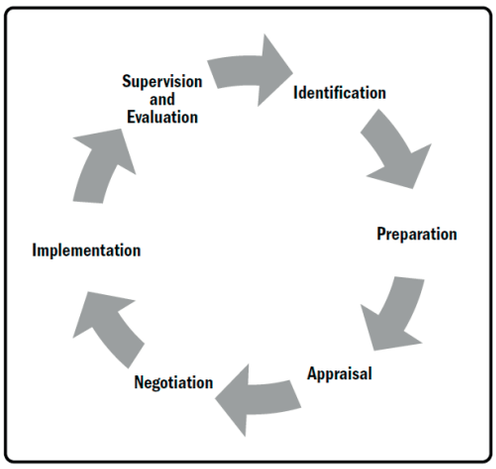

Figure 1 Baum's project cycle [13]

Biggs and Smith state that project-cycle management framework "has become a standard practice for development agencies to organise their activities" with its tools of which *Logical Framework* was the most widely accepted [15]. Logical framework is usually a 4x4 matrix that summarises project's goals, activities, assumptions, indicators and sources of verification in order to measure and report the achievement of objectives [16].

3 Project management success

In the past decade, project success increasingly became focus of project management researchers. Project failure seems to be the rule for different types of projects, and this rate of failure is particularly high for projects in IT industry and in the International Development. ID projects are almost characterized with project failure, dissatisfaction of stakeholders and its beneficiaries [8].

In hindsight, until 1980s, project success was measured with simple metrics, such as time, cost, and specifications. Involvement of customers was minimal in this period. In the 1980s, Critical Success Factors (CSF) were prevalent. CSFs can be defined as the "elements required to create an environment where projects are managed consistently with excellence" [17]. Pinto suggested ten possible CSFs that can be considered: project mission, top management support, project schedule/plan, client consultation, personnel, technology to support the project, client acceptance, monitoring and feedback, channels of communication, and troubleshooting expertise [18].

Latest period (21st century) can be considered as the period of *strategic project management*, and revised set of long-term measures has to be considered (building market share, extending product lines, increasing revenue, satisfying customers, and building for the future) [19], [20]. The traditional short-term measures (the iron triangle that measures efficiency), need to be combined with some long term measures of success (impact on customer – measured one year after project completion, impact on business- measured one or two years after project completion).

4 Project management tools and its effect on success

Ika and group of authors [21] published the paper "Project management in the international development industry" that analysed how project managers in aid industry sector make use of available PM tools (and related them with PLC phases), and tackled project success and success criteria.

This paper highlighted the importance of PM tools in practice and suggested that project coordinators do not perceive planning efforts to be significantly influencing project success. They claim that project monitoring and evaluation tools are essential in measuring project performance throughout PLC, mostly for informing key project stakeholders about project progress and demonstrating accountability through

transparency and documentation [1]. They imply that PM tools are only one of the factors of project success, and that far more important are socio-political aspects and cultural factors. Authors suggested that an important line of research worth exploring would be the extent to which available tools and techniques are used in each of IDPM phases and the analysis of the respective correlations between the success measures [21].

Research published in the book "International Development Projects: Peculiarities and Managerial Approaches" published by Project Management Institute [6]. In their study, authors examined several aspects of International Development projects in NGO sector. They came to conclusion that NGOs usually adopt only some of PM tools (e.g. Gantt charts, progress report), mostly on the basis of their simplicity, and that the organizations that adopt structured and analytical methodologies are more likely to improve their performance. Golini and Landoni also investigated the use and the role of the logical framework in NGOs and highlighted the need for more standardised managerial approach in NGOs [6].

When it comes to International Development projects implemented in the educational sector, Faculty of Technical Sciences implemented about 70 projects in 2014 (Table 1). Most of them were Ceepus (21), FP7 (15), Tempus (8), IPA (7), and Cost (7) (Picture 1).

Table 1 Project types [22].

Project Type	Number of projects
FP7	15
TEMPUS	8
IPA	7
EUREKA	3
COST	7
CEEPUS	21
Bilateral and Multilateral	6
Other	3

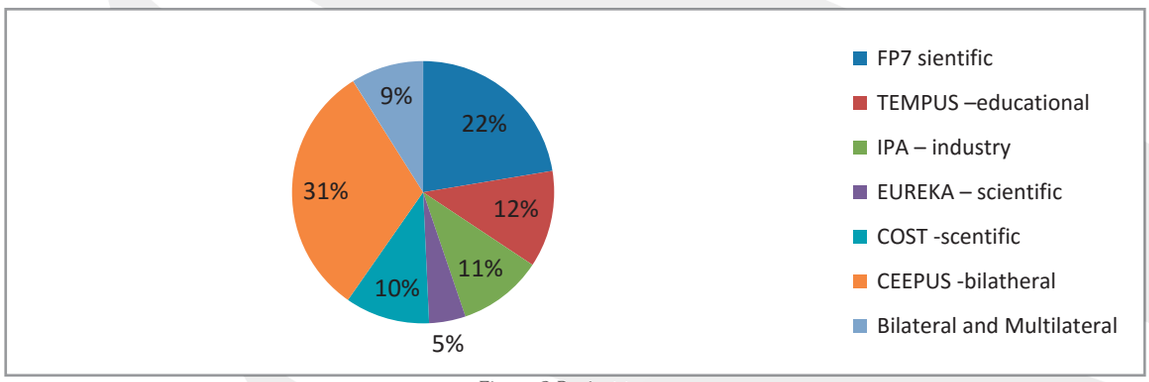

Figure 2 Project types.

Budget for these projects was mostly above 100 000 eur (Table 1).

Table 2 Budget of International Development Projects in educational sector at the Faculty of Technical Sciences in Novi Sad in 2014 [22].

Budget	Number of projects
I category <100 000 EUR	37
II category 100 000 – 500 000 EUR	14
III Category 500 000 – 1 000 000 EUR	8
IV category > 1 000 000 EUR	11

5 Conclusion

Despite the relevance of international development projects, not many studies have been made this topic. Success of these projects has shown to be of vital significance due to its high failure rates. Hence, the purpose of this study was to investigate what are the factors that influence ID projects. In order to do that,

author is planning to find whether project success of ID projects is correlated with planning process, methodology of implementation, inclusion of beneficiaries in all PLC phases, communication with stakeholders, motivation of the project team and project environment.
It also aims at highlighting the importance of applying PM tools in different phases of Project Life Cycle.
Further research on the topic of interest could investigate perspectives on project success of other ID projects' stakeholders - task managers, supervisors, project team, steering committee, beneficiaries, and population at large, as well as investigating similar issues in different sector or region.
Making the new framework for managing International Development Projects is of vital significance. Excising literature on this issue is rather scarce and doesn't include specific characteristics of these projects. This candidates this issue in future research topic of interest.

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Tools and methodologies to ensure the long term sustainability of projects: Challenges and Opportunities

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Abstract: The long term sustainability of any Project needs to be one of the core issues of project management. A well thought out strategy ensures that planned monitoring mechanisms are put in place to assess the status of sustainability at regular intervals during the life of the Project. However, several factors can be responsible for poor sustainability. Some are simple and some are quite complex. Some are within the control of the project management, while others come as external threats. In this paper we discuss some of these threats and the tools, as well methodologies that are usually deployed to overcome these internal and external weaknesses.

Key words: sustainability, monitoring mechanisms, internal and external weaknesses, tools and methodologies

1 Introduction

Generally speaking, the overall sustainability of a project is defined as a percentage of the goods or services that are to be delivered over the long term. A major donor agency, The World Bank, applies this definition to explain project sustainability: 'the ability of a project to maintain an acceptable level of benefit flows through its economic life' [2]. In other words, the first question a potential funding body will ask is: will the project continue to deliver benefits once the funding has terminated and the project has been implemented? In fact, all multilateral and bilateral donor agencies provide funding on the condition that the project will be sustainable prior to, during and after implementation. Working from this premise, monitoring of project sustainability aims to ensure that the required level of goods or services is maintained to the appropriate beneficiaries; the changes that are stimulated by the project, as well as any new initiatives that are derived from the project sustain over time.

The architects of project proposals need to decide from the outset exactly what it is that needs to be sustained. In terms of projects that affect the public sector of life this is critical and will take place during the planning stage. Although some outcomes may be difficult to anticipate and describe as not all benefits are tangible [3]. Therefore, during the planning of a proposal the responsible partners or consortium must ensure that an assessment of the environmental, economic and social impact of the project is undertaken. During the implementation phase the necessary steps should be identified to ensure that project output is sustained during not only implementation, but also during the post implementation life of the project. Consequently, it is important to identify the project activities and results that are intended to last and/or be disseminated during the post implementation phase. Once these factors are identified, it enables those charged with ensuring the 'institutional' sustainability of the project to identify risks and incorporate contingency measures to mitigate them, as well as to develop strategies to enhance the opportunities to achieve project objectives.

As a final measure, a sustainability strategy is developed that articulates exactly what management processes are to be deployed with which to manage the external and internal threats, as well as to monitor the various sustainability indicators over the longer term [1]. However, care needs to be taken during each phase of assessment, analysis and monitoring as not all benefits generated are easy to quantify. For this reason many of the tools and methodologies applied to identify internal and external threats to sustainability have their limitations, particularly as they are applied to the environmental and social impacts of a project.

2 Project sustainability

The sustainability of a project has several dimensions. These are generally recognised as being the continuous operation and maintenance of project facilities, the continuous flow of benefits, and, ongoing

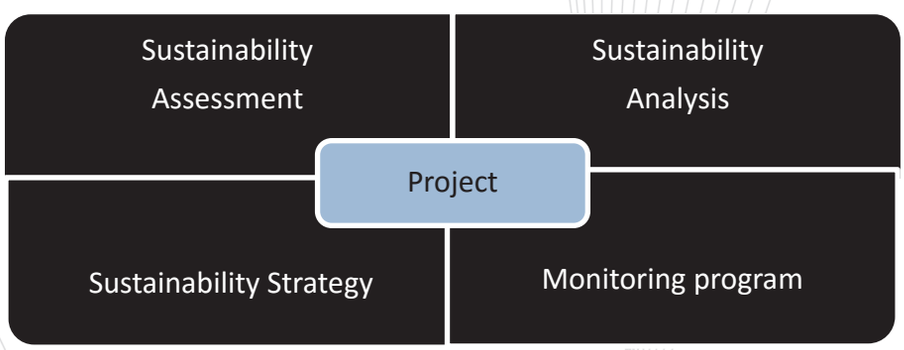
community participation. In addition there needs to be evidence of equitable sharing and distribution of project benefits. Also, evidence of stability in both the institutional and environmental contexts in which the project impacts or operates. Depending on the nature of a project each of these dimensions has the capacity to influence project sustainability in one way or another [1]. Almost all funding agencies would consider the foregoing to be fundamental indicators that a project has been designed to sustain after the implementation phase. These sustainability factors can be further classified in two categories:

2.1 Project-level factors, that is, elements of the project over which management has a direct influence.

2.2 Context-level factors, that is, elements external to the project itself that can be difficult to influence at Project management level i.e. international, supra-national, national, regional and local support.

Yet, sustainability indicators can be far more specific such as those required for projects in the higher education sector. Because of the nature of some of these initiatives, some external and internal weaknesses can be difficult to identify at either project or context level. In an effort to highlight these threats to Project proponents, the European Audiovisual and Culture Executive Agency (EACEA) identifies five specific sustainability indicators at the project level and three at the context level. At project level the quality of the design of the project in meeting academic, professional and/or social needs is fundamental. Second, is there a sense of ownership and motivation displayed by a Project Consortium? Of equal importance is visible evidence of effective management and leadership. A fourth indicator demonstrates that there is active participation by the beneficiaries. Finally, there must be the capacity at management level, for securing adequate resources to ensure the longevity of the project. Whilst, sustainability at the context level is measured by the degree of academic and/or institutional support; the degree of support at national level and national socio-economic support [3] all of which can be difficult to quantify.

For these reasons different kinds of tools or methodologies are applied to ensure the sustainability of any project throughout its lifetime. These are applied at the various stages of project life from design, funding and implementation through to post implementation. Whilst particular tools and methodologies can differ according to the types of benefits a project delivers, there are four universally accepted stages in terms of ascertaining the sustainability of a project. First, an assessment or scoping exercise is always undertaken prior to the formulation of a project proposal. Second, during implementation a sustainable strategy will be developed to guide a more in depth analysis. Third, a monitoring program will be established to be applied at determined time intervals during the life of the project.



3 Sustainability Assessment

Prior to the formulation of a proposal an assessment of the potential environmental, economic and social impacts is undertaken to establish the relevance of sustainability. That is, if the environmental, economic and social benefits outweigh the costs then it is likely that a project can be funded. This kind of assessment should ensure that the proposal embodies the hallmarks of a series of robust and logically linked objectives and activities that will endure over time. Three core indicators are applied to assess project sustainability. For the environmental sector these indicators will reflect the capacity of the project to generate environmental benefits. For the economic sector, the core indicator will be the present and future economic, as well as financial returns. Whereas for the social sector the primary indicator will be the extent and the degree to which the delivery of goods and services can be continued, as well as the percentage of the target beneficiaries that benefit from project activities.

The strength of indicators is used by using both quantitative and qualitative tools and methodologies. For example, on the economic side of things the tools most widely applied are cost/benefit analysis, modelling, regression and other types of economic scenarios. Environmental sustainability is considered through life-cycle analysis, material flows, resource accounting, National Accounting Matrix and

Environmental Accounts (NAMEA), as well as ecological and other kinds of footprints. While social sustainability is assessed by measures of human and social capital and through various kinds of participatory processes.

As it is difficult to quantify some environmental and social aspects, attention should be paid to the limitations of some of these tools or methodologies. For this reason, those charged with carrying out assessments need to be conscious of the fact that it can be difficult to give equal and adequate attention to the cumulative longer term consequences of the overall sustainability of the three sectors. Equally, trade-offs, that is, presenting positive versus negative assessments in the three spheres of life can be difficult to compile, as is reconciling conflicts between environmental, economic and social goals at international, supra-national, national, regional and local levels. It can also be a challenge to assign monetary values to many environmental and social assets in order to obtain comparisons [4]. Whilst this scoping exercise can help to identify the more critical threats that can affect sustainability, at this stage of a project proposal it is unlikely that all external and internal weaknesses will be known. A strategy will assist Project managers to further analyse flush out areas of weakness during the implementation phase.

4 Sustainability Strategy and Sustainability Analysis

A strategy is expected to indicate the ways in which various elements of sustainability are to be identified, assessed and incorporated. In other words, this strategy articulates the management processes that are required to ensure the longevity of the project. As a wide range of factors can affect sustainability these processes should allow those at project management level to:

- Reflect on the strengths, weaknesses, opportunities and threats in relation to the project objectives and expected outputs;
- Identify any new information or other needs for stakeholders to guarantee continued project support.

This reflection and identification work then sets the scene for a further analysis. As a general rule this kind of analysis should consider but not be limited to consider any new external or internal threats that could arise during the implementation of the project with attention paid to the following:

4.1 Relevancy – is there consistency (or lack of it) between the objectives of a proposal because of changes in international, national, sectorial, regional and local priorities?

4.2 Acceptability issues- are all of the stakeholders still open and willing to accept the benefits of the project? Are there any new stakeholders that need to be incorporated to ensure the success of the project?

4.3 Economic/Financial Viability – are there any project outputs which cannot be produced and sold under market determined costs and pricing mechanisms that are not profitable, or neither likely to be sustained?

4.4 Environmental sustainability – have political or other changes emerged that could lead to aspects of the project having a negative environmental impact? If negative impacts were identified in the formulation stage, are additional mitigation measures now required to support or replace those already articulated during the assessment phase? [1].

As an additional measure to the strategy, a post implementation monitoring programme should also set out exactly how the integrity of the various project activities and objectives are to be monitored over time. Because many environmental and social external and internal threats to sustainability can be amorphous, it is imperative that a well-planned monitoring mechanism is put into place to check sustainability at regular time intervals. This kind of monitoring provides the feedback necessary for adjustments to be made in each of the pre-determined key indicator areas and to maintain the project on a sustainable trajectory.

4. Conclusions

Prior to providing funding, donor agencies must be convinced that the benefits of a project will continue to endure over time. The sustainability of a project is therefore one of the factors that influences decisions about whether or not a project proposal comes to fruition. There are many universally accepted tools and methodologies used to assess, analyse and monitor the long term overall sustainability of a project. Nevertheless, it is also widely recognised that many environmental and social issues are not always evident during the project formulation and sustainability assessment phases due to unforeseen political,

economic or other kinds of changes that are beyond the influence of project managers. For this reason alone it is imperative that project managers develop a sustainability strategy to establish the parameters for a more detailed analysis.

A further analysis undertaken during the implementation phase helps to flush out any new external and internal threats that influence a continuous flow of benefits. Project sustainability can be further reinforced if project managers take the time to develop a monitoring programme. A monitoring programme identifies which indicators, or signposts across the environmental, economic and social sectors, the presence of which are necessary to ensure the continuous stream of benefits that a project is expected to deliver. Ongoing sustainability evaluations are imperative to assist develop the means with which to manage any new or unexpected threats that, because of issues beyond the control of project management could not possibly have been identified during the assessment and analysis stages.

Acknowledgement

The authors would like to acknowledge the experience and further expertise gained in terms of project sustainability as being directly involved in the execution of WP 7 – led by University of Alicante, Spain - which is the sustainability component of **Contract no** 530213-TEMPUS-1-2012-RS-JPHES**, WBC Inno** Modernization of WBC universities through strengthening of structures and services for knowledge transfer, research and innovation. This project has been funded with support from European Commission, within TEMPUS IV programme.

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Overview of dissemination and raising awareness activities within the project WBCInno

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This paper presents activities and outcomes within Work Package 6 (WP6) of project Modernization of WBC universities through strengthening of structures and services for knowledge transfer, research and innovation (WBCInno). The title of WP6 is Designing of dissemination and raising awareness mechanisms and the involvement of public and private stakeholders in the Triple Helix model of innovation.
Within of WP6 have been achieved 3 levels of dissemination: Awareness-delivering the main message of the project, understanding-provision of more detailed information on the project and deliverables and participation-dissemination in action, where the project outcomes were presented for further use.
The University of Banja Luka, was the leader of WP6. The WBC project partners adopted the Action Plan and the Consolidated Plan for Dissemination and Raising Awareness. The second document includes the dissemination strategy and tools, target audiences and dissemination calendar, with particular focus on the design of project identity. Furthermore, the document includes the individual plans for dissemination of all the WBC partners. Each WBC partner university has designed the website, organized Info days, Workshop, Open door day, and several public appearances. WBC partners also maintained day-to-day collaborative work within and between Business Service Offices (BSOs) and project teams as well as with other stakeholders and target groups.

Key words: dissemination, raising awareness, innovation

1 Intrduction

Dissemination and raising awareness of project activities in the implementation of TEMPUS WBCInno project were a very important part. The project had the work package 6 (WP6) that focused specifically on dissemination and raising awareness. Within this Work Package, the consortium members disseminated project results and achievements by using various dissemination strategies, channels and instruments. Project information had been shared within the project life cycle, both internally and externally (outside the partner institutions).The University of Banja Luka, was the leader of WP6.
The WP6 provided 3 levels of dissemination:

- Awareness-delivering the main message of the project;
- Understanding-provision of more detailed information on the project and deliverables,
- Participation-dissemination in action, where the project outcomes were presented for further use.

The main project dissemination goals were to:

- Ensure the best coordination and optimal use of project resources and results during and beyond the lifetime of the project;
- Raise awareness of external audience about the project through a number of dissemination activities;
- Explain the project target audiences the benefits of strengthening universities structures and services for knowledge transfer, research and innovation;
- Make project outputs available to a wide range of stakeholders, within the WBC region;
- Communicate the project results to the target audience;
- Increase awareness of both project partners and general public regarding project issues and promote best practices that lead towards this direction.

These dissemination goals were achieved thanks to the active participation of all members of the project consortium.

2 The work plan for work package 6

The first activity under WP6 was the development of an action plan. The action plan was prepared by the University of Banja Luka in accordance with planned deliveries in the project application.

Table 1 List of planed activities.

DISS1	6.1	Elaboration of Consolidated Plan for dissemination and raising awareness
	6.2	Design, printing and publishing of promotional materials
	6.3	Design and maintenance of web sites (WBCInno and 5 BSO sites)
	6.4	Ten Info days and public appearances
	6.5	Five Workshops
	6.6	Five Open door days at WBC universities
	6.7	Final Conference on knowledge triangle

For each activity were defined duration together with precisely defined dynamics of implementation.

3 Plan for dissemination and raising awareness

3.1 Dissemination strategy

The first version of the Plan for dissemination and raising awareness was written in February 2013. The document is being updated during project implementation as appropriate and with the consent of partners.

Plan presented how the planned dissemination will ensure appropriate use of the results during and beyond the lifetime of the project.

It presented the dissemination strategy, the target groups to be addressed, different dissemination tools, events and dissemination calendar. All project partners were actively involved in the fulfillment of the agreed objectives in this document and its updated versions.

Strategy for the dissemination of these activities was based on the following assumptions / requirements.

Entrepreneurial university itself is the efficient system of information exchange. Right balance between centralized information exchange with the environment through one central office and at the same time encouraging faculty and department initiatives among other is a very important question of dissemination model.

Usage of several methods of dissemination, both formal and informal, was planned, in order to achieve high visibility of the project.

The dissemination strategy was based on the request that the appropriate and most effective methods of dissemination and communication will be used for each target group, considering the special characteristics and needs.

A sustainable model of dissemination has been consisted of following approaches for different target audiences:

- Mailing lists (e-brochures, e-leaflets, e-mails on project progress);
- Efficient communication among partners supported by DataStation platform (available at the address http://wbcinno.datastation.com/);
- News, reports and public deliverables posted on project web site, 5 web sites of BSOs as well as websites of stakeholders (Tempus Offices, EVE Platform of EACEA, Chambers of Commerce, Regional Agencies, etc);
- Information days, open door days, and thematic workshops;
- Articles and news published over WBC-INCO platform (available at the address: www.wbc-inco.net) as well as e-newletters distributed through their email list;
- Articles about the project results published in Tempus newsletters;
- Printed material (brochures, leaflets, reports, publications, etc);
- Meetings with policy-makers and key actors for the knowledge transfer, research and innovation;
- One-to-one interviews (telephone or personal);
- Customized trainings offered to the university staff, students, BI/STP staff and tenants.

The Business Service Offices have been established at five WBC universities. Important part of BSOs activities is: promoting the university research/innovation resources/results, developing partnerships with enterprises connecting researchers and students with business partners, supporting BIs/STPs, encouraging students in creative thinking and articulating ideas, maintenance of innovation management web platform.

3.2 The audience for dissemination

The scope of the project and the importance of knowledge transfer, research and innovation, as well as development of partnerships with enterprises cause the list of potential project audiences to be quite long.

Primary audiences that have been targeted by the project are:

- The wider audience of WBC Institutions;
- Academic community;
- University staff;
- BI/STP staff /tenants;
- Private and public enterprises and SMEs;
- WBC scientific community, researchers;
- Students;
- Government representatives;
- Policy makers and stakeholders;
- Social partners (Associations of SMEs, Development agencies, Chamber of Commerce…);
- Unemployed graduates;
- Financial fund representatives.

3.3 Project identification by The WBCInno logo

To achieve maximum visibility, the project needs a personality. The project identity is linked with a graphically coherent and consistent representation of the WBCInno logo (as can be seen in Fig. 1) on project results and documentation. Every event, presentation, newsletter, deliverable (both public and restricted), leaflet, sticker, etc. used WBCInno logo. That graphical representation helped provide interested parties with the message that the project conveys.

Figure 1 The WBCInno logo (two options)

4 Dissemination tools

Different dissemination materials have been designed, crafted and produced throughout the course of the project.

4.1 The WBCInnoDataStation Platform

Efficient communication among partners was supported by WBCInnoDataStation platform (available at www.wbcinno.datastation.com) [6]. The platform had an important role in the overall project because it functioned as the principle communication and document management tool of the consortium. It provided a wide array of functionalities including registration link for consortium members, document uploading/downloading for project partners, exchange of ideas, launching discussions, etc. It provides several services to Consortium partners and members of the WBCInno that allow users to autonomously publish several types of content and to collect feedback.

4.2 The WBCInnoweb-site

The WBCInno website:http://www.wbcinno.rs/ (as can be seen in Fig. 1) [1] had an important role in the overall project because it functions as the principle public dissemination tool for project results and news.The website was the main source of information on the project activities and achievements:

conferences, workshops, trainings, project contests, state of the art in the area of knowledge transfer, research and innovation, from the aspect of strengthening of structures and services of WBC universities. Contact information about all members of the consortium are available on the website, in order to have easier communication with those potentially interested for the project.

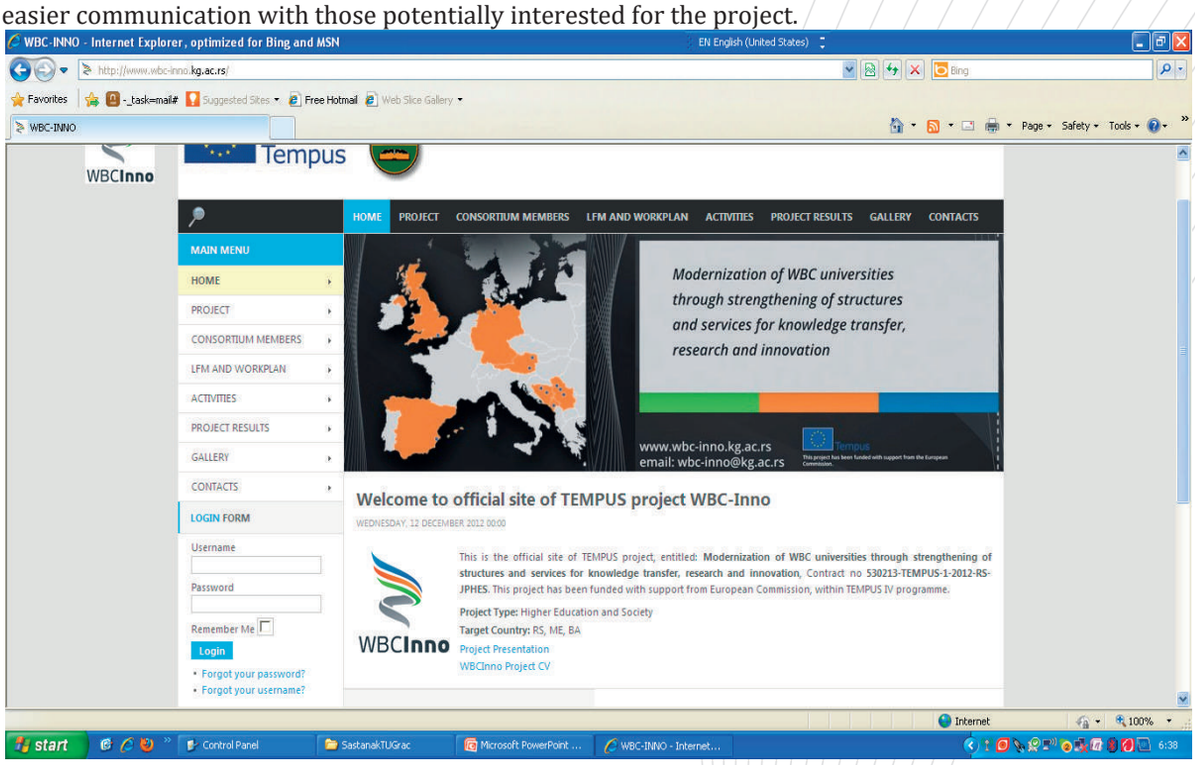

Figure 2 Screenshot of WBCInno home page.

4.3 Printing and publishing brochures, leaflets and other material

For the really efficient promotion of WBCInno project, appropriate printed and electronic promotional material has been made and distributed to wider target groups and public at large.

- Promotional poster on the project,
- Printed and electronic leaflets on WBCInno project and brochures on BSOs [2], [3], [4],[5],
- Printed and electronic material: Catalogue on innovation potential of WBC universities, Regional University Innovation Platform, Development strategy for BIs/STPs, surveys on questionnaires, Methodology for innovation management etc.;

5 Conclusion

Dissemination of information about the activities and results achieved within the WBCInno project was one of the most important activities. Given the state of structures and services for knowledge transfer at the universities of Western Balkan countries, raising awareness of its importance in these institutions, should be one of the most important activities in the following period. In this sense the WBCInno project leaves the WBC universities (as a legacy) complete dissemination mechanisms for efficient awareness spreading about its importance and the ways to improve the situation in the area.

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Application of poly-jet technology in rapid tooling

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The paper describes the application of poly-jet technology mainly applied for rapid prototyping of smooth surfaced and fine detailed models. In this paper application of this technology will be demonstrated for printing of tools for precision copolymer casting process. This process has been used for years for small series production, both for engineering and aesthetic plastic parts. Opposite to the standard injection moulding production, where machined steel moulds are used, with application of rapid tooling it is possible to use printed plastic moulds for copolymer casting process. Advantages of this approach are shown through trial production of prototype segments and elements of tools with critical geometry complexity for sensor cover and tube acceptor parts on Alaris 3D printer.

Key words: poly-jet, rapid prototyping, rapid tooling, copolymer casting

1 Introduction

There are many different definitions of rapid prototyping but one of those that best describe this process is that rapid prototyping is a group of techniques for the rapid production of the part or assembly using three-dimensional computer aided design (CAD) data.
Also, there are many types of 3D printing processes. Some of the most applicable and at the same time the most important ones are stereolithography (SLA), Digital Light Processing (DLP), Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM) and Poly-jet technology.
Stereolithography is based on the technology of additive model manufacturing that uses base with liquid photopolymer, so called "resin" and UV laser in order to produce the model layer by layer. The models produced using this method are not strong enough and they are most often used for production of non-functional prototypes of high precision as well as for the production of casting moulds [1].
DLP is similar to stereolithography and the only difference is that this method uses safelight instead of UV laser. The models obtained by DLP technology have the same application, same advantages and disadvantages as those produced with stereolithography, and they can use the same material. Costs for model production are relatively high in both methods.
Producing of 3D model using SLS technology is based on method of powder fusing and hardening. This production process allows the production of very complex geometries but it is not very precise in production of small features.
FDM process is based on the melting and extrusion of material through nozzles making one layer at time. Various materials can be used in this technology but sometimes a problem can appear while removing support material.
Poly-jet technology is based on high quality printing where liquid polymers are joined and hardened using UV lights. This type of printing is most appropriate for development of completely assembled prototypes and very detailed geometries which makes it suitable for application in casting moulds as well.
Rapid tooling is not new on the market but existing technologies are developing every day following and adjusting to the development of rapid prototyping. This is due to the fact that injection and plastic casting tools are very expensive and development of such tools is very time-consuming process. Injection and casting tools are made of metals and their machining is very demanding process. Rapid tooling for more complexed geometry is very complicated which makes the process even more expensive. Previously mentioned tools are designed as tools for injection of plastic mass under the pressure and at high temperatures. They are adjusted to large series production, but they are not adjustable to changes (customization). Thus, it can be said that rapid tooling describes a process which is actually the result of combining of rapid prototyping with conventional tooling in order to produce a mould or parts of functional model in less time and with lower costs than traditional machining methods.

In these cases, rapid tooling using the process of rapid prototyping is an advantage. Even the most complex model geometries are not problematic for producing neither they increase the cost of the process. In 3D digital environment the model can be easily modified and the surfaces are easily added, removed or scaled. Models like this are suitable for small series production up to 5000 pieces [2].

2 Poly-jet technology

Objet's Poly-jet technology, featuring ultra-thin build layers from 16 until 28 microns, allows high-speed, easy, and clean production of smooth surfaced and fine detailed models. With this technology, 3D printers usually have two heads with small nozzles that the liquid polymer material flows through. The model material flows through one head, and support material through the other. Both materials than harden, the model material gets the characteristics ranging from flexible materials like rubber to hard ones like ABS plastics. The support material becomes crumbly and should be removed. These characteristics of various materials, which are constantly improving, allow wide range of application of this technology. Thus, this technology is applied in many life spheres such as electronics, engineering, and recently more frequently in medicine and dentistry. Such a wide range of application is also supported by the large spectrum of biocompatible materials that can be used in this model production technology.
The heads in those 3D printers apply the layers of these polymers up to several microns. Such thin layers allow very precise and smooth model surface. UV lamp moves along with printer heads and every apply layer is hardened and then the next layer is applied. This process repeats throughout the whole printing. The heads are always positioned at the same plane and height on the Z axis while the height of the printed model is achieved by lowering of the working table for the thickness of printed layers.
Precision with this type of printing is 0.1 mm and such precise and smooth surfaces makes this 3D printing technology one of the most ideal processes for two-component cold plastic casting, especially having in mind that those materials are not suitable for higher temperatures. However, the use of this technology is still limited with somewhat higher prices of materials and 3D printing equipment [3].
Key aspects related to the application of the PolyJet technology in producing moulds are [4]:

- primarily relatively low initial costs for creating moulds, which depend on the type of the thermoplastics and complexity of moulds.
- mould produced with PolyJet technology is relatively fast and mould is produced within a few hours,
- it allows the constant design changes at minimal cost thus giving greater freedom to engineers and designers.
- since the moulds made by this technology are very accurate and with smooth surfaces, in most cases this process does not require post-processing.
- the complex geometry, thin walls and fine details in making moulds are easily achieved.
- pre-programming is not required as well as manual intervention during the 3D printing process.

3 Precision copolymer cold casting process

Precision copolymer casting process has been used for years for small series production, and very successfully both for engineering and aesthetic plastic parts, as a notably more feasible, faster and simpler alternative to standard injection moulding production with machined steel moulds. Most commonly used materials in the process are 2-component polyurethanes (PU), and acrylics (PMMA), that feature hardening (curing) by catalytic chemical reaction, on low temperature range, up to cca 100ºC. In certain cases specific materials are used, such as carbon fibre reinforced plastics [5].
Polyurethanes in particular have inherent high versatility and a wide hardness range from soft but very durable elastomers to hard plastic. Their physical and chemical properties are similar to most common design and engineering injection moulded thermoplastics (ABS, SAN, PC or PA). In some cases, they areeven exceeding them – high impact strength and abrasion resistance, good dielectric properties, dimensional and chemical stability, biocompatibility and low body irritability, and, with additives, flame retardancy or UV stability. Many high performance engineering parts, such as roller wheels and gears, are commonly made from polyurethanes even in large volume series in the industry, and such gear, rod, or lever parts are mostly being cast in the pilot facility with basic equipment currently at disposal, answering to local needs for spare parts.
The process is also convenient for structures with large variations in wall thickness, problematic or impossible to achieve with injection moulding due to deformation problems in cooling phase. And another featured advantage is that, unlike injection moulding, no high temperatures nor pressures are involved, so other elements and components, like various metal inserts or threads, can easily be

encapsulated in the cast parts, even delicate electronic components, PCBs, connectors and sensors, without any risk of damage.
Major technological problem of the process is the long curing time of PU, 4-8 hours in normal room temperature conditions, making serial production slow when it comes to thousands of units, and limiting practicality and competitiveness with injection moulding, as time savings gained with faster and simpler casting mould production would be lost again in much slower production.
Optimal adequate solution is to accelerate the curing process. Increasing curing temperature can achieve this, but inevitably causes problematic side effects with internal tensions building up in the material, resulting in deformation and warpage of cast parts.
Alternative accelerated curing by UV light or radiation has shown better results and easier control of the curing process, but requires additional light source equipment, and works from the outside, with rays having to pass through the closed mould to reach the part inside, thereby also degrading the mould material structure.
The aim is to overcome the limitations, revive the cold copolymer casting process, advance it and expand its application range to the level of competitive standard for feasible small volume production of complex precision parts, by integrating alternate advanced technologies.

4 Case study

The following example shows the process of rapid tooling for two-component plastic moulding using Poly-Jet technology.
Trial production of prototype segments, encapsulated in moulds, and casting trials with these moulds, have already been performed, with equipment at hand in the pilot facility. Referent parts used in this trial are actual real SENSOR_COVER and TUBE_ACCEPTOR parts from Portable Digital Analyzer devices (PDA). These two parts are shown in *Figure 1.*

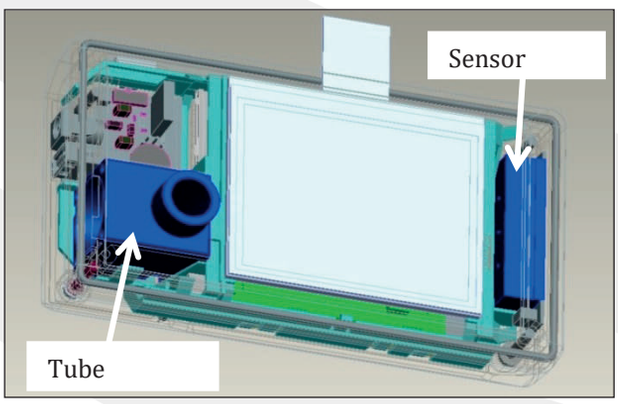

Figure 1 Referent used parts Sensor Cover and Tube (Courtesy of BELIT)

They are among crucial parts of the PDA device, structures that carry and connect sensor printed circuit boards (PCBs), light sources, samples and optical fibres, and the parts are chosen because they feature most of the challenging geometry convenient for the process trials – corrugated mould parting lines and surfaces, combination of small and precise geometry features and very thin walls, undercuts and required mould opening from multiple directions etc.
These two parts are modelled in one of the 3D CAD packages and as STL files were sent to 3D printing. The *Figure 2* shows these modelled parts.

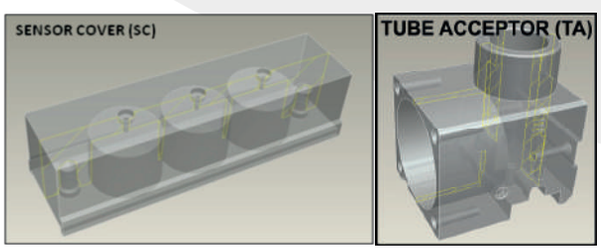

Figure 2 Completed STL models ready for 3D printing

3D printing of these master models is performed on mid-range Object Polyjet machine Alaris30 at the Collaborative Training Centre at the University of Kragujevac.
Initial RP segments are successfully produced in PolyJet RP and satisfying resulting cast parts have been obtained, verifying the maturity and adequacy of the technology for rapid mould tooling in the process. Significant advances are still very likely in technologies and materials that are to be integrated in the process, by the time when it is expected that the project is fully developed. Printed rapid prototyped mould segments and master model for sensor cover are shown in *Figure 3*, while in *Figure 4* are shown casted Sensor Cover parts master model made by technology of precision copolymer cold casting process.

(a) (b) (c)

Figure 3 (a) RP master model for sensor cover; (b) & (c) Rapid prototyped mould segments for sensor cover.

Figure 4 casted Sensor Cover parts master model.

5 Conclusion

Advancements in 3D printing technologies improve the accuracy of the printed parts, making them more suitable for demonstrations of design, testing, and also specially important in education and research. The same advancements are expected to lead to the reduction of RP systems prices. Once the major limiting factors in two-component cold plastic casting are overcome, which is mainly related to the curing process, this kind of production could become sustainable and possibly optimal solution for small series production.

Acknowledgements

We would like to thank to Belit company for their contribution and for sharing the part of company`s project results for the purpose of this paper.

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Possibilities of application of composite materials – an innovative approach

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This paper is an attempt to transform research results into innovation. The composite material is basically a combination of two constituents of different mechanical properties, with the aim to obtain the required properties of the new material.
This paper will present the possibilities of use of these materials.

Key words: composite materials, methodology, innovation.

1 Introduction

This paper discusses the application of composite materials and improved aircraft, whether military or passenger, ships and cars. The basic issue is the question why the composites materials are better than others. Today, with the increase of the consumer market, new products have been introduced in order to replace materials such as metals, cement etc., which are very heavy, corrosive and less environmentally friendly. One such material is the fibre reinforced composite. In the past 30 – 40 years fibre composites have been competing with materials such as steel, aluminium and concrete in cars, aircraft, military, buildings, bridges, bicycles and everyday sports goods. A very important aspect of fibre reinforced materials is their mechanical behaviour. **Centre for composite and new materials** at Faculty of Engineering University of Kragujevac among others has group of researchers which investigate all aspects of application of new materials in different areas, especially for application in automotive industry. Our task is to improve opportunities for efficient and effective application of scientific research results of the University in order to develop the economy and society, promote knowledge transfer between the University and industry, supporting the placement of new technologies and innovations.

Composite materials consist two or more constituents such as fibers and matrix which make layers mutually bonded to form multilayered composite called laminate. Fibers carry loads giving strength of composite, and matrix bond fibers together and have role in transfer loads to fiber, forms outer shape of composite and between other properties defines its behavior influenced by environment. Fibers are made of carbon, glass, aramid (such as kevlar) or metal, and the most often they are 60-70% of composite volume. Matrices may be made of polymers, such as thermosets or thermoplastics, metals, such as aluminum alloys or magnesium, ceramics etc.

2 Classification of composites

Great efforts have been made in finding materials that are light, of high resistance and as a high modulus of elasticity, which has led to the development of composite materials. Of course, the price of such material should be as low as possible. The ideal material is combination of two material complementary properties. They have improved properties compared to their betting areas; these properties are mainly mechanical, such as toughness, strength, stiffness, etc., resistance to external influences such as humidity, temperature, abrasive effects, etc. Composite materials have replaced metals, due to its corrosion resistance and low weight in many applications throughout the automotive industry. These materials are divided into two basic groups: thermostable and thermoplastic.
Composite materials are complex structures, and classification can be made according to different criteria:

- According to the type of matrix: plastic, metal, ceramic or carbon,
- According to the type of fibres: glass, carbon, boron, aramid etc.,

- According to the geometry of reinforcements: reinforcement short or long fibres or particles, etc.,
- According to the characteristics of the fibre and matrix.

The generally accepted classification of composites is to:

- The reinforced materials - reinforcement package in the form of particle, pellet, short fibre,
- Fibre-reinforced materials,
- Composites reinforced strong fibre.

It is possible to make the following division:

- Composites with discrete particles embedded in a matrix,
- Fibre reinforced composites in which basic building materials fibres and the matrix,
- Layered composites - laminates which consist of several different layers of material.

3 Use of composite materials in the automotive industry

Composite materials are used in the automotive industry since the 50s of the last century. The advantages of such production of automobile parts are light-weight, low investment in production, reducing costs by grouping parts, improved mechanical properties, corrosion properties, etc.

For the production of large series of automotive parts is used today and direct injection moulding. The composites used for cheaper applications consist of a thermoplastic or thermo-hardened matrix reinforced with glass fibres. Such compositions, due to lower prices, contain particles of mineral fillers. Glass fibres are replaced by cheaper fibre of vegetable origin. In recent years significantly increased the use of polymer composites in the automotive industry. Due to their small mass, which means lower fuel consumption, as well as knives costs in investment, facilitating the transition to such production, polymer composites are very promising in the automotive industry.

Polymeric composites appeared in cars shortly after the end of World War II. Use them at the beginning were limited to small and minor components. A major step forward was the passenger car Chevrolet Corvette, produced in 1953, and whose parts were made of polyester reinforced with glass fibres. In East Germany, the 1950s began to be produced Trabant, which represents the beginning of the use of plant fibres, considering that his chassis was made of cotton fibre in the polyester matrix.

In later years, the 70s, the need for lower mass of cars has contributed to the development of many new applications for composite materials. These materials have begun to be seen as the materials used to produce structural components, such as leaf springs or wheels.

Today, many car parts made of composite materials, while it is an essential factor in protecting the environment. Therefore, more research is directed to the use of biomaterials in composites. For models in which price is not a limiting factor used thermo set composites of epoxy matrix and carbon fibre.

A large number of parts can be made from composite materials, such as engine mount, parts of the floor, doors, tank, fenders, bumpers, hoods and trunk, and so on. Among the parts of the engine are made of these materials usually appear piston, connecting rod, crankshaft, camshaft, valve lifters, various levers …

Since composite materials are produced and mechanically very responsible assemblies and components, such as axles, coil springs, drive shafts, fasteners, connectors. Of paramount importance with parts made of these materials have their mechanical properties. In the application of the best qualities showed composites with carbon fibres.

4 The mechanical behavior material reinforced by strong fibers in automotive engineering

Laminate is made from layers mutually bonded to form multilayered composite. Composite materials consist of two or more constituents such as fibers and matrix. Matrix bond fibers together, gives shape of composite, have role in transfer loads to fiber. Usually fibers are 60-70% of composite volume and they are made of carbon, glass, aramid (such as kevlar) or metal.

In the present paper we discuss bulk wave's propagation. The properties of these waves are determined by the dependence between the propagation direction and constitutive properties of media. Here we considered slowness surfaces, as indicators of dynamical behavior, in order to obtain information about wave propagation in arbitrary directions. The surfaces associated with wave front surfaces are slowness surfaces, with slowness defined by the inverse of the wave front speeds. Constitutive equations are developed for material which is made of unidirectional reinforced thin sheets, which form model of material. Degrees of wave surfaces deviations depend on the degrees of anisotropy, and may give valuable information about dynamic deformations. The materials used in the present analysis are fiber reinforced materials with two families of continuous elastic and mechanically equivalent fibers, having axes of symmetry along bisectors of the fiber directions and along the normal to the plane tangent to fibers.

Here is considered orthotropic materials modeled as fiber reinforced materials with two families of mechanically equivalent fibers. Constitutive equations employed here are developed for material which is made of unidirectional reinforced thin sheets, whose combinations form model of material. Here we determinate slowness surfaces, as indicators of dynamical behavior, analytically and numerically to obtain valuable information about wave propagation in arbitrary directions. Degrees of deviations of wave surfaces depend on degrees of anisotropy, and may give valuable information about dynamic deformations.

4.1 Constitutive equations in linear elasticity

The material reinforced with two families of continuous fibers has the plane of symmetry tangent to both families of fibers, as the monoclinic symmetry and, therefore, has thirteen independent material constants. When two families of fibers are mechanically equivalent, the material behaves like orthotropic Axes of symmetry along the bisectors of the fiber directions and along the normal to plane tangent to fibers, reducing further number of independent material constants to nine.

The best way when developing constitutive equations for elastic materials is to find an equation for the *strain energy density* of the material as a function of the strain. The strain energy density, if the material is isotropic, can be a function of strain measures that do not depend on the direction of loading with respect to the material. That the strain energy can be a function of invariants of the strain tensor only that is, combinations of strain components that have the same value in any basis. The strain tensor always has three independent invariants, which could be the three principal strains, or the three fundamental scalar invariants, which are more convenient to use in practice. Strain energy W, for linear elastic materials, may be defined as quadratic of strain ε_{ij} in form

$$W = \frac{1}{2} C_{ijkl} \varepsilon_{ij} \varepsilon_{kl}, \qquad (i, j, k, l = 1,2,3). \tag{1}$$

When is material reinforced by two families of mechanically equivalent fibers material behaves as orthotropic and has nine independent material constants. The local fiber directions are denoted by the unit vectors a_i and b_i for bidirectional reinforcement. In that case we say that the vectors a_i and b_i are "mechanically equivalent" if the response is unaltered when a_i and b_i are interchanged. When materials have axes of symmetry along bisectors of the fiber directions and along the normal to plane tangent to fibers, Spencer [1,] has shown that the most general quadratic form of expression for strain energy function is

$$\begin{aligned} W = {} & \frac{1}{2}\lambda(tr\boldsymbol{e})^2 + \mu\, tr\boldsymbol{e}^2 + \gamma_1\left[(\boldsymbol{a}\cdot\boldsymbol{e}\cdot\boldsymbol{a})^2 + (\boldsymbol{b}\cdot\boldsymbol{e}\cdot\boldsymbol{b})^2\right] + \gamma_2(\boldsymbol{a}\cdot\boldsymbol{e}\cdot\boldsymbol{b})^2 + \\ & \gamma_3(\boldsymbol{a}\cdot\boldsymbol{e}\cdot\boldsymbol{a} + \boldsymbol{b}\cdot\boldsymbol{e}\cdot\boldsymbol{b})tr\boldsymbol{e} + \gamma_4\cos 2\phi(\boldsymbol{a}\cdot\boldsymbol{e}\cdot\boldsymbol{b})tr\,\boldsymbol{\varepsilon} + \\ & \gamma_5\cos 2\phi(\boldsymbol{a}\cdot\boldsymbol{e}\cdot\boldsymbol{a} + \boldsymbol{b}\cdot\boldsymbol{e}\cdot\boldsymbol{b})(\boldsymbol{a}\cdot\boldsymbol{e}\cdot\boldsymbol{b}) + \gamma_6(\boldsymbol{a}\cdot\boldsymbol{e}\cdot\boldsymbol{a})(\boldsymbol{b}\cdot\boldsymbol{e}\cdot\boldsymbol{b}) + \gamma_7\left(\boldsymbol{a}\cdot\boldsymbol{e}^2\cdot\boldsymbol{a} + \boldsymbol{b}\cdot\boldsymbol{e}^2\cdot\boldsymbol{b}\right), \end{aligned} \tag{2}$$

where λ, μ, γ_1, γ_2, . . . , γ_7 are even functions of $\cos 2\varphi$, and 2φ angle between the two families of fibers.

The elasticity tensor may be calculated by taking double partial derivation of W with respect to strain tensor, which leads to the expression for the stiffness tensor as follows

$$\begin{aligned} C_{ijkl} = \frac{\partial^2 W}{\partial e_{ij}\partial e_{kl}} = {} & \left[\lambda\delta_{kl} + \gamma_3(a_k a_l + b_k b_l) + \gamma_4\frac{1}{2}(a_k b_l + a_l b_k)\cos 2\phi\right]\delta_{ij} + \mu(\delta_{ik}\delta_{jl} + \delta_{jk}\delta_{il}) \\ & + \left[\gamma_3\delta_{kl} + 2\gamma_1 a_k a_l + \gamma_6 b_k b_l + \gamma_5\frac{1}{2}(a_k b_l + a_l b_k)\cos 2\phi\right]a_i a_j \\ & + \left[\gamma_3\delta_{kl} + 2\gamma_1 b_k b_l + \gamma_6 a_k a_l + \gamma_5\frac{1}{2}(a_k b_l + a_l b_k)\cos 2\phi\right]b_i b_j \\ & + \frac{1}{2}\left[\gamma_4\delta_{kl}\cos 2\phi + \gamma_5(a_k a_l + b_k b_l)\cos 2\phi + \gamma_2(a_k b_l + a_l b_k)\right](a_i b_j + a_j b_i) \\ & + \gamma_7\left[a_r\left(a_j\delta_{rk}\delta_{il} + a_i\delta_{rk}\delta_{jl}\right) + b_r\left(b_j\delta_{rk}\delta_{il} + b_i\delta_{rk}\delta_{jl}\right)\right]. \end{aligned} \tag{3}$$

When two families of fibers are initially straight, then the fiber geometry may be described in the Cartesian coordinate system $x_i, i = 1,2,3$, where X_3 is the normal to the plane of the fibers the unit vectors, which represent fibers, $(a_i) = (\cos\varphi,\ \sin\varphi,\ 0)$, $(b_i) = (\cos\varphi,\ -\sin\varphi,\ 0)$. In this paper slowness curves are calculated for waves propagating in the plane tangent to both families of fibers, that is in the plane of symmetry. For a fiber inclined for $\varphi = 45^0$ and $\varphi = 90^0$ slowness curves calculated in the plane of the fibers, for considered material for which $2\gamma_1 = 110{,}45\cdot 10^9\,\mathrm{Nm}^{-2}$ is given in Figures 1 and 2 In these figures quasi-longitudinal waves are represented with solid lines, whereas two quasi-transversal waves are represented with broken lines.

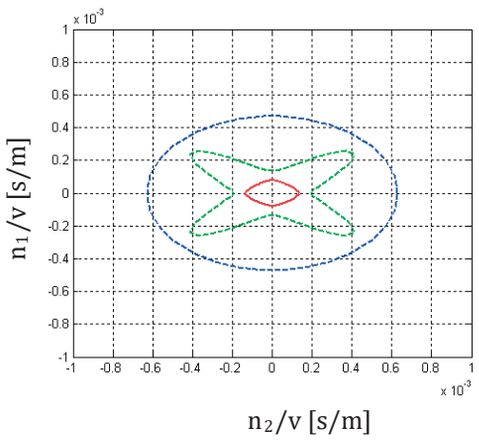

Figure 1 Two families of fibers, propagation in the plane of fibers $\phi = 60°$

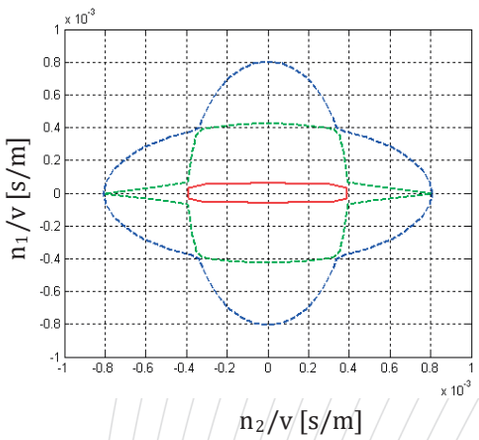

Figure 2 Two families of fibers, propagation in the plane of fibers $\phi = 90°$

5 Conclusions

In the present paper mechanics of continuum treat material on macroscopic level as an anisotropic continuum and general conclusions about an anisotropic material behavior, in mechanical sense, are drawn from considering of bulk waves propagation. This approach may be used as a first approximation of dynamical behavior of the real parts with anisotropic characteristics.

Numerical results show that a coordinate free formulation may give answers about the influence of fibers' direction as well as about the influence of fibers' strength on the wave propagation.

Such approach gives valuable information for designers in automotive industry where dynamical behavior play important role.

Acknowledgements

This work was supported by EACEA and TEMPUS programme, within WBCInno project (530213-TEMPUS-1-2012-RS-JPHES).

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Investigation and Innovation of Friction Stir Welding Process

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Research field related to geometrical and mechanical parameters in friction stir welding process is current and insufficiently explored, it is particularly present considering the class of aluminum alloy series 6000 (AlMgSi). The research paper is related to the friction stir welding of aluminum alloy 6082-T6 (AlMgSi1Mn) with the thickness of 7.8 mm. The research paper includes forces measurement: the down force - Fz, which is known as the welding force, traversing force Fx - and side force - Fy, as well as mechanical testing - tensile testing of welded joints and tensile tesings of welding zone using standard machines and standard test pieces. The paper includes the drawings of the designed supporting equipment which allows measurement of forces by the friction stir welding process, the analysis and discussion of the process are included, as well as results. The experiment was performed in the laboratory of the Mechanical Engineering Faculty in Podgorica.

Key words: Friction stir welding - FSW, welding force, pin, shoulder, tensile tests.

1 Introduction

During the nineties of the last century a new method of joining similar and dissimilar materials in the solid state without melting of material, known as friction stir welding - FSW is developed. The process is patented by The Welding Institute - TWI in England in 1991, and invented by Wayne M. Thomas who has successfully joined plates of aluminum alloys [1]. It is primarily used to join plates of larger thickness. Tools that are used in the process of welding are cylindrical and consisted of two concentric parts, which are rotating at the great speed. A larger diameter part of the tool is called the shoulder, while the smaller diameter part is called the pin (Figure 1). Rotating tool slowly approaches the joint line and plunges into material (Al alloys - sheet metal with of thickness 7.8 mm), which creates heat. Due to that the temperature increases to the heat metal forming where mechanical mixing and joining of materials is performed, enabling the tool to move in the longitudinal direction or along the joint lines (Figure 2). After passing of the tool along the joint lines the solid phase of weld (joint) remains, where the upper plane remains smooth and flat thanks to the tool shoulder, while the lower plane of the workpiece is formed from the basis on which the workpiece is standing and it is also smooth and flat [3, 5, 6].

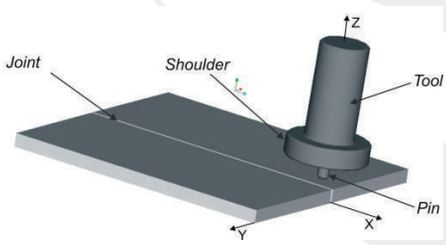

Figure 1 Presentation of tools and sheet

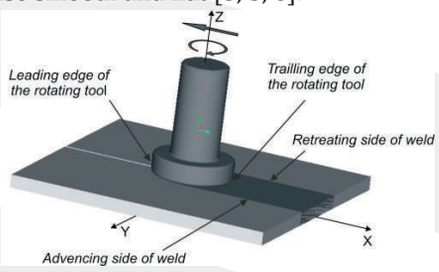

Figure 2 Presentation of friction stir welding process

2 Materials and experimental procedure

For the friction stir welding process, a vertical milling machine of great power was used. The process is conducted in laboratory conditions, similar to the production. Material used in the experiment includes the sheet aluminum alloy 6082-T6, whose chemical composition is given in Table 1, and mechanical properties of basic material in Table 2. The size of workpiece is 2000 x 50 mm, and it was obtained by cutting boards of sheet with the thickness of 7.8 mm.

Table 1 Chemical composition of used alloy 6082-T6 (AlMgSi1Mn) / Wt. %

Al	Fe	Si	Ti	Cu	Zn	V	Cr	Mn	Mg	Na
98.29	0.21	0.83	0.01	0.002	0.060	0.006	0.001	0.15	0.43	0.001

Table 2 Mechanical properties of used alloy 6082-T6 (AlMgSi1Mn)

Proof Stress 0.2 %(MPa)	Tensile Strenght (MPa)	Shear Strenght (MPa)	Elongation A5 %	Hardness Vickers HV	Melting Point (^{0}C)	Modulus of Elasticity (GPa)
310	340	210	11	100	555	70

Material used for making welding tools in the experimental research, for work in the hot conditions, is č.4751 steel and is thermally processed. The tool is designed in Pro/Engineer, a program for parametric modeling (Figure 3).

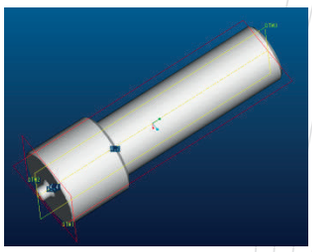

Figure 3 Model of the tool designed in Pro/Engineer

The diameter of the tool shoulder in a central point of the plan is D=26.46 mm, while the pin diameter d=5.92 mm. Tilt angle of the pin is α=3.87^0. Schematic presentation of the tool with dimensions is given in Figure 4, and the used tool in Figure 5.

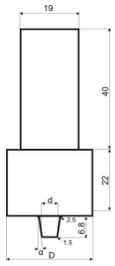

Figure 4 Tool: D=25 mm, d=5 mm i α=3^0

Figure 5 Tool made of steel Č.4751

Rotation speed of the tool at the central point of the plan is 630 rpm, while the welding speed 125 mm/min. Macrostructure of the alloy 6082-T6 is shown in Figure 6, Figure 7 and Figure 8 present the complete process of friction stir welding with basic tools and materials with supporting equipment. During the process of friction stir welding recording of forces was performed, as well as temperature and acoustic emission signals.

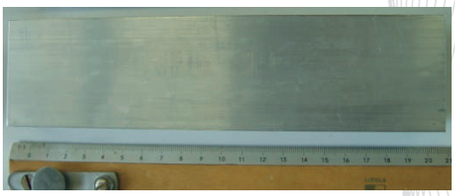

Figure 6 Macrostructure of alloy 6082-T6 (AlMgSi1Mn)

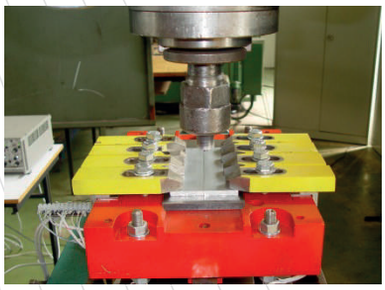

Figure 7 Machine is idle

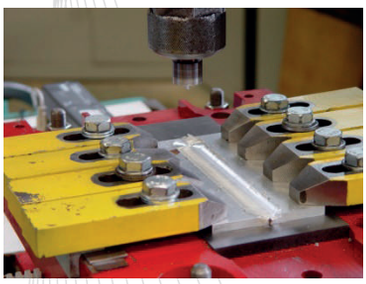

Figure 8 Machine performing FSW

For mechanical testing of welded joints, tensile tests are used. The testing is performed with the standard testing machines and test pieces. For the tensile tests, MEST EN 10002-1:2008 standard was used [7], and testing is performed at an ambient temperature. Testing machine is used when testing with modules of 200 KN, 500 KN and 1000 KN. Samples which are cropped from welded workpieces were taken from two normal directions. One sample is normal to the direction of welding y - direction (side direction), and the second is taken from the welding zone and coincides with the direction of welding x - direction (longitudinal direction). Figure 9 provides a schematic view of test pieces, and Figure 10 and Figure 11 provides the samples of the test piece in the central point of the plan in y and x direction.

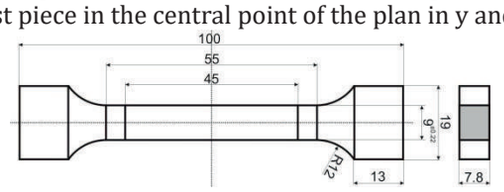

Figure 9 Test piece for tensile testing is made by the standard MEST EN 10002-1:2008

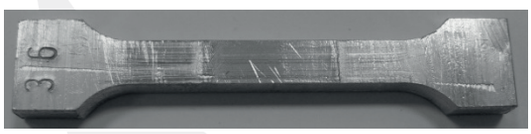

Figure 10 Sample (test piece), y - direction normal to the direction of welding

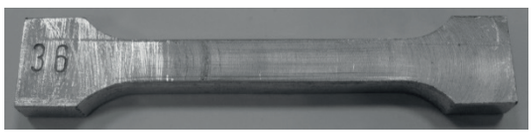

Figure 11 Sample (test piece), x - direction, which coincides with the direction of welding

3 Results and Discussion

During the process of friction stir welding - FSW, measurement of forces by a precise analog digital measuring equipment connected to the information measuring system was performed. Sensors used in strain gauge (HBN 6/120LY11) affixed to the special carriers that are adapted to the conditions of the experiment and directions of the measured forces. Figure 12 shows the force diagram of a function of time in the central point of the plan. During the welding process, welding force Fz has the highest value when the rotating tool plunges in the material (workpiece). At that point, workpiece is heated due to the effects of friction, pin tool and workpiece. Then the welding force Fz begins to decline until the moment of contact of the shoulder and workpiece surface, when the force reaches its greatest value, because the large surface shoulder begins to plunge in the workpiece. Workpiece becomes more heated due to the friction resulting from the shoulder and pin simultaneously. Then the welding force Fz begins to decline until the moment when the milling machine switches to transverse movement or selected welding speed 125 mm/min, where force Fz retains its constant value, until the moment when the tool exits the workpiece. Value of the traversing force Fx largely depend on the speed of welding, and specific effect has the geometric size of the tool, while the least value has the side force Fy.

When using adopted welding parameters (Rotation speed: 1000, 800, 630 rpm and welding speed: 200, 125 and 80 mm/min), different values of tensile strength Rm are obtained. Figure 13 shows the diagram of stretch in the central point of plan, test pieces from y and x - directions, with values of tensile strength Rm. The diagram shows that the tensile strength is larger for the test pieces which are taken from the welding zone than the tensile strength from the test pieces which are taken from the side y - directions, so that the relative ratio of $Rm_x/Rm_y=1.15$, while a relative ratio of the percentage elongation of the test piece from the x - direction and the test piece from the y - direction $\varepsilon_x/\varepsilon_y=1.66$.

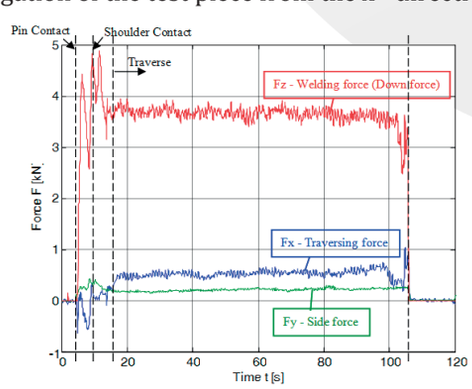

Figure 12 Diagram of the Fz, Fx and Fy force in the FSW process

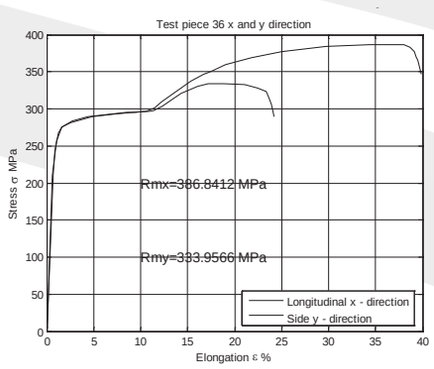

Figure 13 Diagram: Stress - Percentage Elongation

When tensile testing of samples of the welded workpiece, a small forming velocity is used. Samples that were created for tensile tests of the dimensions 100 mm x 19 mm x 7.8 mm are not processed by upper and lower surface of workpieces. On the upper surface of the workpiece of test piece from the y - direction to the place where the tool has passed a small dimple could be spotted, while in welding place of retreating side a small ridges occurs. While the underside of the test piece remains flat and smooth, at the point of connection of workpieces the tear could be recognized. On the sample from the x - direction the prints of the tools are shown at the upper side, whose size depends on the rotation speed of the tool. If the rotation speed is larger than the prints are smaller, and if the speed of turning tools is less, then the print of the tool can be clearly seen as a parallel ridges in form of a circle. Figure 14, presents a stretched test piece cut from y - direction, while Figure 15 presents a stretched test piece, cut from x - direction.

Figure 14 A stretched test piece, cut from the y - direction

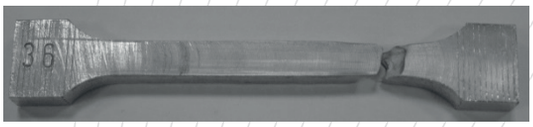

Figure 15 A stretched test piece cut from the x - direction.

4 Conclusion

The experimental research successfully completed the joining of aluminum alloy 6082-T6 using friction stir welding procedure (FSW).

Experimental research has established that the dimensions of tools (shoulder diameter, pin diameter and tilt angle of the pin) have large effect on the quality of weld as well as regimes of welding (welding speed and rotation speed).

Regarding the research of FSW and determination of functioning of the input and output sizes of the process, experimental tools and supporting equipment were made. The paper presents a measurement of force which is defined by the components in x, y and z direction and mechanical tests were performed - determination of the tensile strength of welded joints and the tensile strength of welding zone.

Based on the experimental results of FSW welding joints of aluminum alloy 6082-T6, it can be concluded that this procedure with the use of optimal parameters of welding, welded joints with good characteristics can be obtained.

For further researches, good experimental conditions are made, and information base, which promise significant results in research that follows.

Acknowledgements

This work was carried out as a part of the research on the project: RTPPIMS&NS, Number: 01-376, funded by The Ministry of Science of Montenegro.

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Production of Monoclonal Antibodies for Diagnostic Tests

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Monoclonal antibodies (mAb) are monospecific antibodies with high affinity for particular antigen, produced by hybridoma technology. mAbs are widely used in diagnostics of infectious diseases. Infectious diseases represent a broad group of disorders, but today one of the major concerns are ones sexually transmitted within the population. The most common among sexually transmitted genital infections worldwide is chlamydial infection, caused by intracellular bacterial pathogen. Early diagnosis is very important because untreated *Chlamydia trachomatis* infections are responsible for a large proportion of infertility throughout the world [1]. There are no commercially available diagnostic mAbs specific to *Chlamydia* antigens produced in Serbia on the market. Current diagnostic tests use mAbs that are supplied from abroad. Using our product, *Chlamydia* specific mAb, will dramatically reduce test expenses so the price will be affordable for more frequent screening and thereby prevention of complications caused by *chlamydial* infection.

Key words: monoclonal antibodies, production, chlamydial infection

1 Chlamydia trachomatis

Chlamydia trachomatis is an intracellular bacterial pathogen that causes several ocular and genital infection in humans. Statistically, *Chlamydia* is the most frequent sexually transmitted infection in the Europe and United States (Table 1) [2]. This infection is the most common among young, sexually active people. *Chlamydia* prevalence among young persons aged 14-24 years is nearly three times higher than the prevalence among persons aged 25-39 years. It is estimated that 1 in 15 sexually active females aged 14-19 years has *Chlamydia* [3].

Table 1 Incidence of *Chlamydia trachomatis* in the Europe and the United States from 2000-2013

Country	**Average rate per 100,000 Residents per Year**
Iceland	618,82
Norway	424.42
Denmark	371.42
United Kingdom	281.07
Bulgaria	136.28
Serbia*	128.53
West Virginia	570.4
Alabama	567.3
Delaware	627.5

*This data was taken from the site of the Institute of Public Health of Serbia

Unfortunately, this bacteria causes 'silent' asymptomatic infection and prolonged, untreated infection is responsible for a large proportion of infertility throughout the world [4]. In pregnant women, early diagnostic is very important because of high risk of pre-term delivery. *C. trachomatis* infection can be effectively cured with antibiotics once it is detected. Considering this and the fact that chlamydial infections can lead to serious health problems with both short- and long- term consequences, diagnostic is the most important part of treatment.

1.1 Diagnostic test

Laboratory services for the diagnosis of *C. trachomatis* became feasible in the early 1980s when cell culture systems were developed for the inoculation of clinical specimens. These systems complemented cytological methods and moved the diagnostic field forward. Throughout the 1980s and 1990s, diagnostic testing and screening with noninvasively collected specimens were developed.

Nowadays, some diagnostic tests involve usage of monoclonal antibodies (mAb), molecules that are specific for a single antigen and produced by hybridoma technology. Hybridoma technology features effective usage of innate functions of both immune cells, isolated from the immunized mice and cancers, allowing production of hybridoma cells, which continuously generate monoclonal antibodies specific to antigens of interest (Fig. 1). Hybridoma technology is primarily developed for the purpose of research. Now days, this technology was faced with a transfer from the research bench to the industry for a large scale commercial production of mAbs.

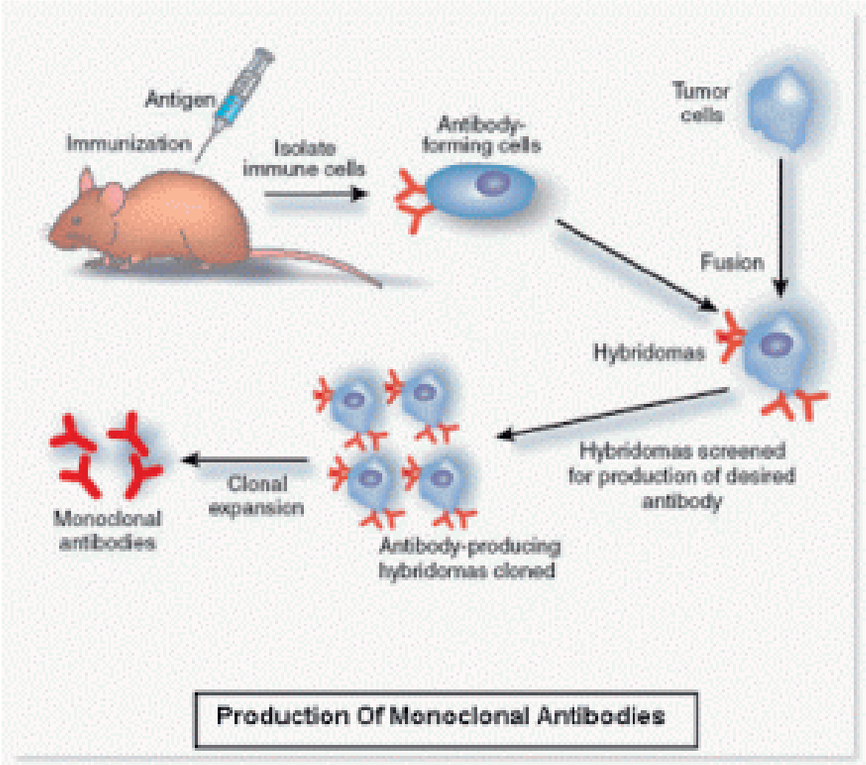

Figure 1 Schematic overview of hybridoma technology that resulted in the production of monoclonal antibodies [5].

Our idea is to produce specific monoclonal antibodies (mAbs) for diagnostic of *chlamydial* infection. There are no commercially available diagnostic mAbs specific to *Chlamydia* antigens produced in Serbia. By using our product, *Chlamydia* specific mAb, this diagnostic test would be more affordable for frequent screening, so the prevention of complications would be more effective. Our idea resulted from long- term research and lot of effort and dedication put by each member of our team. Monoclonal antibodies (mAb) are specific antibodies for single antigen, produced by hybridoma technology. There are several routine diagnostic tests used to detect *Chlamydia* in the blood, urine samples and in genital swabs:

- Nucleic acid amplification tests (NAAT).
- Nucleic acid hybridization tests (DNA probe test).
- Enzyme-linked immunosorbent assay (ELISA, EIA). This quick test involves monoclonal antibodies specific for *C. trachomatis*, detects bacteria in urine specimen and genital swabs.
- Direct florescent antibody test (DFA). This test also involves monoclonal antibodies to *Chlamydia* antigens and reliably indicates a local presence of this bacteria.
- *Chlamydia* cell culture

2 Business model Canvas

Technology transfer is the process by which basic scientific and fundamental discoveries are developed into practical and commercially relevant applications and products or process by which patents and intellectual property raised from academic research are transferred to industry. Before money is spent on patenting we need to establish clearly if a market exists.

Through business model Canvas, we want to develop our idea for the production of mAbs to antigens that are not commercially available on Serbian market. The mAbs will be used in diagnostics. Series of studies are necessary to obtain mAbs as an end product that will be ready for the market. Our product contributes to diagnostic of sexually transmitted infectious disease, caused by *Chlamydia trachomatis.* What makes this idea unique is that no laboratory in Serbia has yet developed the production of monoclonal antibodies against specific serotypes of *C. trachomatis*, and diagnostic laboratories should be our potential customers. On the market, there are companies that sell existing, imported, monoclonal antibodies, but we are working to design new ones that will be competitive for the quality and price. The price of our product will be slightly lower because it does not include the costs of import. Our product will have to pass all the tests established by the Law of the Republic of Serbia.

For initial investment, we will use the resources of our research laboratories with the possibility of equipment from parent institutions. A time period required for the realization of our idea is estimated to at least six mounts. The target groups are couples who want to have children and pregnant women because of the high risk of pre-term delivery. What makes us unique is our concept where we would have the production of mAb against specific serotypes of *Chlamydia*, because currently no laboratory in Serbia has developed the production of mAb. Production and consequently diagnosis of sexually transmitted diseases is very advisable for couples intending to have children because men are carriers of the infection but have no direct health effects. Communication with our potential consumers is planned to be conducted primarily through direct contact with the selected gynecologist or urologist in state and private laboratories. We will define the price of product on the basis of the total investment in the development and placement of the product to the market and on well- known methods for pricing. The potential market is already defined, but with the correct placement of our product, the expansion of the market is possible.

3 Conclusion

The ultimate goal of this product emphasizes the huge benefit of precise diagnosis. We will strongly support the interests of our consumers and our product will improve and provide more precise diagnosis. Our motive is that immunological research in Serbia becomes suitable for implementation of diagnostic and prevention. Our product will be in service of health improvement and the quality of life.

Acknowledgements

Institute of Virology, Vaccines and Sera-Torlak; Belgrade, Serbia
Institute of Medical Research of the Military Medical Academy; Belgrade, Serbia
Laboratory for Cell and Molecular Biology, Center for Preclinical Testing of Active Substance CPCTAS, Faculty of Science; Kragujevac, Serbia
WBCInno project, University of Kragujevac, Serbia

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Marks that cannot be protected by trademark in the law of Republic of Serbia

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Trademark as a subjective right that protects marks which undertakings use to mark their own goods or services, represents one of the most efficient legal instruments for the purpose of distinguishing goods or services of different undertakings on the market. However, it should be borne in mind that not all marks are eligible for marking of goods or services of undertakings, for reasons of legal certainty, protection of public interests, protection of interests of other undertakings, and interests of third parties. In that sense, national regulations governing the trademark law stipulate which marks cannot be protected by trademark as a subjective right, which is the reason for such marks to practically never appear on the market as marks by which goods or services are marked. Regarding that, the Law on Trademarks of Republic of Serbia contains exhaustive list of marks that cannot be protected by a trademark, whereby each of them, together with the reasons for exclusion from legal protection, shall be subject of consideration in this paper.

Key words: trademark law, marks that are used to mark goods or services, exclusion of marks from protection by trademark as a subjective right.

1 Mark as a subject of trademark protection

The subject of trademark protection is a mark that can be represented graphically, provided that such mark is capable of distinguishing the goods or services of one undertaking from those of other undertakings [1]. The Law on Trademarks of Republic of Serbia does not specify explicitly which marks can be protected by trademark as a subjective right, instead it only presents marks as an example, and so it is stated that a trademark may consist of words, slogans, letters, numbers, images, drawings, combinations of colors, three-dimensional shapes, combinations of such marks, as well as of graphically presenable musical notes, etc. From this we can conclude that the legislator clearly did not want to engage in prediction of all potential forms of marks, but he/she left the practice to determine whether a specific mark may be registered as a trademark or not [2]. However, on the other hand, the Law on Trademarks of Republic of Serbia specifies, in exhaustive and very detailed way, which marks cannot be protected by trademark as a subjective right, so one can say that the legislator has determined which marks may be registered as a trademark in a negative manner.

2 Marks that cannot be protected by trademark

As already mentioned, the Law on Trademarks of Republic of Serbia stipulates which marks cannot be registered as a trademark, where the disrespect of this prohibition has the annulment of trademark as a consequence, which can be applied to its full duration [3]. Thus, a trademark cannot be used to protect a mark:

- Which is contrary to public policy or to accepted principles of morality. Mark which is contrary to public policy would be, for instance, the mark consisting of words, slogans or symbols that are calling for the violent overthrow of the constitutional order, violation of guaranteed human or minority rights, or cause racial, national or religious hatred. [3] On the other hand, when it comes to marks contrary to accepted principles of morality, one should distinguish between two groups of marks. The first group consists of marks that are immoral per se, such as, for instance, swastika, marks consisting of swearwords or other improper content etc, while the second group consists of marks that are, from the standpoint of social morality, quite acceptable, but in the context of the

goods or services which they are marking, they adopt an immoral meaning, for example, the mark made up of image and name of Vuk Karadžić intended to mark a liquor [4].

- Which in its general appearance is not capable of distinguishing the goods or services in the course of trade. In order for a mark to be protected by a trademark it must fulfill the requirement of distinctiveness, that is to be capable of distinguishing, in the course of trade, the goods or services of one undertaking from those of other undertakings. Distinctiveness of a mark, as a rule, is not estimated in relation to the goods or services for whose marking is intended, but objectively, in terms of whether the mark itself is suitable for appearing in the course of trade to function of distinguishing identical or similar goods associated to different offerors [4].
- Which consists exclusively of three-dimensional shape determined by the nature of the goods or the shape of the goods which is necessary for obtainin certain technical results. This provosion refers to the conditions relating to three-dimensional marks that one wants to protect with a trademark. Namely, three-dimensional marks can be protected by a trademark, if they, in addition to basic conditions, fulfill two additional conditions. The first condition consists of the requirement that the form of a three-dimensional mark is not exclusively determined by the nature of the goods. In accordance with this condition, one can not acquire protection on the basis of trademark law for, for example, the form of an apple, banana, etc. The second condition refers to the requirement that the form of a three-dimensional mark is not determined by the technical function of the goods [4]. The form of goods is determined by its technical function in such a case when the technical function of the goods could not be realized if the goods had some other form [4]. In accordance with this condition, one cannot acquire protection on the basis of trademark law for marks in the form of, for example, a hammer, saw, etc.
- Which consists exclusively of signs or indications which may serve in trade to designate the kind, quality, quantity, intended purpose, value, geographical origin, or the time of production of the goods or of rendering of the service, or other characteristics of the goods or services. In this case we are talking about descriptive marks. The need for descriptive marks to be excluded from the possibility of trademark protection has arisen for two reasons. The first reason consists in the fact that descriptive marks lack distinctiveness, given that they are marks that mark certain types of goods or services in a general way, instead of marking goods or services of a particular undertaking, while the second reason consists in the necessity for mentioned marks to remain in free use in the course of trade [4].
- Which became customary in the current language or in the bona fide and established practices of the trade for marking specific types of goods or services. Namely, the marks in question are marks which, in the initial phase of their use, were suitable for marking certain types of goods or services, but through long-term use have become a generic term, ie. synonym for a particular type of goods or services, because of which they cannot be protected by a trademark, such as marks which consist of words refrigerator, kaladont, etc. [4].
- Which in its appearance or content may mislead relevant public for instance as to the nature, quality or geographical origin of the goods, or other characteristics of the goods or services. For instance, such would be the marks „Hungarian Feta“ for the type of cheese from our region that could mislead the consumer into believing that the goods originate from Hungary, or verbal mark written in Japanese language, where the consumer might believe that the goods are originating from Japan, or the verbal mark „extra“ that could mislead the consumer into believing that it is a product of the highest quality, etc. [3].
- Which contains official marks or hallmarks of quality control or warranty or imitations thereof, except with the written approval of the competent authority. These marks are excluded from protection because there are legally established signs of quality, with which certain kinds of goods are marked, regardless of who the manufacturer is [3].
- Which is identical to an earlier trade mark, for identical goods or services. This prohibition derives from one of the basic principles of trademark law, the specialty principle. The mentioned principle implies that the trademark proprietor has the exclusive right to use the trademark for marking goods or services specified in the application for trademark registration [5]. On the other hand, the right of the trademark proprietor to prohibit third parties to use the same or similar trademark has a broader scope, because it does not cover only the goods and services listed in the application for trademark registration, but also those that are identical or similar to them [5].
- Which is identical to an earlier trademark of another undertaking for similar goods or services, or similar to an earlier trademark of another undertaking for identical or similar goods or

services, if because of that identity or similarity, a likelihood of confusion exists on the part of the public, which includes the likelihood of association with the earlier trademark. This prohibition also follows from the specialty principle.

- Which is identical or similar, for the identical or similar goods or services, to the mark of another undertaking which is well known in the Republic of Serbia within the meaning of Article 6 *bis* of the Paris Convention for the Protection of Industrial Property. According to the Law on Trademarks of Republic of Serbia undertakings are not obliged to register marks which they use to mark their own goods or services. In that sense, unregistered mark, which due to long-term use, has become known as the mark of a certain undertaking, or goods or services, in the trademark law, is called notorious or well known. Such marks are enjoying double protection because, first, such a mark cannot be protected by another person for identical or similar goods or services, and secondly, if such protection is to occur, originary user of such mark is entitled to special claim for denial of trademark [3].
- Which, regardless of the goods or services referred to, represents a reproduction, imitation, translation or transliteration of another person's trademark or its substantial part, which is, with the participants in the course of trade in the Republic of Serbia, undoubtedly known as a mark with a reputation (a *famous* trademark), where the use of such trademark without due cause would take unfair advantage of, or be detrimental to, the distinctive character or the repute of that trademark. Marks are considered to be *famous* if their recognition in the course of trade has reached such a level that they became a part of the language of market participants so they can use them as synonyms for the names of the products which they mark [6]. Namely, these marks have a special form of protection in the sense that they are not applicable for the specialty principle, which means that such a mark cannot be protected by a trademark on the name of another person, not only for the identical goods or services, but not for any other goods or services [3]. In addition, the protection includes the prohibition of the actual use of such mark.
- Which in its appearance or content, infringes copyright or other industrial property rights. Thus, for example, trademark cannot be used to protect reproduction of work of fine art, the title of copyright work, the name of the character in the literary or other artistic work, the name of the patented invention, shape of a body, image or drawing in respect of which legal protection by design is achieved, etc, if the appliciant of an application for trademark registration is not the proprietor of the copyright or industrial property rights on the goods for which he requests trademark registration [4].
- Which represents or imitates a national or religious symbol. Namely, the marks in question are marks whose usage for marking of certain goods or services offends national or religious feelings of members of a particular nation, religion or religious group, as for example, marks made from the personal portrayal and the name of Jesus Christ [3].

3 Marks that can be protected by trademark on certain conditions

Unlike previous groups of marks that cannot be protected by trademark at all, the Law on Trademarks of Republic of Serbia stipulates two groups of marks that can be registered as a trademark, provided that the consent of the competent authorities or person has been given. Namely, these are the following marks:

- A mark that contains a state or other public coat of arms, flag or a symbol, name or abbreviation of the name of a country or of an international organization, or imitations thereof, unless the competent authority of the country or organization concerned has given its authorization for such use.
- A mark that contains a personal portrayal or name of a person, or the name of his estate. The name of a person or the name of an estate can be registered as a trademark, provided that they are sufficiently distinctive, whereby the personal portrayal or the name of a person can be protected as a trademark only with the written consent of that person, and if it is a deceased person in question, then with the written consent of a parent, spouse and children of the deceased, and the name of a historical or other deceased famous person can be protected with the permission of the competent authority and the written consent of the spouse and relatives within the third degree of kinship, [1] and the name of an estate cannot be protected by a trademark on the name of another person, unless it fails to transfer the estate on the person seeking trademark protection [7].

4 Conclusion

The Law on Trademarks of Republic of Serbia, which is compliant with European Union regulations governing this matter, precisely defines which marks cannot be protected by trademark as a subjective right. In this regard, we can distinguish marks that are absolutely excluded from the possibility of trademark protection, and marks that can be registered as a trademark with the fulfillment of requirements stipulated by the Law on Trademarks. In this manner, a precise and exhaustive negative enumeration of marks in the above mentioned Law, provides legal certainty and adequate protection of legal interest for undertakings who wish to register a particular mark, as well as undertakings who already protected a particular mark by a trademark. Namely, in this way there is no possibility of registration of marks which are on this list, that is, there is no possibility of registering the mark without obtaining the appropriate approvals. Bearing this in mind, it can be said that our legislator in the best possible way protected the public interests and private interests of the participants in the course of trade.

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SESSION 4: Entrepreneurship, employment, start-up

Fostering an entrepreneurial culture in Western Balkans by establishment of creative and entrepreneurial framework with schools and universities

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The cooperation between the academic and educational community, the support structures such as BIs (business incubators) and STPs (science and technology parks) and industry in general is widely recognised as desirable. When it comes to the cooperation in the field of education, research reports consistently find that the cooperation practices are highly fragmented and uncoordinated throughout the Europe. The same applies for Western Balkan countries where in many cases there are no direct and structural links between the schools, universities and businesses and/or business support structures. The situation is to certain extent better when it comes to the relations with the universities, however the education system in this region does not encourage entrepreneurial culture and creativity among pupils and students at satisfactory level. Specific direct and indirect measures would help to foster entrepreneurial culture in WBC, improve the perspective of young generations and subsequently contribute to long-term knowledge-based economic growth in the region as suggested by SEE2020 (South East European 2020 Strategy).

Key words: university-business cooperation, entrepreneurial culture, social entrepreneurship, entrepreneurial education, creativity, cooperation in the field of education, Western Balkans

1 Introduction

In recent years, the Western Balkan countries (WBC) have adopted a variety of reforms and programs in order to improve the performance of their research and innovation sectors (R&I), both at national and regional level. These endeavours are essential, having in mind the integration into European Research Area (ERA) and the importance of education and R&I for the overall success of the EU-integration efforts of the Western Balkans. The importance of this relation was confirmed once again during the latest events in the framework of the Western Balkans Process, also known as the "Berlin process". [1] In this context of recent developments of R&I sectors in WBC, also a significant number of EU and internationally funded R&I projects should be mentioned that have been implemented (or are still implemented) in the region. The projects were addressing different topics of relevance such as the coordination of research and innovation policies (WBC-INCO.NET), RTDI evaluation competences (EVAL-INNO) or innovation policy learning (WBinNO) – to name just few, thus in this way equally contributing to the overall development of the R&I sectors in WBC. One of these projects is also WBCInno project, focusing on modernization of WBC universities through strengthening of structures and services for knowledge transfer, research and innovation, which will be referred to later. Over the last decade, also the literature on R&I systems in WBC has grown significantly (partly as outcome of different projects implemented), not least on major RTDI obstacles and challenges still existing in the region. One of the key challenges identified is still unsatisfactory level of national, regional and international cooperation and communication among relevant stakeholders. Although, certain positive developments regarding regional cooperation have been achieved and led to joint regional R&I declarations and strategies. [2] Now, based on research conducted within WBCInno project [3] this paper will focus on cooperation between the academic and educational community on one side and the R&I support structures such as BIs (business incubators) and STPs (science and technology parks) on the other side, suggesting some measures and support actions for improvement of the cooperation. It is assumed that such improved cooperation would also foster entrepreneurial culture among pupils and students providing benefits not only to young generations: a student gains valuable softer skills and a more relevant industry-related qualification; the local labour market is strengthened and companies benefit (directly or indirectly) from access to more highly skilled employees; the better employment outcomes and higher levels of student satisfaction provides an improved profile for the university, whilst academic staff also gain knowledge of current industry practices. [4] Furthermore, such initiatives that enhance cooperation among different stakeholders can

also lead to innovative solutions for socio-economic problems and later to social change, which seems necessary in Western Balkans.

2 Entrepreneurial culture

The concept of *entrepreneurship* has evolved over time and is often used to emphasise different features. The most common idea associated with this term is the idea of starting a for-profit business, even if this is a very limiting definition. Related to this, one of the most frequently asked questions, and at the same time one of the oldest research questions in the field of entrepreneurship (e.g. McClelland 1961; Weber 1930; Schumpeter 1934) is "*how and to what extent does national culture influence entrepreneurial action, the rate of new firm formation and ultimately economic development"?* [5] Understanding the real impact of culture and the ways in which culture may be mitigated by contextual factors such as institutions is also of importance for policy–makers concerned with promoting entrepreneurial activity [6] – in this case e.g. BIs / STPs and universities and schools jointly with ministries in charge of education, science and research in WBC. The *entrepreneurial culture* as a concept in both the entrepreneurship and broader management literature has been described for example as "*a form or type of culture which is creative, innovative, takes risks and challenges the status quo*" (Ireland, Hitt, & Sirmon, 2003). [7] It has also been applied at the national level to "*describe country or societal values and attitudes towards entrepreneurship"* (e.g., Birkinshaw, 1999; Hayton & Cacciotti, 2013; Tan, 2002, 2006). [8]

> *"To the extent that cultural values lead to an acceptance of uncertainty and risk taking, they are expected to be supportive of the creativity and innovation underlying entrepreneurial action. Entrepreneurial actions are facilitated both by formal institutions (e.g. property rights, enforceable contracts) and by socially shared beliefs and values that reward or inhibit the necessary behaviours (e.g. innovation, creativity, risk taking; Hayton, George & Zahra 2002; Herbig and Miller 1992, Herbig 1994; Hofstede 1980). It is because of this subtle but widespread influence of culture that is necessary to seek a deeper understanding of the phenomenon".* [9]

2.1 Entrepreneurial culture in Western Balkans

It is a wide spread assumption that the entrepreneurial culture (both in the narrower and broader sense) in WBC is not developed (to a satisfactory level). Thus when speaking about fostering entrepreneurial culture in this region, broader concept should be applied and analysed which is not only related to e.g. awareness raising activities in order to motivate young people or young researchers to start own for-profit businesses or related to providing structural institutional framework in which academic and innovation supporting institutions might assist in this endeavour. Such an analysis should as well include some thoughts on the *social entrepreneurship* which extends the definition of entrepreneurship by its emphasis on ethical integrity and maximizing social value rather than private value or profit (e.g. Dees 2001; Massetti 2008; Jansen 2012). Newly developments such as the *Belgrade declaration on development of social entrepreneurship in the region of Western Balkans and Turkey* [10] are promising approaches, also for further and more in depth future scholarly analysis of development of entrepreneurial culture and social entrepreneurship in Western Balkans. This paper however tackles both entrepreneurial culture and social entrepreneurship only marginally and focuses on research conducted within WBCInno while developing a *Strategic development plan for Business incubators and Science and Technology Parks in Western Balkan Region*. Table 1 gives an overview on all strategic goals and measures suggested by the development plan. Measure six (M6) – *Establishment of creative and entrepreneurial framework with schools and universities* is in the focus of this paper. The elaboration of other suggested measures is probably part of some other chapters of this publication.

Table 1 Strategic Development Plan for Business Incubators and Science and Technology Parks in Western Balkan Region

Strategic goals and suggested measures	BIs / STPs	Universities
	M1 Improvement of organizational and financial framework of BIs/STPs	**M6 *Establishment of creative and entrepreneurial framework with schools and universities***
	M2 Infrastructure development that suited to meeting start-up and spin-off needs	M7 Creation of mechanisms and structures for high-tech innovation in cooperation with universities and research centers
	M3 Implementation of collaborative software platforms for improved communication and innovation management	M8 Organization of competitions and awards for best business plans, best student's/researcher's ideas
	M4 Improvement of services for tenants of BIs/STPs	M9 Improving visibility, promotion and internationalization of BIs/STPs for their sustainable development
	M5 Application of new incubation models – virtual business incubators	M10 Networking among BIs and with STPs and universities on local, regional and EU level

2.2 Some challenges identified

Not only in WBC are cooperation practices between academic and educational community, the support structures such as BIs (business incubators) and STPs (science and technology parks) and/or industry in general fragmented and uncoordinated. Last year published report of the European Commission on measuring the impact of university-business cooperation [11] finds out that such cooperation practices are spread throughout the Europe. However, in many cases in WB region there are no direct and structural links at all between the schools, universities and businesses and/or business support structures. Even within some R&I and educational institutions the structured communication and cooperation towards knowledge transfer is weak or not existent, as experienced by the author during WBCInno benchmarking visits in WBC. Especially in developing regions such as Western Balkans, which is characterised by weak economic structure, low level of industrial production, low performance results of the educational systems and high unemployment levels, new and innovative models of "doing things a different way" is strongly desired.

> *"The key challenge in cultivating an entrepreneurial culture globally is figuring out the best ways to unleash the potential of all people to innovate, create, catalyze, be resourceful, solve problems and take advantage of opportunities while being ethical." [12]*

In particular confronted with huge youth unemployment (up to 60% in some WBC) and severe brain drain, policy-makers in WBC should put the youth policies much more in focus and provide environment that encourages young people to recognise and take advantage of opportunities given in their own country.

> *"Youth employment and entrepreneurship policies are likely to be more effective if they are closely linked and integrated with educational policies including the structure and content of school curricula, extra-curricular activities and after-school programs. Vocational needs of young people should be central. One approach is to craft an overall youth policy."[13]*

The political backing of the current heads of government, foreign ministers and economics ministers of all WBC (as well as other relevant EU representatives) for initiatives towards youth in Western Balkans, as mentioned in the conclusions of the Vienna Summit 2015, is extremely important for the years to come. Those initiatives range from strengthening reform efforts of the education systems in order to provide youth with relevant basic and transversal skills, to encouraging mobility of the youth within the region by promoting and enhancing existing programs such as CEEPUS, to supporting the development of a vocational training system in the region. However, very often the scope, effectiveness and impact of good national and even regional R&D initiatives are limited despite solid political backing. In some cases the relevant political, academic or economic players are not directly involved and/or implementation is hindered by change of government and related change of political priorities. In both cases, a lack of coordination, cooperation and communication is evident.

3 Establishment of creative and entrepreneurial framework with schools and universities

WBCInno identified several objectives and support actions which can improve a) cooperation and communication between education institutions and innovation support structures; b) communication towards youth; c) skills and competences of young people. Such activities when implemented are likely to contribute to fostering entrepreneurial culture and in the end potentially to reducing unemployment and preventing brain-drain. Specific objectives, expected impact and benefits as well as efficiency indicators identified by the Strategic development plan [14] are briefly described below.

3.1 Providing structural institutional framework

Since there is often no link between educational institutions and business support structures, one of the first steps towards improved cooperation should be to reconsider existing internal regulations. It is expected that the provision of the institutional framework for structured cooperation will facilitate the process of initiating/intensifying cooperation and, at the same time, initiate follow-up processes – awareness raising and definition of concrete joint activities and their implementation. Efficiency indicators can include: the number of revised governing structures of BIs/STPs; the number of new pieces of legislation; the number of new cooperation contracts etc.

3.2 Developing a set of awareness raising activities

The main impact of developing a set of awareness raising activities is making first practical steps towards realization of cooperation in more concrete terms. All of the groups involved (both – institutions and their end users and/or beneficiaries) are more aware of the possibilities for cooperation and its benefits. Students as target group are more aware of their opportunities for future professional development. Efficiency indicators identified are: the number and types of organized motivational events and developed promotional material.

3.3 Involvement of BIs/STPs in the education and research process

Involvement of BIs/STPs and other stakeholders from business sector in the education process is extremely important, if not the most important instrument towards entrepreneurial culture in WBC. It leads to the increase of the overall quality of education offer, modernization of the institution, as well as to its openness to the society. Even more relevant is the fact that the students gain valuable softer skills and a more relevant industry-related qualification while also academics gain knowledge of current industry practices. Combination of the skills of traditional academics and those of entrepreneurs during the education process might also facilitate the development of beliefs, values and behaviours supporting innovation, creativity and risk taking among students. Also, companies and support structures are in the position to improve the capacities of their employees, and also have access to a pool of future young experts and professionals in their respective fields. Efficiency indicators identified are: the number of courses (formal and LLL) introduced/revised; the number of lectures involving BIs/STPs; the number of placements in companies; the number of companies involved and the number of PhDs with the industry.

3.4 Realisation of additional activities towards cooperation improvement

It is expected that such activities like organisation of brokerage events, science days, training events, fairs and competitions etc. would additionally lead to the increased cooperation and networking among relevant actors. Young people can have a whole new view of science as something interesting and motivation to get involved in the scientific ventures. Efficiency indicators identified are: the number of brokerage events and "science days"; the number of training events, lectures and workshops; the number of project proposals; the number of participants in various events etc.

4 Conclusions

Starting a project or designing and launching one's own business are exceptions, not the rule in most young people's experience – not only in Western Balkan countries. Encouraging and giving young people the opportunities to learn how to start a project or conceptualize own ideas into businesses is extremely important not only for shaping their personality and possible carriers but also to foster entrepreneurial culture within one country and increase the number of innovative solutions to ever growing number of social problems. Motivation, creativity and in particular cooperation are indispensable components for change, also social change.

Acknowledgements

This paper is developed within WBCInno Project (http://www.wbc-inno.kg.ac.rs/), funded by TEMPUS. The author thanks WBCInno project partners for fruitful cooperation.

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Enhancing employability and competitiveness in graphic and creative industries using blended learning environment

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In graphic and creative industries in Serbia exists the discrepancy between rapid technological changes, educational outputs and equipment investments. Due to the absence of a life-long professional development system, related educational institutions and enterprises gradually lose their competitiveness level compared to the EU counterparts. The blended learning environment combining distance learning platform with real-world workshops can provide the basis for continuous re-training of both employed and unemployed graduates in the domain of graphic and creative industries.
The online learning platform acts as university-enterprise cooperation framework supporting the EU Opening up Education initiative to stimulate development and availability of open-education resources. Access to the virtual laboratory with the contemporary knowledge base and testing possibilities will boost competitiveness and growth to reach the EU level. The platform also implements certain parts of the Strategies for Education Development by 2020 of the Republic of Serbia like the lifelong education of vocational teachers and university staff raising the quality of all education levels.

Key words: blended learning environment, employability, life-long learning, graphic industry

1 Introduction

Over the past few decades of the digitization era, the graphic industry is characterized by high-frequent technological changes reflected through the constant introduction of improved technologies, materials and business models [1]. Although new technologies impose demand for continuous re-training, there is no significant national framework for life-long education in the field of graphic and creative industries [2]. Enterprises in the field report a lack of proficiency of the undergraduate and graduate students and pupils doing their internships so they are forced to allocate some internal funds to re-train their operators and engineers [1]. The current situation reveals the need for a support system in preparing students to enter the labour market after graduation and remain competitive through entire career.
With support from the Serbian Ministry of Science and Technological Development, the Department of Graphic Engineering and Design aims to blend the real-world workshops on the equipment (machines, devices and measurement instruments) in laboratory or industrial facilities with the web-based learning platform- online graphic centre. The distance learning platform will be available at the same time to students, university staff, vocational teachers and all interested parties from the industry. As web-based, platform allows viewing, search and download of material using mobile devices (phones, tablets) as well as verification of acquired knowledge by solving tests.

2 Blended learning environment

Segments of developed online graphic centre are:

- the interactive virtual laboratory,
- the interactive knowledge base with integrated testing possibilities to monitor the progress of the user and
- the base of research results.

2.1 Interactive laboratory

Interactive laboratory presents graphic systems and processes in the virtual environment through multimedial content, machine visualisations and production simulations.
Virtual environment (see Figure 1) reflects the real world production with simulations of production scenarios and problems [3].

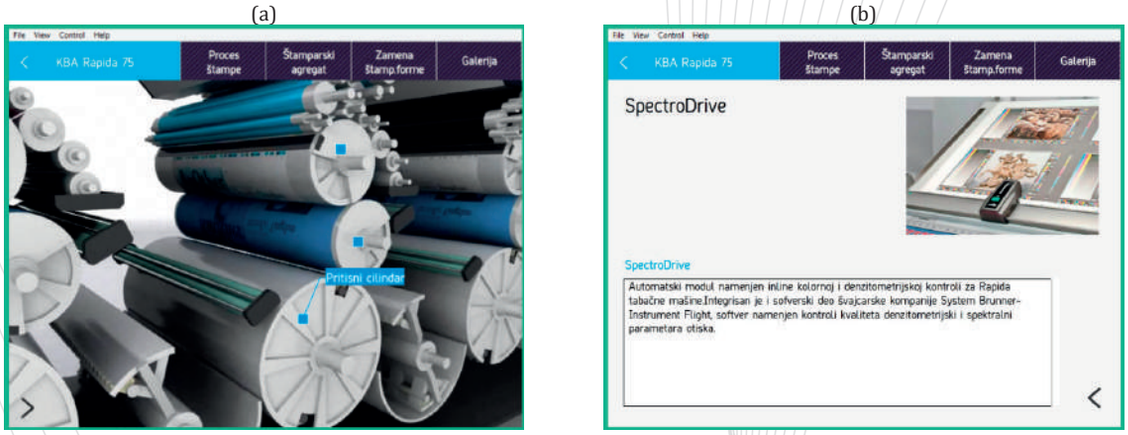
Multimedial content enhances the learning experience and, therefore, the learning outcomes by providing multitasking, parallelism and interactivity (hypermedia and hypertexts) [4].
Machine visualization demonstrates operational principle and enables component disassembling which is often very difficult, economically unprofitable or dangerous in a real environment. Scientific visualization is a young field with enormously rapid development in proportion to the benefits of its application [5]. Visualization provides a realistic view, manipulation and decomposing of complex graphics system using the software Adobe Flash with Action Script programming language for 2D modelling and interactive animation and Autodesk 3ds Max Studio 3D modelling and animation.

(a) (b)

Figure 1 Online graphic centre– interactive laboratory: (a) menu with available machines; (b) navigation through production line

Figure 2 shows an example of a 3D visualization of offset printing machine with interactive content.

(a) (b)



(c)

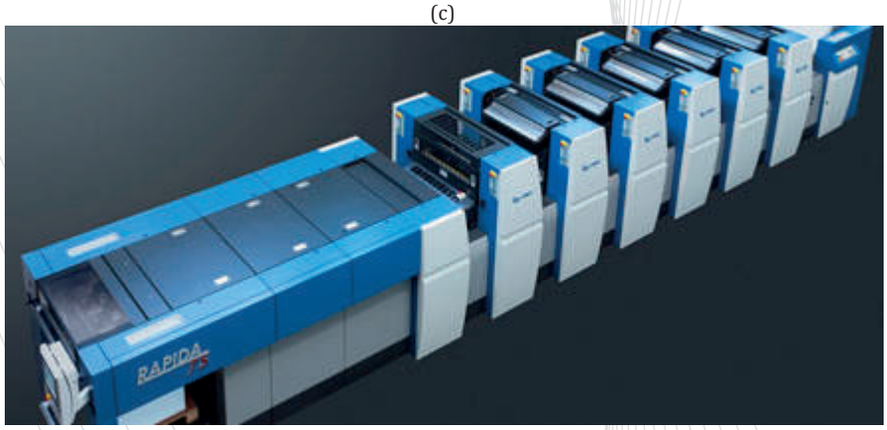


Figure 2 Example of a 3D visualization of graphic system (offset printing machine): (a) visualization of printing plate replacement procedure; (b) an explanation of the printing control console; (c) integrated video tutorials

Production simulation is an intermediate step between theory and actual application. Simulations of graphic systems promote the development of problem-solving skills without the costs of the graphic system (costs of material, energy and engagement of operators/instructors).
Simulation provides a simple demonstration of consequence caused by improper system adjustments without the risk of accident or damage. Unlike operators that solve production failures on the base of long experience, simulators allow a "trial and error" learning method by varying system settings, analysing potential problems and possible solutions [3]. Figure 3 presents an example of machine simulator (cutting machine).

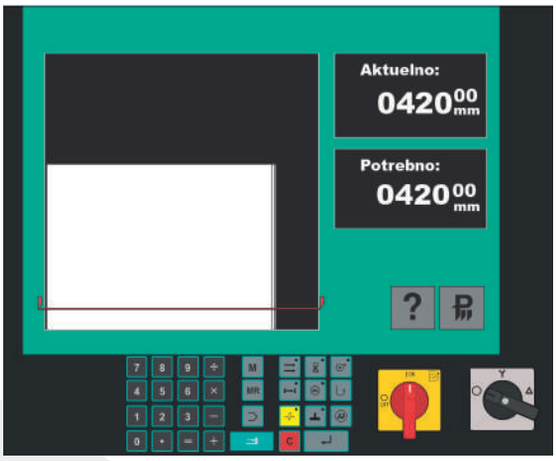


Figure 3 Interface of simulator for cutting machine

2.2 Knowledge base

The interactive knowledge base is structured through a broad range of customised modules- courses from graphic engineering, design and creative arts scaled to a different level of knowledge and a role of the user.
The storage of educational content on the web server and communication between users is accomplished using LMS (Learning Management System) platform and courseware tools. In addition to individualized self-paced learning and training, the distance learning system provides an individualized evaluation of knowledge through a variety of tests with constant feedback and progress monitoring.
Figure 4 demonstrates one learning unit from the Printing Techniques course.

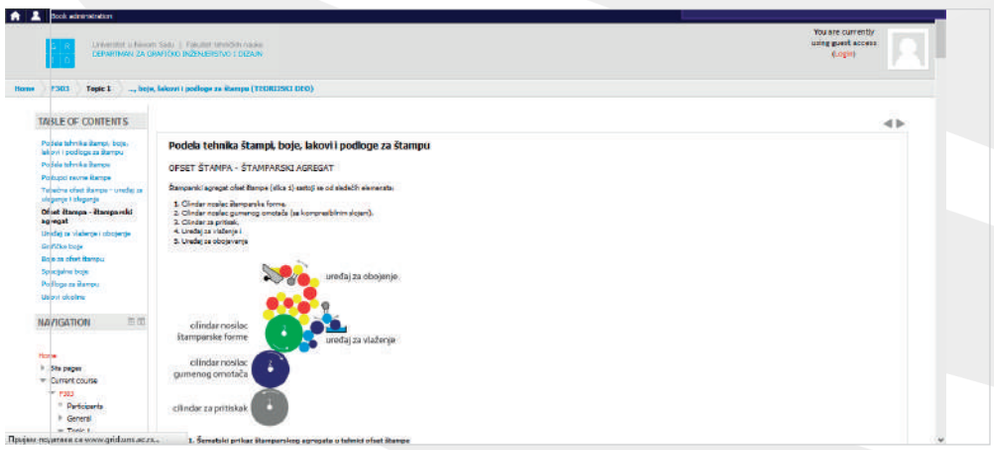


Figure 4 Example of learning unit in distance learning platform

2.3 Base of research results

The research results have been consolidated under a joint base of scientific - technical papers, allowing the dissemination of state-of-the-art knowledge in graphic and creative production for Serbia and the region. The research base accelerates study program modernization of related educational entities (vocational schools and universities) and further collaboration between the educational and the industrial sector.

2.4 Workshops

Working with the simulators can be supplemented with training on the machine in a real production environment. The concept of blended approach is illustrated in Figure 5.

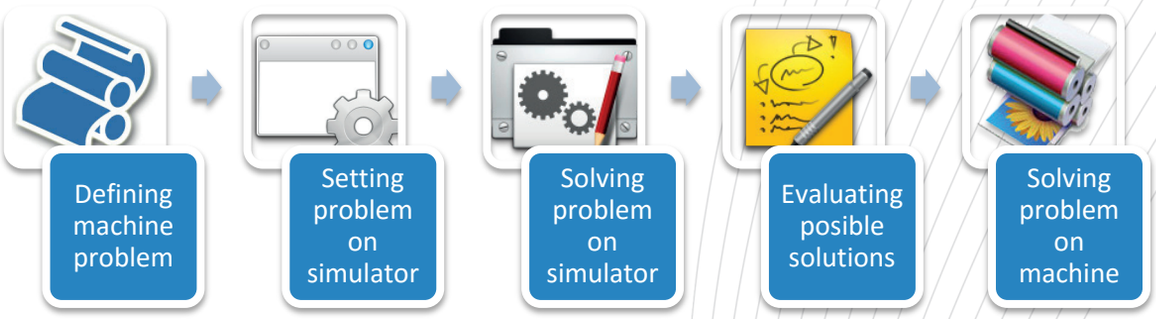


Figure 5 The concept of combining workshops and simulators for solving problems in production

3 Educational strategies

The global market and technological-scientific innovations change the business environment and requirements of participants in the industry who are now required to constantly acquire new skills, monitor trends and adapt to new technologies [1]. On the other hand, ICT innovations bring new learning channels and significantly transform the educational process by introducing the concepts of re-training and life-long learning [2,3,6].

The online graphic center is in accordance with Serbian and European educational strategies by stimulating open-education resources [6] and facilitating the life-long education of vocational teachers and university staff [2].

4 Conclusions

The main intention of the established blended learning environment is to reduce the gap between scientific research, educational outcomes and industry requirements.

The synergy of the distance learning model and the conventional workshops in a laboratory or an industrial facility supports several national priorities: better employability of graduates, easier job-specified re-training, better knowledge transfer between high educational institutions and vocational high schools, and stronger collaboration between educational and industrial entities.

Acknowledgements

This work was supported by the Serbian Ministry of Science and Technological Development, Grant No.:35027 „The development of software model for improvement of knowledge and production in graphic arts industry“.

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The relation between job design and job satisfaction in the context of knowledge sharing in organizations

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The objective of a human resource strategy is to manage labor and design jobs. Recent strategic human resource management practices introduced a broad, flexible job design and networked teams. This approach requires overlap of employees' knowledge as well as sharing of knowledge between them. The main assumption is that job design influences knowledge sharing through incentives. Knowledge management in organizations is manifested on four levels: processes, products, people and performance. Two implications of knowledge transfer throughout the organization are individual commitment to learning and adaptability. The assumption is that they lead to further improvement of competences of individuals, which leads to their job satisfaction.

Key words: job design, job satisfaction, knowledge sharing, knowledge transfer

1 Introduction

Today's business environment requires that all employees in organizations have to learn and adapt rapidly to changes in their organizational environment, because nowadays changes are rapid and unexpected and uncertainty in business operations is high. To achieve this, they must possess a number of new competencies required to act in such business environments: adaptability and commitment to learning, knowledge sharing and life-long learning which would enable them to adapt to unexpected obstacles and changes. Employees in organizations possess different levels of knowledge, skills and abilities and it is very important for leaders to recognize competences of their employees and use them effectively in order to improve organizational performance. On the other hand, job design matters to knowledge sharing for motivational reasons, in a way that jobs contain different characteristics which have different effects on individual knowledge sharing behaviour.

2 Knowledge sharing

Knowledge management in organizations makes an impact and is manifested on four levels: the level of processes, products, people and performance. Knowledge management at the level of people encourages and promotes learning among employees which leads to the fact that the organization is evolving and changing as a response to demands and changes in its environment, while the use of knowledge management concept increases flexibility of employees and their job satisfaction due to the increased ability to solve problems and coming to grips with new challenges.

Knowledge management is the process of acquiring, storage, sharing and applying knowledge. Sharing of knowledge viewed as an organizational process plays a key role in creating new business opportunities and generating new ideas [1-3]. Knowledge sharing is a process in which individual knowledge can be converted to understandable and practically applicable knowledge of other people. As a prerequisite for sharing knowledge, an individual or a group must cooperate with other members of the organization with the aim of knowledge sharing, which results in common benefit [4,5]. In other words, if knowledge is effectively shared, transmitted and communicated throughout the organization, this results in performance improvement of employees involved in the process, as well as improvements in overall organizational performance [6].

Knowledge sharing implies a voluntary act of individuals who participate in the exchange of knowledge with other employees, even though there is no pressure from the organization to do so, and can be seen as a composite and complex process that involves complex human behaviour [7]. The process of knowledge sharing often involves communicating tacit knowledge that can not be distributed and transmitted through formal channels of communication and for whose transfer can be expected only on a

voluntary basis. Taking into account all of the above, an organization can not effectively use knowledge without a proactive attitude of its employees towards sharing their knowledge and acceptance of others knowledge [8].

Organizations that aspire towards improving their performance should pay attention to the promotion and encouragement of learning and knowledge sharing among its employees. Three approaches that are used to enhance the process of knowledge sharing among employees are [9,10]:

- approach based on technology in which the modern information and communication technologies used to improve the process of sharing knowledge;
- approach based on simulations where material and immaterial reward strategies are used to encourage the sharing of knowledge between employees;
- organizational approach where organizational structure, processes and management style, or leadership, used to effectively and efficiently implement the concept of knowledge sharing.

3 Job design

Traditionally, job design has focused on the job itself rather than on the specific individuals who are to assume the job. Job design refers to identifying the relevant tasks and activities and allocating them across employees in a way that allows the organization to reap benefits from specialization, as well as bundling job tasks to take into account possible synergies between tasks. Jobs possess certain characteristics that have psychological implications, so the job characteristics theory states that three groups of core job characteristics activate the three critical psychological states [11,12]. The three psychological states that the relevant literature has focused on are:

- the experienced meaningfulness of the work,
- the experienced responsibility for work outcomes, and
- knowledge of the actual results of one's own work efforts.

The three job characteristics that correspond to these three psychological states are autonomy, task identity, and feedback, respectively. Autonomy concerns whetherthe job gives the employee the opportunity to decide when andhow to carry out specific tasks or, in other words, is the degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work andin determining the procedures tobe used in carrying it out [11]. A high degree of autonomy may allow the employee to free up time for learning and development [13]. Many studies have established the importance of job autonomy by finding positive relations between job autonomy and the proclivity to act proactively [14], personal initiative [15], and felt responsibility [14].

Task identity is the degree to which the job gives the employee the opportunity to undertake job tasks from beginning to end; it relates to whether an employee completes a whole, identifiable piece of work [11]. Identifying with one's job tasks is important for how meaningful the employee perceives the job to be, which has considerable implications for an employee's motivation in a given job [16].

Feedback is the degree to which the employee receives direct and clear information about performance on carrying out different job tasks. Receiving feedback on one's performance is a critical element of feeling competent in the job and is thus a strong predictor of motivation and performance [17]. The two types of feedback are one that is a characteristic of the job itself and the second one that stems from managers through practices such as evaluation or more informal verbal feedback [18].

4 Motivation

Motivation management can better be tailored to the specific needs of a particular job when different types of motivation are taken into account. Different types of motivations, however, may lead to different performance qualities [19,20]. Some work motivation theories distinguish between different types of motivation: notably, intrinsic and external motivation [21]. External motivation means that an individual engages in an activity to attain a positive or to avoid a negative external outcome. Typical external motivators include external rewards, such as money and praise, as well as avoidance of punishment. Individuals feel pressured from the outside when externally motivated. In contrast, intrinsic motivation involves doing an activity because it is in accord with the individual's intrinsic interest and personal values [22]. An intrinsically motivated individual is mainly absorbed in the process of doing an activity, whereas an externally motivated individual is concerned with the external outcome attained from doing the activity. Intrinsic motivation therefore implies that the individual is free from pressure and tension when engaging in a particular behavior [17].

To understand human behavior and its consequences more fully, we need an even more fine-grained motivation typology. An individual can internalize external demands such that behavior is self-regulated yet not intrinsically motivated, so we can define another motivation type, introjection, which occurs when an individual takes in an external regulation but does not accept it as his or her own [17]. An important hallmark of introjected motivation is to promote feelings of worth [23,24]. This behavior is no longer contingent on others' external rewards and punishments but, instead of that, an individual monitors and administers its own sanctions and rewards [17,19,22,24]. Introjected motivation is in accordance with the ought self-regulation of regulatory focus theory that is, the individual is not acting on verbalized expectations and demands but rather on how the person believes others want him or her to behave [25].

5 Commitment to learning

Fostering and promoting a culture of learning within the organization encourages employees to share knowledge with each other, that is to continually learn from each other. Employee commitment to learning, not only increases the competitive advantage of the organization, but also contribute to its success and [26]. Many conducted research on this topic: [27,28] have shown that the sharing of knowledge and commitment to learning have a significant impact on the competence and innovation resulting in the improvement of organizational performance. In other words, learning and personal development of employees drastically increase the innovativeness of their organizations [29]. Also, it has been shown that when employees themselves control the learning processes in the organization, there is a more effective and faster development of their competencies [30]. Results of these studies showed that expression of culture that promotes knowledge sharing and a favorable climate for knowledge sharing between employees leads to a higher level of commitment to learning.

6 Adaptability

Adaptability is the ability of a system to be changed to meet the demands and challenges of the environment with the use of existing resources and encourage the development of new resources, knowledge, skills, etc. Organizations can improve the adaptability on two levels:

- the level of employees: change in the attitude of employees, their professional development and changes in work organization;
- the organizational level: changing the organizational structure, change in the attitude of managers and leaders as well as their professional development.

Adaptability of an individual within the organization represents its ability, knowledge, skills, and willingness to change and innovate. Being adaptable and being able to learn quickly and effectively is a prerequisite to any employee of today's organizations [31]. Adaptability improves the competence of employees and this leads to their increased job satisfaction [30].

7 Conclusion

Job design influences knowledge sharing through incentives, as it was shown in many studies. As it was said before, job design matters to knowledge sharing for motivational reasons in a way that jobs contain different characteristics which have different effects on individual knowledge sharing behaviour. On the other hand, improvement of employees' competences through knowledge sharing increases their job satisfaction and can lead to benefits both on personal and organizational level. This is due to their commitment to learning and adaptability that are, on the other hand, implications of knowledge sharing and this implicates the link between job design and job satisfaction in the context of knowledge sharing. Many studies, e.g. [27,28] have shown a clear association between job satisfaction and creativity, innovativeness and effectiveness of employees. By sharing knowledge, employees come into possession of new knowledge and skills and at the same time are more committed to learning because they see it as both individual and common benefit so, thanks to new knowledge and skills, they become more adaptable to the challenges and changes in the organizational environment and perform their work competently and thoroughly.

Online license transfer

Acknowledgements

This paper is presented as a part of macro project "The Right for the First Chance" (P/N:114-451-2408/2014-02) funded by the Provincial Secretariat for Science and Technological Development of the Autonomous Province of Vojvodina

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Factors of Job Satisfaction/Dissatisfaction among scientists

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On a sample of 400 respondents, consisting of scientists working at the University of Novi Sad, a study was conducted by means of an on-line questionnaire based on the theoretical concepts of Herzberg's two-factor theory of motivation, with the aim of testing the attitude of scientists towards their job satisfaction. The main aim of the study was to identify key factors of job satisfaction among scientists working at University of Novi Sad.
The results indicate that job satisfaction is the highest when it comes to: the organisational structure of the parent Faculty in terms of good and timely information exchange, opportunities for scientific promotion, conditions for personal development, other conditions for work, perception of practical applicability of knowledge, perception of high level of personal commitment to work, possibilities of professional advancement and training.
At the same time, job satisfaction is the lowest for: tangible rewards, opportunities for personal development through the implementation of the Bologna Declaration, the evaluation of teachers by students, other benefits within university institutions, communication of scientific workers with the government and other institutions in the field education and science.

Key words: job satisfaction, attitudes toward work, human capital, scientists

1 Introduction

A number of scientific papers have confirmed that job satisfaction is one of the most precise indicators of the work motivation. Job motivation is conditioned by a range of correlated factors of variable relevance, depending on a series of objective and subjective conditions. Job satisfaction is generally considered from two standpoints. There are attempts to determine the factors conditioning the satisfaction on the one, along with the consequences the job satisfaction/dissatisfaction has on other attitudes, productivity and various other forms of the work, on the other hand. In the beginning, the studies of factors that lead to job satisfaction implied that there is only one general factor. However, an indisputable fact was verified later on, stating that there are numerous factors influencing the job satisfaction. The factors are interactive and change depending on personal traits of employees, socio-demographic characteristics, jobs performed, work situations, characteristics of the organisation and the level of life satisfaction in general.

2 Motivation to work

If motivation is defined as the process that initiates, guides and maintains goal-oriented human behaviour, a person's motivation is one of the most significant factors, able to a great extent, to organize, guide and influence the quality and intensity of employees in the work process. Work motivation is analysed on the basis of employees' satisfaction with particular job aspects, by studying the employees' attitudes towards individually analysed job segments [1].
One of the crucial issues in occupational psychology is understanding the relations between the outer (extrinsic) and inner (intrinsic) work motivation. Psychologists, as well as all those having knowledge of the human nature, emphasize the importance of the inner motivation, while those with only a superficial understanding of a person's attitude towards work, mainly recognize the outer work motivation only. A theoretic approach justifying the outer work motivation is found in the perception of an individual as a rational economic being, originating from classical, the so called machine theory of organisation, while the perceptions of an individual as a social being or perceptions of an individual as self-actualized person represent the theoretic approaches justifying the use of the inner motivation, originating from subsequent, the so called psychological theories of organisation [2].

3 Motivation – hygiene approach to motivation (theory by F. Herzberg)

In the list of books studying the job satisfaction, the most common starting point is the theory by F. Herzberg. Regardless of the fact that Herzberg established his theory in the late 50's of the previous century, when the positions on organisation management were much more different from the present day positions, a number of subsequent studies has been based on the fundamental principles of Herzberg's theory. [3]

According to this theory, the intrinsic factors causing satisfaction are associated with the job content (job, recognition, advancement) and they satisfy the individuals' need to prove themselves (need for accomplishments, recognition, responsibilities, personal fulfillment through the job nature itself and need for personal development and advancement, for self-actualisation). They are able to motivate people to work, have motivating needs and are referred to as motivators or job content factors. [4] These needs get satisfied only if a person holds a stimulating and challenging job position, engaging the person in an adequate manner. The absence of motivators still does not lead to dissatisfaction, only to the absence of satisfaction. Dissatisfaction is caused by another set of factors that do not arise from the very nature of work, but from characteristics of the environment in which the work is carried out, mainly referring to the physical conditions of the working environment, social conditions of the working environment (the management and administration system, interpersonal relations), safety at work, salary distribution, business policy and workplace status. These factors are called contextual factors (environmental factors) or hygiene factors, since they have preventive effect; they prevent dissatisfaction, but are not sufficient to cause satisfaction.

Table 1 Factors influencing motivation (F. Herzberg):

External factors (hygiene)	Internal factors (motivators)
Working conditions	Job purpose and content
Company's business policy	Achievement and success
Salary	Possibility of improvement and self-actualisation
Benefits	Advancement possibility
Management	Responsibility towards work
Interpersonal relations	Recognition

4 Intelectual capital

The human capital consists of the following human qualities: creativity, skills, experience, culture, motivation and ability of employees, human relations and cooperation with business partners. It is a driving force of the other values in the business system. [5]

In the current world, the most important factor in the development of a country is knowledge. The biggest competition among the companies and the countries is exactly in the area of knowledge. The most profitable investment in the contemporary economy is the investment in knowledge. Knowledge becomes a decisive factor of business success and the competitive advantage of contemporary companies. [6] Today, the most important countries in the world are the countries that have a high level of investment in education and science. Developed countries turn to activities that require less work, raw materials and energy, and as much wisdom and knowledge as possible. Knowledge, information, skills and innovation have become the main resources of the post-industrial society. [7]

5 The study

5.1 Problem of the study

The problem of the study was to identify those factors which scientists are the most and the least satisfied with.

5.2 Sample of respondents

The sample of respondents included the scientists employed at the University of Novi Sad, who entered all the data on their previous scientific results and personal and professional information in the scientific records, compiled in the electronic form in the database of the Provincial Secretariat for Science and Technological Development. The overall sample involved 400 respondents.

5.3 Instruments

A questionnaire designed by the author Željka Bojanić [8] was used to measure job satisfaction. It was developed on the basis of theoretic postulates of Herzberg's motivation-hygiene approach to motivation

(describing internal and external factors that influence one's job satisfaction). Several factors were selected according to which job satisfaction was measured. These included the following:

- internal (advancement, recognition, achievement and success, responsibility towards work and self-actualisation) and external (money, amount of salary, benefits, business policy, working conditions and interpersonal relations);
- willingness to accept changes (changes conditioned by the Bologna Declaration);
- evaluation and self-evaluation;
- organisational aspects of the University;
- business communication and exchange of information among scientists at the University of Novi Sad, as well as the exchange of information with other universities at the national and international level and other state institutions in the domain of education and science.

The respondents responded to questions from the questionnaire according to the instructions provided at the beginning of the questionnaire, by choosing one of the five alternatives provided along the summarised attitude scale. It is a Likert type of scale, which contains statements for which the respondents, by giving answers, express their degree of agreement and/or disagreement. The questionnaire that measures attitudes of scientists regarding their job satisfaction was distributed via electronic mail. It was presented in the form of a Web application, which contributed to the efficiency of responding, and answers were provided in a short period of time. Automatic update of database was carried out after completing the questionnaire.

5.4 Hypothesis of the study

The hypothesis was formulated in accordance with the problem being the subject matter of the study, and it reads as follows: "There is a correlation between the human capital features and job satisfaction at the institutions of higher education of the University of Novi Sad.

6 Results

Based on the integrated analysis of theoretical and empirical work on the factors of the job satisfaction of scientific workers, there are extracted core factors which determine the level of satisfaction or dissatisfaction with work of the scientific workers at the University of Novi Sad. The factors of job satisfaction, which have been confirmed as important for the scientific workers, generally belong to the group of internal factors, according to Herzberg's Two-Factor Theory, although the effect of external factors has been perceived as well.

Items:	AS	SD	Rank
...good and timely information exchange that leads to faster, better and more efficient results	4,65	0,76	1.
...practical applicability of knowledge for students	4,40	0,78	2.
...feeling of competence	4,39	0,87	3.
...opportunities for scientific promotion	4,29	1,05	4.
...conditions for personal development	4,22	0,98	5.
...communication of scientific workers with the government and other institutions in the field education and science	2,94	1,28	26.
...tangible rewards	2,87	1,36	27.
...acknowledge for good job done	2,80	1,32	28.
...opportunities for personal development through the implementation of the Bologna Declaration	2,79	1,19	29.
...evaluation of teachers by students	2,62	1,33	30.

The internal factors that significantly determine the job satisfaction of scientific workers at the University of Novi Sad are extracted as follows: opportunities for scientific promotion, conditions for personal development, perception of practical applicability of knowledge, perception of high level of personal commitment to work, responsibility for work.

Although the external factors are less important than the internal ones, there has been distinguished a factor that is slightly more important than the others. The distinguished factor relates to the organisational structure of the parent Faculty, i.e. Department.

Factors determining the job dissatisfaction of scientific workers mainly belong to the group of external factors. These are the following: tangible rewards, other benefits within university institutions, newly

introduced relations between students and teachers based on the implementation of the Bologna Declaration (such as the evaluation of teachers by students), communication of scientific workers with the government and other institutions in the field of education and science.
The first two factors are related to tangible rewards and other benefits within university institutions, while the other two are related to the relationship between teachers and students, based on the implementation of the Bologna Declaration, and lack of regular communication with other institutions in the field of education and science, which influence the work of the University and its institutions.

7 Conclusion

On the basis of all the findings of the research, it could be concluded that a lot of qualitative data have been obtained in relation to the job satisfaction of scientific workers from the higher education institutions at the University of Novi Sad. The results show that there are not enough incentives from the wider social environment for the development and promotion of intellectual resources of universities. Few scietific workers have the opportunity to participate in developing strategic documents, or in solving important problems of social development. Issues of the job satisfaction of scientific workers are very important, because the job satisfaction has positive effects on the achievement and work performance. There is a long time accepted principle that a satisfied worker is a productive worker. Hence, it may be concluded that job satisfaction is generally a significant factor in increasing the efficiency and creating opportunities for social advancement.

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Generating Conversion in Start-ups: To Brand or Not To Brand?

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Numerous studies have already indicated the relations between entrepreneurship and marketing, but very few of them offer guidelines to build a strong start-up brand. Branding is a matter of perception. It's not just affixing a name or a symbol to an offering – it delivers an added value to the customer, whether on functional or emotional level. By communicating with its stakeholders, the organization does not build the brand at the market, but in the minds of consumers in order to make them believe that their brand is superior to its competitors. Considering the fact that today everything goes branded, then why would start-ups had to limit their activities just to build minimum viable product (MVP) for minimum viable segment (MVS), and how branding can be *LEAN*?
The aim of this paper is to highlight the significance of brand strategy for start-ups as well as to find the connection between MVP and MVS, and *AARRR* strategy and *LEAN* branding, starting from the fact that *lean* means creating more value for customers with fewer resources. These assumptions are supported by relevant literature review, and the study findings are useful both to academic and professional communities, with particular importance and applicability for entrepreneurs and start-ups.

Key words: start-up, brand, entrepreneurship, minimum viable product, segment, marketing strategy

1 Introduction

There are numerous views of what the start-up really is, but the most often quoted definition is that "start-up is a temporary organization that is looking for a scalable, repeatable, profitable business model" [1]. Scalable start-ups are traditionally associated with technological entrepreneurship, where entrepreneurs start their business venture, believing that their vision will change the world and the created results will reach millions. In most cases, the large investment by "venture-capital" funds (also known as high risk capital) is necessary in order to achieve scaling.
The first phase in start-up development, the phase of *constitution* implies articulating intentions to start a business venture [2], [3]. The second phase, the phase of *consolidation*, is followed by recognition of entrepreneurial chances, gathering initial minimum sustainable team development and testing business models. The third stage – the *competition* is characterized by the provision of resources and the creation of organizations and applications for market competition – for start-ups this phase is characterized by the creation of minimum sustainable products, testing of initial demand and looking for investors to finance the investment with the aim of rapid growth. The fourth phase, *competitiveness* means the release of the organization on the market in a big way with a stable scalable product that can generate income and also meet the large demand. Considering its specificity, each stage requires a different approach, and success factors in the first phase are different from the factors of success in the following stages. The researchers van Gelderen, Thurik & Bosma [4] in their work emphasize that it is necessary to devote special attention to the second and third stage of creating start-ups. In order to reach the fourth stage, competitiveness, start-ups need to devote a special attention to their brand strategies. Following sections describe and emphasize the importance and the role of branding in launching start-ups.

2 Minimum viable team

The success of start-ups and subsequently micro, small and medium-sized enterprises largely depends on the initial team founder. According to a survey conducted by N. Wasserman [5], only 16.1% of start-ups were founded by one of the founders, while 17.5% refers to technology start-ups and 11.7% related to the natural sciences. More than one-third of start-ups have two founders and one quarter has three founders [5]. Although there are many reasons for self-launching a new business venture, a large percentage of founders decide to form a team of founders [6]. The reasons are tangible and often intangible. Tangible

reasons related to three types of capital founders can bring: human capital, social capital and financial capital. On the other hand, as one of the intangible reason, personal recognition i.e. personal brand of founder or potential co-founders have a significant impact on successfully finding a co-founder.

3 Minimum viable product vs. minimum viable brand

Minimum Viable Product (MVP) is a product that offers the highest possible return of investment (ROI) with minimal risk. The term was first defined by Fran Robinson, and then was popularized by Steve Blanc and Eric Reese. The concept of the MVP was developed with the aim to early target the early adopters to help organizations in gathering feedback, on which basis the following adapting and improving the product would continue. MVP is designed for first users - innovators, and most often early adopters who continue to guide the development of products by sharing their experience of using the product. MVP is actually a strategy and process that should support the faster development and entering the market of new products. The purpose of the MVP is to enable testing assumptions that the organization has, with minimum resource expenditure. MVP should encourage and accelerate the process of acquiring knowledge about the organization's customers and the business model. Although, at this stage the product is minimal, it must carry the distinctive values per se, the values of team founders, and the values of emerging start-ups as well.
In addition, the entrepreneurship and marketing literature and practice is familiar with a concept of *minimum viable brand* (MVB). According to Denise Lee Yohn [7], a MVB is comprised of the core elements of a brand that are necessary to ensure internal focus and alignment as well as external relevance and differentiation. A framework for defining and developing a MVB consists from the "6 What's" [7]:

- What we stand for? – *brand essence*
- What we believe in? – *defining values*
- What people we seek to engage? – *target audience(s)*
- What distinguishes us? – *key differentiators*
- What we offer? – *overarching experience*
- What we say and show? – *logo, look, and lines (messaging)*

3.1 Minimum viable segment and MVB

The MVB should be guided by the principle that *focus is essential for new product viability*. A brand should be positioned in a specific way to a specific target customer. Some entrepreneurs may fear that focusing their brand appeal will alienate potential customers – especially when market demand is unclear. But the exact opposite is true. When brands embrace and embody a clear identity and unique positioning, they attract people who are most likely to be loyal, high-quality customers.
One of the first steps in defining the future of start-up business is to define the target customer or target market. Many entrepreneurs who follow lean development methodology are totally focused on the development of MVP, and defining of *minimum viable segment* (MVS) is completely neglected. MVS essentially means focusing attention on the segment of potential customers who have the same needs and problems that organizations want to resolve and satisfy with a product that develops [8]. Defining the MVS and focusing on this group of customers is important because customers with divergent needs will tend to focus MVP in different directions and thus make it harder for the further development which would cause spending already limited resources which the organization has at this early stage. Also, another strong reason for defining the MVS lies in the references that an organization builds which are critical in the early stage of entering the market. If the users have the same needs and desires, the same organizations' solution will help in organizing the support. MVS is also crucial for the success of the market launching strategy – *Go To Market* (GTM) but also for the entire business model.

3.2 Growth strategy and MVB

Dave McClure, founder of 500 Start-ups, defined an *AARRR* model that is focused on monitoring and generating the growth. AARRR is an acronym for metrics that start-ups should follow in order to develop a successful business venture. AARRR stands for *acquisition, activation, retention, revenue* and *referral* [9]. Figure 1 (a) presents this model, with the description of five steps that users, customers pass in the process of generating value for the company. The value for the company not only that creates a transaction (income), but also generates the recommendations that satisfied customers are providing to their environment and through the creation of content for the organization as well.

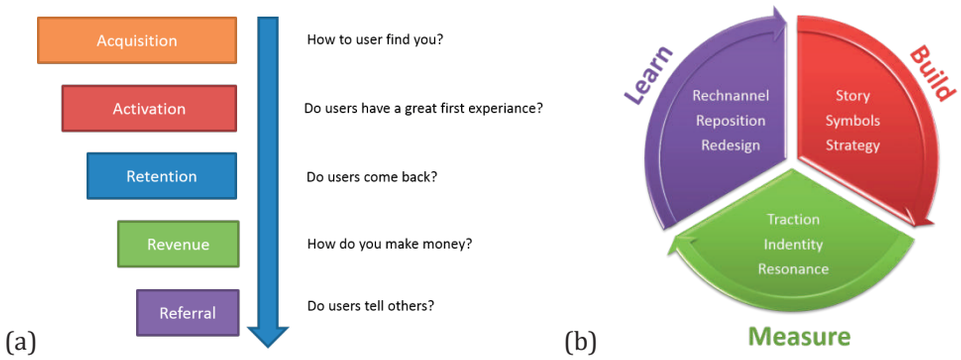

Figure 1 (a) AARRR model ; (b) Lean branding

3.3 Lean Start-up and Lean Branding

Lean branding is idea that just as products are never truly finished, brand as well must be committed to adaption and evolution. A brand is the unique story that consumers recall when they think of you, and lean principles have changed how we create, sustain and recreate brand. Entrepreneurial literature knows the concept of *build-measure-learn* [10] which represents the main activities in lean branding (Figure 1b):

1. *Build*.

Behind every great brand is a promise that fulfills its customers aspirations. When most people think about aspiration, they imagine long-term dreams or perpetual objectives. Human aspiration are opportunities for brands to build relationships. For start-ups, having a brand story is not optional, they must BUILD own story. To develop brand story, start-ups needs to answer to six questions from Table 1.

Table 1 – Brand story questions [10]

Brand story part	Customer asks	Customers really thinks
Positioning	"How are you useful to me?"	Why should I buy from you?
Promise	"What do you promise to do for me?"	Why should I buy from you?
Personas	"What do I need/want from you?"	Why should I buy from you?
Personality	"Who are you?"	Why should I buy from you?
Product	"What will you offer, over time?"	Why should I buy from you?
Pricing	"How much is this going to cost me?"	Why should I buy from you?

Human beings form a first impression of something online within 50 milliseconds [11]. Colours, words, images and their infinite combinations can be used to influence consumer perception. Minimal elements that will be needed by start-ups to create a brand experience are: logo, colour palette, typography, imagery and mock-ups.

Brand strategy is about reaching out, engaging and converting. Reaching to ears and eyes, hearts and minds, converting and making action. For brand communication, start-ups will use channels that are in line with MVS habits. For start-ups, key ingredients for developing communication strategy are: social media marketing, landing pages, search engine optimization, content marketing, paid advertising, email list, video, review systems, media relations, point of purchase optimisation and partnerships.

2. *Measure.*

Measure phase for Lean branding is something that is known as validated learning which Eric Ries introduced in *The Lean Start-up*, claiming that start-ups "exist to learn how to build a sustainable business. This learning can be validated scientifically by experiments that allow entrepreneurs to test each element of their vision" [12]. Brand traction is process of measuring the traction that each of communication strategy components generates for start-up brand. Brand/market fit align start-up core promise, positioning, product journey and personality with the aspiration of a specific set of buyers personas. People change, and their aspirations change, start-ups change focus on other market segment, and thus brands should be changed. Start-up brand visual identity plays a major role in the way how start-up will be recognized in the marketplace. To measure the effectiveness of start-up brand visual symbols in establishing a compelling, conversion-friendly identity, start-up can look at the level of

awareness, positive and negative affect, emotional impression, comparative advantage, feedback and conversion that they generate.

3. Learn.

With re-channelling start-ups are switching from one brand communication channel to the next to adapt to changing market conditions. Repositioning means pivoting brand story in response to changing market realities. Brand stories communicate the whole experience that start-up brings to the market. Re-design start-up brand means that start-up need to have dynamic brand with few basic elements and more space for creative freedom and adaptations.

4 Conclusion

A highly prevalent assumption which in many cases was a reason for start-ups collapse is the believing that they are just a smaller version of the big companies and that the principles of management and development of start-ups and large organizations are the same. Over the past ten years there have been significant developments of start-up movement that has significantly changed the view of the start-ups and the initial development phase of a new business venture.

In addition to define the minimum viable products and minimum viable segment, entrepreneurs recognized the trend in formulating and developing and minimum viable brand. Guided by the general principles of the brand strategy, with adjustments to the entrepreneurial climate, start-up companies can successfully build their brands as well. In order not to struggle to build passionate relationships with their audience, entrepreneurs and start-ups need to adopt and implement some of the lean key principles in their own brand strategies. On the road to success, models such as AARRR and *lean branding* will certainly help them. The lean branding is a very useful tool for building the relationship with audiences in a validated, iterative way. Start-up companies which operate into the old way miss out on the most crucial element for their success – which is a relationship based on shared value.

Future research on this topic should include a condition for formulating and implementing brand strategy in start-ups in Serbia, and then in all Western Balkan countries, followed by a comparative analysis of the use of marketing strategies in tested start-up companies.

Professionals and those who want to become one in the field of marketing and entrepreneurship, must know that great brands do more than just satisfy customers – they create passionate ones, just as the founders of start-up companies were when they launched their idea.

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Business Dynamics Simulator for Startups, SMEs and New Projects

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The aim of the paper is to show result of uses of the Business Dynamics Simulator on the population of the sixty students. The simulator helps in: (A) designing 5-years pro-forma financial statements for rapid business plan creation, (B) simulating strategic decisions to improve survival rate and support growth, (C) producing fundamental analysis and company/idea valuation, (D) fostering entrepreneurial education, training & research, in risk-free, enjoyable, realistic and interactive simulation environment.
The usability of Business Dynamics Simulator is tested on 40 students at Vern' University of Applied Sciences business school in Zagreb and 20 students of Founder Institute - world's largest entrepreneur training and startup launch program.
The main conclusion is that the use of simulators can improve entrepreneurial cognition by identifying the impact of resource bundling and the management of information to realize the opportunities that have been identified in the process of entrepreneurship.

Key words: business simulation, computer modelling, entrepreneurship, scenario analysis

1 Introduction

The aim of the project was to understand the business dynamics of technology startups and to develop an interactive learning environment to support entrepreneurs and SMEs managers. Managing successfully startups is a formidable challenge for people who do not have experience running businesses and well-developed management skills determining that only 1 in 5 firms survive after 5 years [1]. Our overall objective and vision is to improve the survival rate of technology startups by allowing entrepreneurs and SMEs managers to simulate various future business performance scenarios and growth strategies (e.g. cost optimization, capital raising, human resources management, part-time staffing, marketing and pricing strategies) in a safe environment prior making their strategic decisions. Using System Dynamics (SD) modelling approach the Business Dynamics Simulator provides a generic template in the field of entrepreneurial education, training, research and decision support for new companies, allowing them to simulate future 5-years pro-forma financial statements and business performance indicators, helping them to learn to cope with business dynamics complexity, evaluate diverse managerial strategies, make smarter future strategic decisions in risk-free, enjoyable, realistic and interactive learning environment.
Entrepreneurial cognition is defined here as the extensive use of individual heuristics and beliefs that impact decision-making [2]. Recent research on cognition indicates that entrepreneurs use heuristics in their decision-making more than their managerial counterparts in large organizations [3]. Consequently, they often make significant leaps in their thinking leading to innovative ideas that are not always very linear and factually based. Information is an important part of the new venture process, and as noted above, information that entrepreneurs use in the discovery process and in starting new ventures is often nonlinear in nature [2]. In the bundling of resources, entrepreneurs use their available information to make decisions to produce a product that utilizes the available resources in a superior and more efficient manner [4]. The information and its application and know- how are available to the entrepreneur through previous learning [2]. The information owned by the entrepreneur is deeply embedded, socially complex know-how of how to recombine resources and this know-how combined with entrepreneurial decision-making is a source of firm heterogeneity [2]. Consequently, the management of a start-up involves the bundling of multiple resources in a systemic way with limited information, which is influenced by the existing mental models and heuristics.

2 Methodology

Using SD modelling approach we have developed Business Dynamics Simulator for Technology-based Startups, SMEs and New Projects within existing firms allowing entrepreneurs to forecast future 5-years pro-forma financial statements and learn the business dynamics responsible for growth and development of their technology-based companies. Up to present, the business dynamics model based on accounting SD double-entry bookkeeping principle [5] have so far been tested with various stakeholders, in particular startups entrepreneurs and business school students.

SD engine core of the business model is shown in Figure 2 and business model user interface (desktop version) is shown in Figure 3. Similar web-cloud solution is also developed.

Business simulator consists of multiple modules sorted in two main categories: (A) financial modules (e.g. balance sheet, profit & loss, cash flow statements) and (B) operating modules (e.g. staffing, marketing & sales, branding, orders, product development).

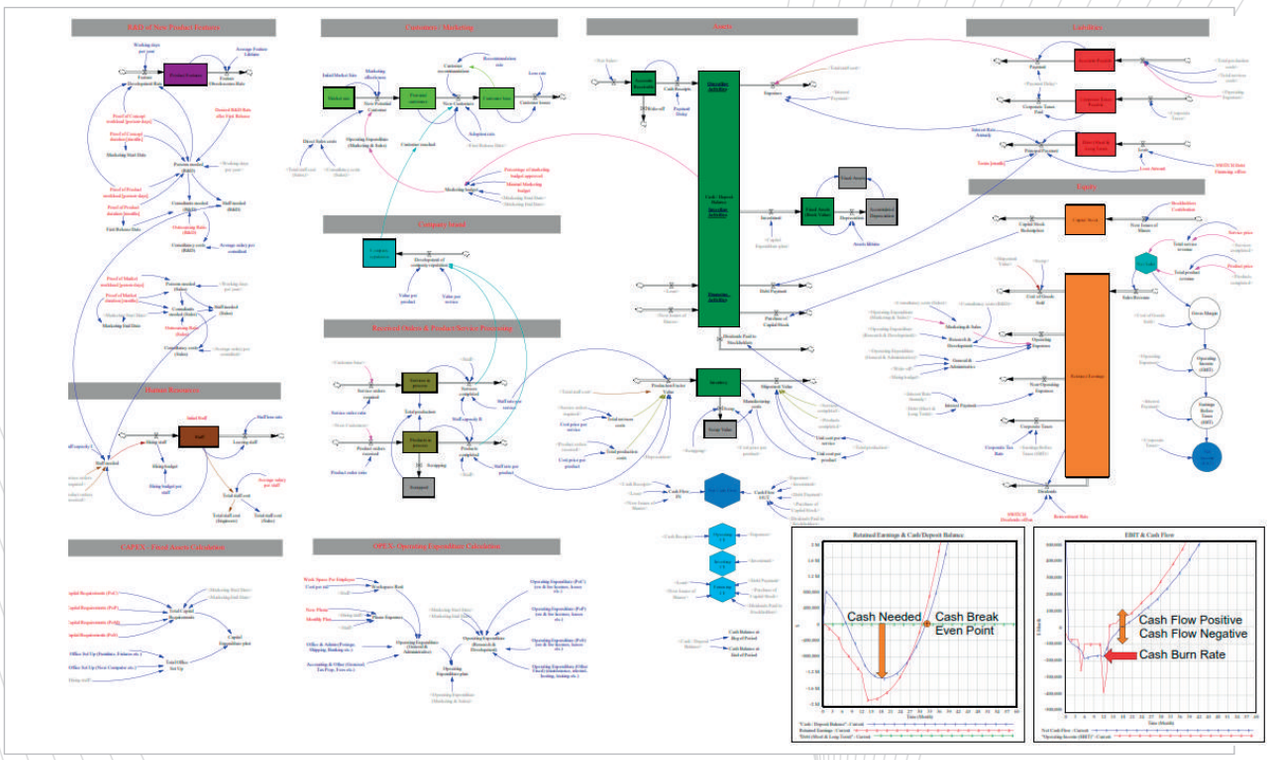

Figure 1 Business dynamics model core.

Applications of the business simulator are in business planning & strategic decisions making:

- it covers 6 functional capabilities: financial, marketing, production, learning, supply-chain, staffing,
- it allows pro-forma financial statement forecasting of: (using separate modules)
    - Balance sheet, Profit & Loss, Cash Flow statement (FIN),
    - Financial Reporting & Ratio Analysis (REP),
    - Business/Idea Valuation (VAL),
- it allows forecasting/projection & modelling/simulation of business operations & market dynamics:
    - Staffing / Hiring (STAFF), Market growth dynamics and Competition strategies (M&C), Product Development & Inventory (DEV), Production Planning & Costing (COGS), Pricing & Revenue (REV), Operating Processes & Expense (OPEX), Capital Expenditures (CAPEX),
    - it allows company valuation & investment optimization (INV) by answering e.g. How much cash do entrepreneur needs and when? What will be cash burn rate, when entrepreneur can expect cash breakeven point and positive cash flow? How does entrepreneur make money with it? What does entrepreneur or investor think the company is worth?
    - it helps in entrepreneurship Education/Training/Research, e.g. How to help entrepreneurs avoiding stagnation? How to prepare successors in family startups? How to prepare managers to continue the initial growth of the startup?

The most important graphical outputs of the model simulation are: Retained Earnings and Accumulated Cash Balance (stocks in equity and assets) shown in Figure 3A and Earnings before Interest and Taxes – EBIT and Total Cash Flow (flows around equity and assets) shown in Figure 3B. From these graphs it is

possible quickly to read Cash Needed for investment, Cash Break Even point, Cash Burn Rate and points when negative Cash Flow becomes positive.
Business model allows simulation in two modes: (A) simulation mode and (B) gaming mode. Simulation mode allows setting the model initial parameters and initial conditions and one-time running of the simulation for whole 5-years numeric integration period, while Gaming mode is more interactive and allows moving forward and backward in time: month-by-month, quarter-by-quarter or year-by-year and interacting with model parameters in theses time steps.

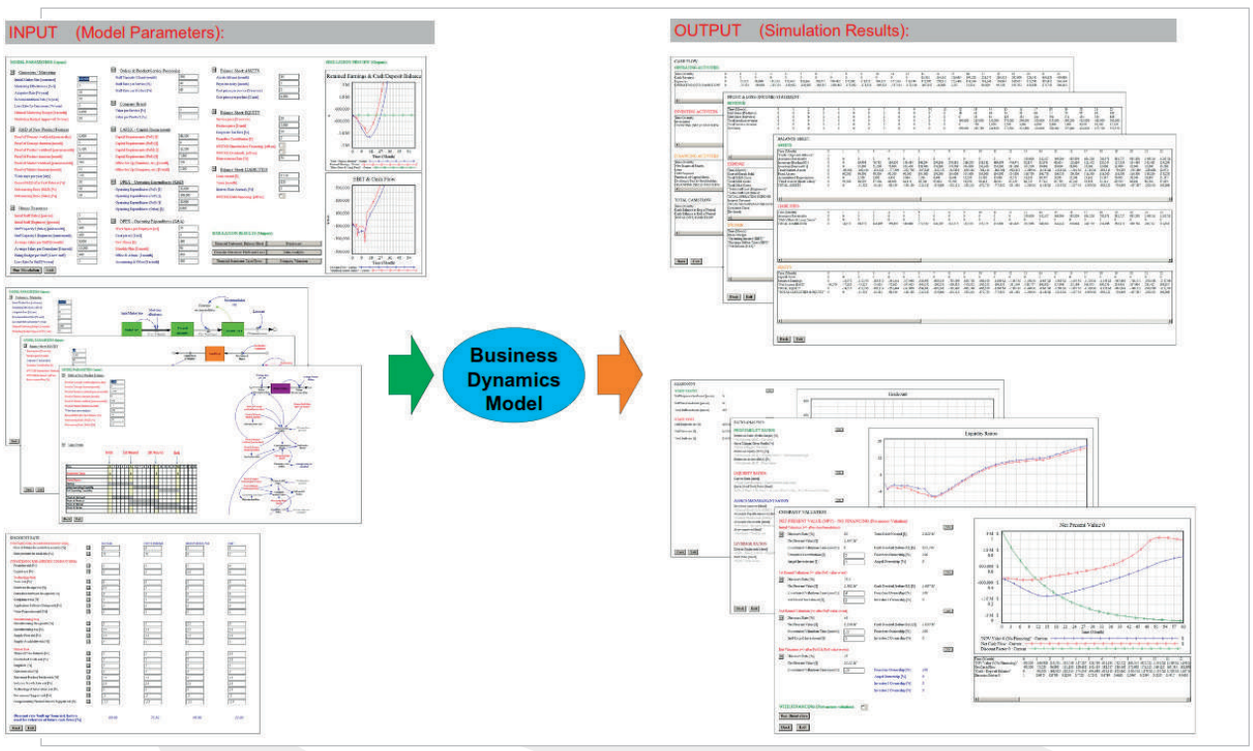

Figure 2 Business dynamics model user interface.

The business model is validated and initial model parameters are calibrated based on the real financial and operating data for startup called "Green Devil Control Systems Ltd." which are available in [6].
In purpose to test the experience with the simulator we have design an online Business Simulator Questionnaire for 20 students of Founder Institute and 40 students of Vern' University of Applied Sciences business school in Zagreb.

3 Results

The summary of the surveys of the online Business Simulator Questionnaire can be aggregated in following statements:

- 89% of future entrepreneurs would prefer a simulation of their future businesses.
- the biggest problem the future entrepreneurs see regarding a success of their future business are: (1) They don't know will this be profitable business or not and if yes, when I will be cash breakeven. (2) They don't know how much to price my product/service that the market will accept. (3) They don't know how to make financial projections for good business plan. (4) They don't know how much I have to invest and how much of ownership I have to give to potential investors.
- at the scale from 1 (I can't find any solutions) to 5 (I have the perfect solution and I am already doing it), the most of them value by 3 current solution to resolve these problems.
- the most of them (67%) do not plan to contact any business consultants (for business planning or market research)
- regarding the question how would other business simulation approaches help to solve their problem: (1) Own Excel calculations: for most of them do not help solving the problem. (2) Excel models developed by others: for most of them is partial solution, but still unsolved. (3) Business Simulation as a web-cloud service: for 40% of them would represent perfect solution and for 40% would represent also partial solution. The largest concert for them is estimation of model parameters for their future business.

- for most of them the idea of financial performance analysis & valuation of their own company/idea is significantly appealing.
- 100% of participants would prefer using business simulation software in entrepreneurial education and training.
- regarding the question what features they would require the business simulator to have the most important are: (1) Market dynamics (Market Metrics: Customer Aquisition Cost (CAC), Lifetime Value of Customer (LTC) etc.), (2) Profitability estimation (Net Income: Monthly, Quarterly, Annually), (3) Company / Idea valuation (How much your idea worth at current stage), (4) Gaming control (so that you can simulate your future decisions month-by-month, quarter-by-quarter or year-by-year), (5) Pricing strategy simulation (based on demand-supply curves), (6) and Wizard (e.g. 10 steps for building financial business plan).

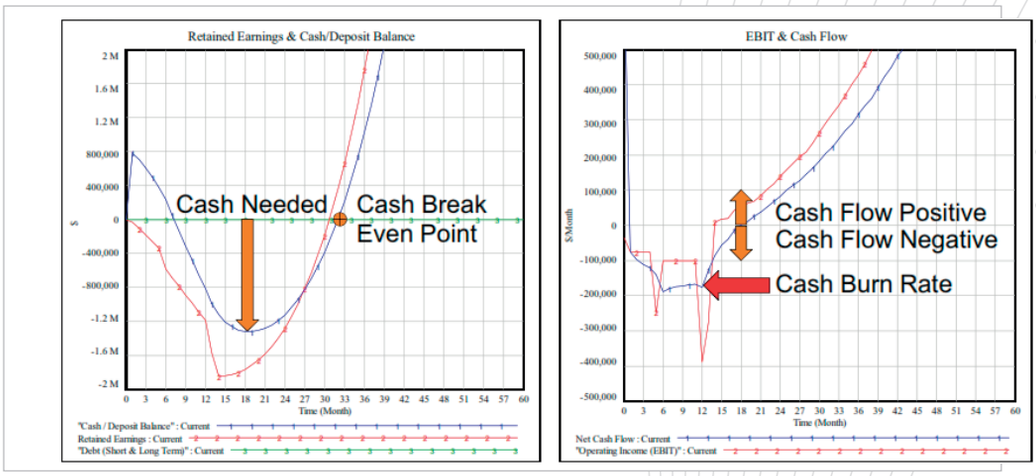

Figure3 Output example: (A) Retained Earnings & Accumulated Cash Flow and (B) EBIT & Total Cash Flow

4 Discussion and Conclusion

So far we have tested the business simulator on following users/stakeholders: (A) 20 startup entrepreneurs, students from Founder Institute (most of them without financial background) and (B) 40 students from Vern' University of Applied Sciences business school in Zagreb (with financial background). Based on our survey we can conclude that there is a significant demand for the business dynamics simulator for entrepreneurship in particular a domain of entrepreneurial education, training and research. Startup community is a bit sceptical and therefore besides business simulator a benchmarking for the model parameters has to be offered and the good resource for that is Startup Genome Report that annually offers referential business metrics for startups (e.g. churn rates, conversion rates, customer lifetime value – CLV, customer acquisition cost – CAC etc.). And finally the user expectation of the ideal business dynamics simulator can be summarized in this phrase – easy to learn, hard to master.
The use of simulators can improve entrepreneurial cognition by identifying the impact of resource bundling and the management of information to realize the opportunities that have been identified in the process of entrepreneurship.

Acknowledgements

We thank to Vern' University of Applied Science and Founder Institute for allowing us to test the Business Dynamics Simulator on their students.

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This project has been funded with support from the European Commission.
This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

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