Teaching and Research Synergy in the context of University-Industry cooperation

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EUI-Net

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FOREWORD

IT is obvious, without teaching no research, as we understand it today, but nevertheless for that same reason there will not be much to teach without research. A quarrel where the emphasis should be laid, either from an a priori or an a posteriori perspective, may be an interesting subject for some quality amusement, but for a more constructive or practical understanding of the advancement of knowledge as reached and passed through either horizontal to collaborators and colleagues in the field and elsewhere in the academic community or vertical to a next generation and the rest of society it might be better to learn what happens in the practice of both where however the demarcation, for that matter, between them often is not so clear at all. The aim of this learning is not to report another epistemological earthquake, but to gain sufficient necessary reflective substance to compose suitable models for comprehension aiming to know possibilities for practical improvement.

THINKING and talking about nowadays' research needs the understanding right from the start that research is not a prerogative of the academic world. High quality and advanced research is carried out in many companies and already this urges to cooperation between enterprises and universities towards a mutual benefit. Apart from this also the place and role of universities in society as the incubation spot as well of talented young people of which many will become a vital part of the human resources in enterprises urges to safeguard the collaboration between universities and enterprises and to improve it where needed so. The grasp of this has also lead to a next start in the agenda of university-enterprise cooperation by establishing an ERASMUS thematic network in the autumn of 2004 called EUI-Net.

INQUIRING and exploring the synergy between research and teaching and especially within the practice of cooperation between universities and enterprises has been one of the special interests of EUI-Net. Its management team has decided to organise a Workshop devoted to this theme in Tallinn, the beautiful capital of Estonia. The Workshop on Synergy between Research and Teaching has been held accordingly on 4 – 6 May 2006 where a manifold of aspects of this subject has been brought up in many discussions and 42 papers from all over Europe have been presented and published in the Workshop's Proceedings. From these papers and discussions a selection has been made to first outline the teaching and research synergy, secondly to show how research results are and have been integrated in teaching, and thirdly to present university – industry cooperation models in which the synergy between research and teaching is manifest as good practice examples. This selection is presented now in this book, being a next result of the initiative called EUI-Net.

STARTING with four chapters as a first section in the book an identifying survey is given of university – industry activities in which a synergy between research and teaching is present. The complex environment of university – industry cooperation needs to be examined first on the parameters that make, for that matter, also synergetic effects and synergy processes in this environment complex. To carry out this examination in an analytical systematic way a synergy model has been proposed based on an identifying elaboration of a work definition of synergy at different levels in this environment. Next two cases are presented to illustrate in which way synergy between research and teaching is actually effective in the knowledge transfer to students. A study on the awareness of students regarding research in the teaching they enjoy is presented, and also a practical way to introduce students into research work is reported. In the concluding part of this section of the book a few initiatives are described for accommodating the constant demand for innovative ways of knowledge creation and sharing between a university and its industrial partners.

GIVEN this set-up, in the five chapters of the second section of the book cases are presented how to integrate research results in teaching. The continuous progress of technology implemented for the improvement of learning and training raises also the need to reconsider traditional styles of education. New ways to integrate research or research results in teaching are than also to be investigated on their usability. Also cooperation not only with enterprises, but also between universities is needed to acquire sufficient expertise also to integrate research results in teaching. And this brings knowledge management in focus as well. The new ways to integrate research results in teaching make universities also to face new challenges in restructuring their curricula, as do as well today's job requirements due to a continuous change in engineering that at least impose an upgrading and updating regularly of the content of engineering education.

OBSERVING university industry cooperation models has been reserved to the twelve chapters in the last section of the book. The first case and chapter presents the Romanian experience of university adaptation to an international environment and modern academic standards especially with regard also to industrial needs in a upcoming economy. This is a model that gives also much information of starting modernisation possibilities of traditional academic structures. The following chapter reports a Greek model of cooperation between university and enterprise staff especially in an EU (projects) context. Also in this case the model gives information how to improve cooperation possibilities in a rapid developing economy and with an impetus from the EU. The mutual engagement of university research and enterprises' daily working practice is more closely watched in the next chapter. This model shows good possibilities of enhancing creativity impulses and knowledge transfer from universities to enterprises. An even closer look to this engagement is given in the following chapter, focussing on the field of Operations Management, with an analysis towards current requirements and possible needed changes for the development of academic careers. Than, a chapter follows in which the creation and development of long-term sustainable relationships between universities and enterprises to their mutual benefit is regarded, and as a case the relationship between university and the automotive industry is presented, and also their critical success factors are determined.

OFTEN 'occasional cause' to develop further university-industry cooperation in an integrated way is student practical placement as part of completing a study, as well from a point of view of education and training, as also from the point of view of Human Resources Management. Several ways of cooperation schemes as offered in the Bavarian model are presented in these views in a next chapter of section three of the book. The following chapter shows an elaboration of these views focussing on a collaboration of a High-Tech company with a university serving in an area of a rural population by which new labour and career possibilities exercise a stimulating effect on the young. From the perspective of the various needs of modern society a next chapter and case is presented also to follow the transition of the traditional university into an entrepreneurial university. The concept, models and instruments of the entrepreneurial university are discussed. Than, in the following chapter, the focus is entirely back on student placements, but now viewed by more practical organisational perspectives within a good practice model and also in the context of European student mobility.

DISCUSSING student placements and university – enterprise cooperation in an Eastern- and Western European model and introducing a new technological model for interleaving and rendering a student's academic and employment profile as a modern information tool form

the closing part of the book's third section. By now a clear pathway has been created to understand especially in a practical view the synergy between research and teaching on which also models and cases of good practices have been marked and valuable suggestions to enhance cooperation between universities and enterprises in this modern era have been given.

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PART I. TEACHING AND RESEARCH SYNERGY

Chapter 1. Teaching-Research Synergy and University-Industry cooperation in the knowledge based society

Doru Talaba

***Abstract*—** *Starting from the identification of the relative position, missions and flows of activities within the University and Industry sectors in the knowledge based society, a systemic representation is proposed as a starting base for a first synergy definition and identification. Based on the proposed model, the synergy is systematically analysed as a separate issue, at different levels at which it can be identified. The cooperation with the enterprises creates a more complex environment with more parameters that makes more complex the synergetic effects and synergy processes. To cope with these new challenges, the entrepreneurial university is presented in the context of the knowledge based society and the EUI-Net approach to facilitate this new journey for the university.*

I. INTRODUCTION

THE word "synergy" comes from the Greek "συνήρχία (sunergiā)", which means cooperation, derived from "{συνήρετέω} συνήρχος (sunergos)" - working together. The modern meaning is "the interaction of two or more agents or forces so that their combined effect is greater than the sum of their individual effects". That is – the *enhanced* result of two or more people, groups or organizations working together. In other words, one and one equals three!

Starting from these definitions one can say that, out of the input "terms", the synergy itself is something additionally, which normally, should be possible to be identified in the chemistry of the synergetic process.

A sector of the society, which involves two different types of activity, is the Higher Education. The two principal activities are *teaching* and *research*. It is of course of highest interest to know and understand whether a synergy between these processes could exist and what are the mechanisms that govern this effect. However, although

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it is almost unanimously recognized that synergy between teaching and research is very important and exists in many forms, there are very few studies that systematically analyse this issue and almost inexistent frameworks in universities to explicitly stimulate the synergy between teaching and research.

This paper aims to identify the synergy between teaching and research in higher education, in particular in the context of the University-Industry cooperation. As a result, appropriate mechanisms could be designed and put in place at the management level.

There are many ways in which synergy between teaching and research could be regarded and therefore identified. For example it could be approached as "the research added value in the teaching process" or vice-versa, "the teaching added value in the research". As far as the "added value" is concerned, it could be expressed in terms of technical adds on or in terms of financial advantages and so on.

On the other hand, synergy seems to be an additional effect that results from putting two independent entities together. Stitching to the "chemistry" metaphor, when two substances are combined, this takes place in a common environment that could be a test tube or a special recipient. In our case, while the two ingredients are clear (teaching and research), the "common environment" could be the **teacher** that carry out research, or alternatively the **learner** that is carrying out also research (we count here mainly the PhD students but also the students at Master level could be considered). Therefore, another issue that is worth to be studied is the synergy between teaching and research at the level of university professor and at the level of student-researcher.

All these aspects will be studied in this paper in a systematic manner in an attempt to provide a picture of what the author perceives today as being encompassing by the synergy between teaching and research. And when this picture will be clear enough, another ingredient will be added in the chemistry that is "the cooperation between University and Industry, which is anticipating it will again make the picture fuzzy. Therefore in the last part of the paper we will try to clarify what is the relation and what synergy could be generated in the presence of this third "ingredient".

II. FUNDAMENTAL QUESTION: WHY TEACHING IN HIGHER EDUCATION IS TRADITIONALLY ACCOMPANIED BY RESEARCH

To answer this question one needs to answer first to other fundamental questions as "WHAT is supposed to be taught in higher education", "WHO is the most qualified to do it", "WHERE is the most appropriate place for it" and so on. Then other questions from this series such as "WHEN" and "HOW" may lead us closer to our target, i.e. the teaching and research synergy meaning.

To answer these questions, an important observation is that both research and teaching are related to **knowledge**. The main function of research is to generate new knowledge, while teaching main function is to prepare and disseminate knowledge in the society, both existing and new knowledge. Traditionally, the Universities have been regarded as places where the newest knowledge is available and how can a University best demonstrate this if not by producing it self some of the knowledge, if possible the most relevant one for its own teaching? If we assume that knowledge is

the "product" around which the University "business" is organized, then the model we look for becomes clearer: research is the "production process" of knowledge and teaching & learning is the "marketing" of knowledge. Starting from this model, it is clear that the two processes have been organized together in the first Universities and this continued unchanged until modern times. The lack of change comes mostly from the very conservative nature of the old universities that over the years gathered another specific item that is the "tradition".

Of course, in our times of sophisticated business models, one could argue that the two processes could be perhaps better organized apart since they are not very linked. For example the professions of Teacher and Researcher became nowadays too different in their nature and it has been demonstrated that very rarely the good researchers are simultaneously good teachers and vice-versa; another argument from the management point of view could be that both teaching and research could be better organized is the two processes would be apart and so on. All these debates have been exacerbated when the idea of "entrepreneurial University" appeared and increased the complexity of the problem as a whole.

III. Different Synergies between Teaching and Research

The synergy between teaching and research is not an independent item but rather a mutual enhancement in quality, effectiveness, profoundness and even from financial point of view. For this reason, when analysing the synergy, this should be done both from the teaching point of view and research.

A) Teaching: the research added value

A multi-university project developed in UK [2] has led to important new interpretations of the links between teaching and research. The project investigated the nature of scholarship in relation to the advancement, synthesis, and application of knowledge. Results from the project suggest that at the curriculum level, the integration of research, teaching, and learning comes in a multiplicity of ways:

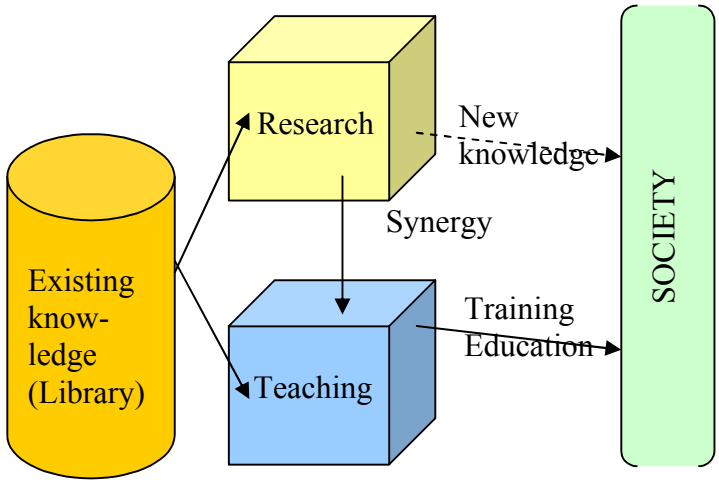


Fig.1

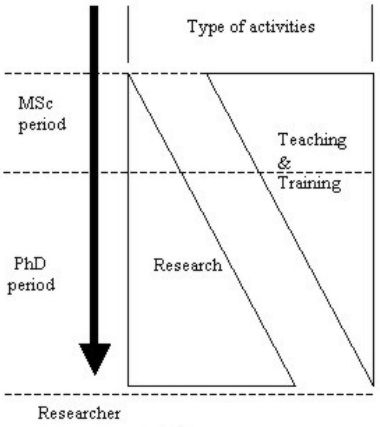
- The introducing of new knowledge resulted from research into curriculum, having thus the possibility to present not only what is already done in a subject but also the prospect from the research point of view.
- Visibility of staff research activity to students;

- ♦ The extent to which student learning mirrors research processes;
- ♦ The ways and extent to which student research competencies are develop- ed and assessed.

Earlier research [2] had demonstrated that students value learning from research active staff. The project has extended this understanding to suggest that students benefit from research processes and skills, and from developing and understanding the complex relationship between research, application, and knowledge. Synergy between teaching, learning, and research opens up new avenues for thinking about how the learning activities of staff (research) might be brought into closer interaction with the learning activities of students through teaching.

B) Research: the teaching added value

Research seems not having special direct benefits from teaching out of the securing human resources needs, as it is the case for any other kind of business sector. However, it is obviously that an effective training of researchers could not be done without a strong professional research environment within the universities. Although training of researchers is still following the traditionalist model of master-disciples, schools around traditions etc, there is a level of postgraduate study where teaching is very much alternated with research. i.e. MSc studies. Indeed, MSc have become the necessary entrance stage for any future researcher. Perhaps at this level, the synergy between teaching and research has the highest intensity since both types of activities are included into a unique programme meant to prepare the postgraduate students for the future profession of researcher.



The last stage of preparation for a research career is of course the PhD, which is still a training period, in which the student is gradually undertaking research tasks in a focused team, finishing by presenting finally a complete scientific approach that demonstrates his qualification at the end (fig.2).

C) Teaching and Research synergy at institutional level

A number of universities, especially those that claim to be research-led are directing their attention to ensuring that links between teaching and research are made explicit, and are incorporated into undergraduate as well as postgraduate courses. It seems that increasingly institutions are seeing the potential for using research in various forms as a way to improve teaching and learning. Some of them have already a clear strategy for this purpose that includes a variety of measures such as [2]:

- evidence-based teaching and research;

- a learning environment which values research;
- greater emphasis on the project element of the undergraduate programme;
- research training for undergraduates;
- the development of taught postgraduate programmes within research centres;
- pedagogic research and its use in planning teaching and learning.

Another aspect concerns the logistics: when teaching and research is organized in the same institution (i.e. in Universities), from the logistic viewpoint, very often, equipment and other infrastructure elements that was developed for research purpose is transferred to the teaching process after the research objectives have been reached or sometime even before. This is a kind of synergy that is very often taken into account and planned even from the early stages. The synergetic effect is clearly measurable in terms of funds that are saved in the area of teaching and become available for other purposes. This synergy allows teaching and research sharing some costs that otherwise could perhaps prevent some research to be funded or the teaching to benefit from the appropriate infrastructure. It is already a practice in some universities that, when seeking approval for redesigned courses subject the teaching teams have to demonstrate how the synergy between research, teaching and learning is achieved at both technical and financial level.

D) Teaching and Research synergy at the teacher level: the dual nature of an academic

At the teacher level, the synergy between teaching and research is nowadays very questionable. It seems entirely plausible that heavy involvement in research and publication, takes time and effort away from teaching undergraduates. Therefore, a balance between the two activities is practically impossible to define. Unfortunately, in most cases as soon as the research results are excellent, the way staff involvement in research enhance quality or effective teaching and the issue of what is quality or effective teaching is left implicit [7].

One can say that the academic staff are facing an eternal dilemma that is best expressed by the question "Teaching and research or Research and Teaching?" Indeed, even making only a qualitative choice is a matter of crucial strategy for a teacher. In any case, the teacher is very often unhappy about the unavoidable unbalance between two aspects. Perhaps instruments like sabbatical year are meant just to help re-establishing the balance between these two natures of an academic. In [5] it is suggested that a good practice would be to "… encourage staff to use sabbaticals to develop research based or research-led teaching".

"… although curricula may offer students the chance to be taught by eminent researchers, pressures to maintain a research profile may well limit student access to these researchers" [5].

Balancing teaching and research is a very challenging task. According to [8], optimisation of staff time can be achieved *only if there is explicit management strategy* that promotes the interdependence between teaching and research. The effective allocation of time could stimulate a *synergistic* relationship between teaching and research by enabling staff to engage in each activity at a level which enhances both activities. According to [8] the main advantages of integrating research into teaching are:

- The teacher is able to give accurate and up-to-date information to students with relevant examples rather than second-hand knowledge from textbooks.
- The teacher's research is also beneficial when presented and opened to challenges from students. This could in turn stimulate new research directions.
- Teaching could be a recruitment platform for attracting students with a passion for research. This is especially important in the science and engineering fields where students form the backbone of the research undertaken.

E) Teaching and Research synergy at student level

Synergy at the level of students should be discussed separately at undergraduate and postgraduate levels. While for postgraduate level, the synergy is very rich as the learner is in a transition towards the status of a qualified researcher as it has been illustrated in fig. 2, at undergraduate level, the student participation in research is more reduced and therefore the synergy is at a lower level, being done in principal with the purpose to train students to become independent learners. The most used forms of involvement are:

- student participation in research events (e.g. seminars, lectures, conferences and colloquia);
- undergraduate and taught postgraduate involvement in staff research;

However, some authors suggest [2] that it would be a mistake to expect students to engage too early in research.

IV. TEACHING AND RESEARCH SYNERGY IN THE CONTEXT OF UNIVERSITY – INDUSTRY COOPERATION

IN modern times, the university social environment is significantly enriched, new actors being articulated to the system. The most important one is perhaps the enterprise, which on one hand is playing the role of the engine of any economy and at the same time is the main consumer of knowledge. The enterprises creates such a high need for new and much diversified and often targeted knowledge that it was impossible for the universities to meet this need. In this context, a more specialized entity appeared, i.e. the research institutes. In contrast with the Universities, the research institutes are more business oriented, "producing" knowledge almost exclusive for direct marketing. However, the lack of synergy with other activities like teaching in case of the university makes their costs sometime very high.

A) The modern context

In this relatively recent context, the university has to adapt its position and approach to a more complex structure of the stakeholders (fig.3). First of all, a more sophisticated relationship is continuously established with the enterprise sector, which became at the scale of history "overnight" the main stakeholder that needed both new knowledge and qualified human resources. While the market of "new knowledge" had to be shared with the Research institutes that are better positioned to "produce" knowledge for immediate use, many universities remained with the teaching as the main activity, while research was kept on the second plane.

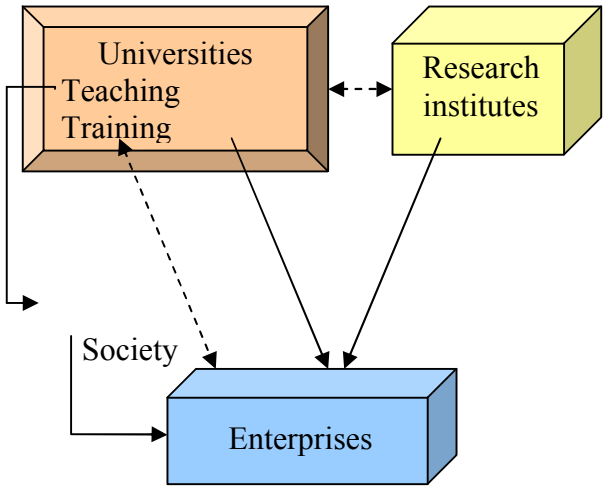


Fig. 3

However, increasingly the universities are better and better positioned on the market versus the research institutes just because of the synergy between teaching and research allows them to offer much competitive prices for the new knowledge generated and delivered. Unless strategic alliances are made with universities, looking forwards to take advantage just on teaching& research synergy, the research institutes have more and more difficulties to cope with the efficiency requirements from industry. To illustrate this situation one should only mention that the overheads headings of the research budget is between 3…7 times greater at the research institutes (usually being at 100%) than overheads rate at the universities (max 20%).

A dramatic experience that demonstrates the effect on the universities of loosing contact with the industrial sector was the case of countries from the former communist bloc where the transition from communism back to the capitalism changed radically the enterprise sector. Everything changed, from the owners to the people, their mentality and many times even the type of activity, production, destination etc. During this famous "transition" phase (which for some of the countries took place 10…15 years), there was no demand of any kind from the enterprises sector; therefore the universities crossed a reform period without the industry flagship. In this context, it is obviously that in the new EU member and candidate countries, the big changes in higher education are currently only at the beginning.

B) The university and its stakeholders

The future an enterprise in a globalised economy depends critically on innovation and its ability to increase productivity through process innovation. Innovation itself depends on the creation, application and diffusion of new knowledge. Since an advanced economy can only compete by creating new product and technology, the creation and diffusion of the knowledge on which this is based has become a factor of utmost importance.

A significant part of the knowledge is produced in the academic research sector. New knowledge and ideas, generated "for the sake of the art", i.e. remaining separated from innovation, are economically worthless. As research achievements they may result in scientific reputation, but for the economic system remain of negligible relevance. In a globalised economy, when the governmental funding has become chronically insufficient, Universities cannot afford to ignore this aspect and remain separate from industry. Therefore a fundamental changed attitude is

needed, as well as new schemes of cooperation, which should be attractive for the enterprises. The production of new knowledge has therefore to be integrated into the mainstream of economical resources. This requires a structural connection between the universities and economic systems of society. The traditional division of labour and functions between academic science and academic teaching and industry (applied research, development, innovation) seems to be already obsolete at least from the university point of view.

C) The entrepreneurial university – the new role in the knowledge based society

Since the 1980s, Higher Education in Europe has had to respond to increasingly complex and varied needs of society. The economic progress of the society and a reconsideration of its theoretical background has directly affected the university sphere. Accordingly, higher education must face a number of new problems. First, the demands of society are such that higher education institutions do not have sufficient capacity to respond. On the other hand, cuts in public spending have meant fewer funds for the University and even the existing funding is increasingly subject to the outcomes produced. The concept of Accountability has appeared, and this means that universities are required to justify themselves to society. All this is aggravated by the fact that knowledge now exceeds resources and this has created a huge pressure on the universities to market the new knowledge they traditionally produce.
Faced very often with institutional inefficiency, the response of many universities has been to adapt to the circumstances and develop an entrepreneurial response. The entrepreneurial attitude is seen as one of the possible solutions for the university to cope with the ever increased complexity of the economic mechanisms. This means that the university should foster on the application of the new knowledge through *innovation* in order to take full advantage of its creation. According the definition [6], in order to become entrepreneurial a university should focus on the application of new knowledge i.e. innovation and this could be approached in three possible scenarios:

1. to transfer the knowledge to incumbent firms;
2. to transfer the knowledge to individuals starting a new firm;
3. to establish a new firm by himself.

Of course, the keyword here is transfer of knowledge. Various success stories from Asian countries and USA could be evocated to illustrate the theory: the industrial platform model (very successful in Taiwan for example), the entrepreneurial model of Stanford (Silicon Valley) and MIT, where the application of knowledge is an essential part of the institutional mission and is very careful assessed and explicitly encouraged etc. These success stories are examples of technology transfer by using the university as fertile field for industrial platforms creation. We will call this a **top-down** approach since it is based on the principle of creation of a hyper-innovative environment, able to feed continuously initiation and rapid grow of new businesses.

Entrepreneurial activity has traditionally occurred at 2 different levels within

universities:
(i) Individual activities of teachers and students:

- consultancy,
- grant acquisition,
- firm creation

(ii) Entrepreneurial universities = Organisational entrepreneurship with the following features:

- Support services for individual activities
- Professional education
- Real estate and other financial investments
- Commercialisation of tuition
- Excellence in research and education
- Consultancy
- Community service

D) Teaching-Research synergy - a key factor for the entrepreneurial university

In the entrepreneurial university, teaching and research synergy takes other valences. As showed earlier, a first step towards the entrepreneurial university is the strengthening of teaching in Entrepreneurship subjects at all levels and creating a real entrepreneurial internal culture, which is of crucial importance for:

- Helping research reorientation towards more feasible and marketable topics and contracts with industry
- Helping research to turn into real solutions able to produce entrepreneurial opportunities.
- Grant acquisition both for research and education innovation
- Innovation and technological transfer, especially through firm creation and spin off companies

This kind of measures is likely to transform the internal mentality in a university, towards an entrepreneurial approach.

V. NETWORKING - AN ENTREPRENEURIAL ROUTE FOR THE UNIVERSITIES IN THE KNOWLEDGE BASED SOCIETY

IN response to the ever demanding environment and the need for change, the author estimates that a solution in university sector is networking. This is clearly improving the opportunities for cooperation, business opportunities, synergy between teaching, research, business, grant acquisitions and links with the enterprises.

A) EUI-Net

EUI-Net network is directed towards opening a new cooperation framework between universities and enterprises. It aims for a level of cooperation characterized by structured institutional arrangements and the emergence of new patterns of academia-business interaction. A significant feature targeted at this level of

cooperation is that, while it attenuates the boundaries between universities and industry, it should also blur the boundaries between teaching, research and consulting activities, creating an interdependent organizational environment. This level of cooperation is more than simply university and industry cooperation, it should represents a shift toward collaboration within integrated knowledge systems. a possible model of which is presented in fig.4.

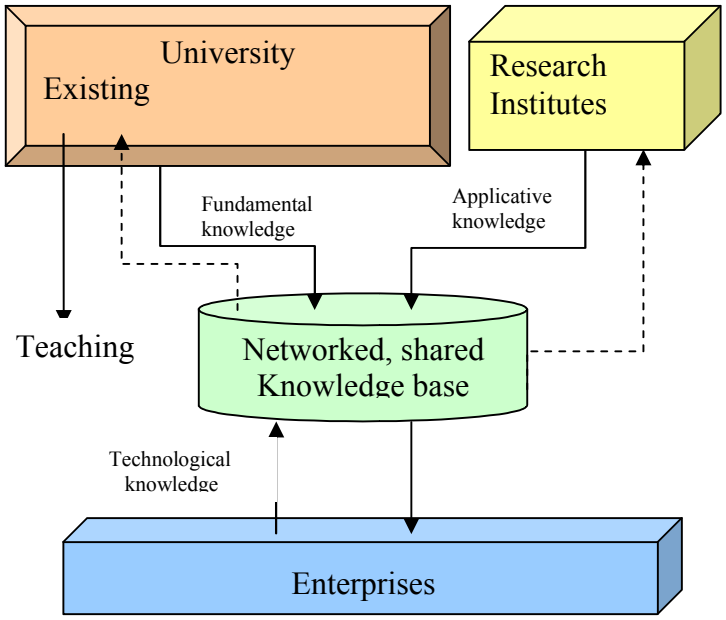


Fig. 4

The first stage of the EUI-Net was to set up its structure, to carry out its first fundamental debates (e.g. on teaching and research synergy), to carry out the first pedagogical projects on Tuning curriculum. This is going to be completed in the first three years. The second stage of the EUI-Net existence is the creation of the background and tools for real interaction between university and enterprises sector, in an entrepreneurial environment able to stimulate the entrepreneurial behaviour of the university in the context of the knowledge based society. The main idea in support of this objective is the creation of a fertile framework and tools for breeding and harvesting the entrepreneurial opportunities.

The initial partnership constitution of the EUI-Net demonstrates that both actors – University and Enterprises sectors – are aware about the necessity of networking and this is an invaluable starting point. In the second stage EUI-Net will expand, especially the enterprises component by including as much as possible micro enterprises and SMEs, which constitute the motor of the European economy. It is estimated that the ideal composition of the network would be of approx 1/3rd universities and 2/3^{rds} enterprises in order to secure a sufficient background for cooperation.

*B) A **bottom-up** approach: University-industry network with a common knowledge base*

Strengthened in this way, EUI-Net II must create as prime necessity a knowledge base able to interconnect all partners and to gather and structure all possible internal opportunities across Europe. The knowledge base will use the knowledge-tree

concept. The foundations of this concept used also for the technology management in large transnational companies with hundreds of networked locations around the world [10] are the researchers and experts within the Network. The experts and researchers gain knowledge and experience in specific fields of technology through the projects they work on, fairs, conferences, technical literature, PhD and postdoctoral; studies, customer contacts, etc. Therefore, they represent the core competence of the knowledge-based network and can be seen as knowledge sensors. This concept empowers any expert in the network to point out new knowledge on technologies, projects and business opportunities.

A new knowledge of this type is made visible in a very simple manner by initiating a knowledge sub-network for it. What the members of the new sub-network have in common is that they are working on that topic and could shape the future of the respective area of business. With the creation of the new sub-network, a new knowledge is added to the knowledge tree. As soon as the knowledge will be of business importance the experts will get personal advantages from being key persons involved in building up the new business. New knowledge is added continually: some that are of interest grow and others that are unimportant die off. Due to this evolutionary process, the technology tree adapts itself constantly to the market and its trends. If the market or a customer expresses a certain demand, the regular business starts. At this point the sub-network can be expanded and its existing know-how can also be applied and expanded according to classical business management processes (e.g. business plan). It is now a the sub-network responsibility to build up the knowledge to a profitable business branch.

Sub-Network know-how comprises a great spectrum of knowledge, which can be used for customer consulting, e.g. selecting the proper technology for a certain service or product. If the customer wishes a certain new knowledge that has not been applied so far, the sub-network dealing with that knowledge only needs to expand the already existing know-how and can start with the project.

The sub-network represents a knowledge exchange area where the experiences of all of the experts with the knowledge form synergies from which customers can benefit but also internal cooperation and business could emerge. This concept is not bounding any member of the network. Rather than that, it adds a *new virtual knowledge layer* to the existing hierarchy of a Network structure.

Knowledge sub-networks can be created quickly and could disappear in a natural way without changing the existing organizational structure.

This tool will be a central pillar of the new EUI-Net project that will be prepared and expected to run in the period 2007-2010. It will be supported by a powerful internet tool connecting all network partners in a common knowledge space. For the opportunities identified, the project will then support internal sub-projects proving an appropriate potential towards new business creation of mutual benefit for the university and enterprises. These sub-projects will take the form of small pilot joint ventures and/or twinning typically involving one university and two enterprises (especially micro-enterprises and SME's), creating thus the best breeding conditions to harvest successful entrepreneurship opportunities.

VI. Conclusions and Acknowledgments

ENTREPRENEURIAL behaviour requires a university to develop a holistic approach, involving a full range of activities, in a highly synergistic way. To turn knowledge into real business will need not only teaching and research but a complex range of activities to be developed, for which the university must integrate into networks with complementary institutions. This will lead to higher levels of synergy, beyond the traditional ones that are targeted in traditional university. Thanks to the generous support of the European Commission, EUI-Net started the journey towards creating an effective model in Europe for the new role of university in the knowledge based society.

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Chapter 2. The Relation between Teaching and Research: The Perception of First Year Students at the University of Leuven

An Verburgh, Jan Elen and Koen Clays

***Abstract*—** *This chapter reports on a small-scale study at the University of Leuven on first year students' perceptions of the relationship between teaching and research. 38 students of a chemistry course answered a questionnaire concerning their awareness of the research activities of their teachers and about their appreciation of the research involvement of their teachers (response rate 95%). In line with previous research the results indicate that students are not fully aware of the research activities of their teachers. In contrast to previous research, students do not mention many positive or negative experiences with the research involvement of their teachers.*

I. INTRODUCTION

DURING the past decade the discussion about the link between teaching and research has been vivid. According to Clark [1] no issue is more basic in modern higher education and 'no issue occasions more superficial thought and retrogressive criticism both inside and outside the academy' (p. 241). In his opinion, the discussion can be organised according to two opposed theses: the compatibility thesis and the incompatibility thesis. In the incompatibility thesis research and teaching are opposed to each other and time devoted to one implies less time for the other. The compatibility thesis holds that teaching and research have a positive influence on each other.

Research on the beliefs or perceptions of academics or administrators about the relation between teaching and research indicates a strong perception of a positive relation between teaching and research (e.g. [2] - [11]). In other words, academic staff members generally agree with the compatibility thesis.

However, empirical evidence on the correlation between the quality of teaching and of research, which would support the compatibility thesis, is limited. In a meta-analysis Hattie and Marsh [12] reviewed 58 studies and discussed several explanatory models on the relation. They found a zero-correlation between the evaluation of teaching and the output of research at individual and department level. They concluded that 'the common belief that teaching and research are inextricably entwined is an enduring myth'(p. 529). In that, they follow Terenzini and Pascarella [13] who identify the idea that a good researcher makes a good teacher as one of the five dysfunctional myths about higher education. In a follow-up study Marsh and Hattie [14] conducted a large scale research in order to test a model on the relationship between teaching and research. Again, they found a correlation close to zero and they were not able to identify possible mediators. Despite these recurrent results correlation studies are still conducted (e.g. [15] - [17]).

Similarly, while the presence of a positive link has not been found, the conviction that the link is worthwhile remains [2]. This resulted in studies that look for factors that may help to establish a clear link between research and teaching or in articles or books that suggest approaches to improve the link (e.g. [18]-[27]).

The appropriateness of correlation studies is questioned by several researchers. Brew and Boud [19] indict for the poverty of the conceptions of teaching and research in these studies and disapprove the 'absence of any debate about what is 'research and what is 'teaching'' (p. 264), because both concepts are difficult to define, let alone to measure. They argue that it would be more valuable to concentrate on student learning than on teaching evaluation.

Many arguments in favour of a positive nexus between teaching and research are related to the expected benefits of research on teaching, and hence on students' learning. Therefore students' perceptions of the relationship between teaching and research, and their positive and negative experiences with the relationship may compliment our understanding of this complex relationship [28]. Several recent studies have addressed students' perceptions of the relationship between teaching and research or took it into account for the explanation of other results (see e.g. [9], [28]-[33]). These studies generally conclude that students know that research is performed at the university although they do not fully understand what it implies. These studies also report students to experience both positive and negative effects of their teachers' research involvement.

Coate, Barnett and Williams [9] interviewed teachers and students and identified as positive effects for the students of research involvement that teachers have more authority, are more enthusiastic, use more up to date content and use less second hand material. Possible negative effects are an unbalanced curriculum, less time for exploring pedagogical approaches and less time for students. The findings of Jenkins, Blackman, Lindsay and Paton-Saltzberg [29] are similar. They organised focus groups with students. In this study, students report increased credibility of the institution when great researchers teach them. Unfortunately, students do not see themselves as stakeholders in the research process of their teachers.

There are indications that the relationship between teaching and research is mediated by several factors. Neumann [28], and Breen and Linsday [30] concluded that the relationship is influenced by motivation of the student, discipline, type and purpose of the course, and the possibility to interact with the teacher.

While most of these studies concentrate on senior students, not much is known about the perceptions of junior students.

The University of Leuven (K.U. Leuven), a research-intensive university and member of the League of European Research Universities (LERU-group), acknowledges the importance of a close link between teaching and research in its educational concept [34]. The educational policy is oriented towards a close connection with research in teaching and towards research experiences for all students as much and as early as possible. As such it is important to gain insight in students' perceptions of the relationship between teaching and research and its influence on their learning. To date no research of this kind with students from the K.U. Leuven has been done. This study is a first small scale attempt to unravel students' perceptions of the teaching-research nexus at the K.U. Leuven. The research questions are: 1. What are students' perceptions of the research activities of their teachers. 2. How do students appreciate the link between teaching and research.

II. METHOD

TO measure students' perceptions on the research activities of their teachers and their appreciation of the link between research and teaching, a questionnaire was used, inspired by an instrument of Healey, Jordan, Pell and Short [35]. The items build on factors revealed as being relevant in previous research. The questionnaire assesses students' awareness of research and of research activities of their teachers. Additionally it investigates students' experiences with the relationship between teaching and research and their appraisal of active research involvement of their teachers.

The questionnaire consists of 51 closed questions of three types: 16 questions with statements to be rated on a Likert type scale from 1 (totally disagree) to 5 (fully agree), 33 questions to be rated as yes or no and 2 questions with a specified answer scale. In addition there were 3 open answer questions and 4 identification questions. The results on the open answer questions are not discussed here. The questionnaire was not formally validated.

The questionnaire does generally not make a difference between different types of academic staff and asks for teachers in general. When relevant, there is a distinction made between professors and assistants. These are broadly the two groups of academic staff who teach at the K.U. Leuven. Professors are academic staff who all have a PhD and who combine research with teaching. Assistants, who prepare a PhD, do mainly research and give mostly practical sessions or tutorials.

In the study 38 first year bachelor students of the Chemistry and the Biochemistry programme of the K.U. Leuven participated. The questionnaire was administered during a regular session in the second semester of the academic year 2004-2005. For the Chemistry students the course was mandatory, for the Biochemistry students it was optional. The response rate is 95%.

Given the low number of respondents a factor analysis could not be done and no other statistical tests were performed. Reported differences are not tested for significance. Results are therefore to be regarded as indicative and explorative.

III. RESULTS

A) Students' perceptions of the research activities at the university and of the research activities of their teachers

Students are aware that research is conducted at the university, though not to the full extent (Table I): they know about the existence of research institutes and centres (mean: 4.49), and about the organisation of research seminars (mean: 4.29). They are also aware that scientific publications are prepared at the university (mean: 4.20) and that the university has a national and international reputation in specific research areas (mean: 4.16). They are less aware of the production of research reports or posters (mean respectively 3.50 and 2.97).

Table I: Students' awareness of specific research activities undertaken at the K.U. Leuven (N=38)

Indicate the extent to which you agree with the following statements. I know that at the K.U. Leuven there are …	*1*	*2*	*3*	*4*	*5*	*Mean*
1. often research seminars and conferences	0	3	1	16	18	4.29
2. research institutes and research centres	0	0	2	16	20	4.47
3. research areas in which the K.U. Leuven has a national and international reputation	0	1	6	17	14	4.16
4. often research posters prepared.	3	9	16	6	4	2.97
5. often research reports prepared.	0	6	13	12	7	3.50
6. professors and assistants who write books, journals and other scientific works	0	2	5	13	18	4.20

(1 = totally disagree, 2= disagree, 3= neutral, 4= agree, 5= fully agree)

Although research is an essential part of the duties of all teachers at the K.U. Leuven, the respondents clearly underestimate the percentage of research active teachers (Table II). Most students (81%) think that between 40 to 80% of their teachers are actively engaged in privately financed research. And none of the students think that more than 80% of their teachers do research. Most students think the research activity of their teachers is similar to the remainder of the university (42%) or indicate not to know (21%) (Table III).

Table II: Distribution of students' perception of the percentage of their teachers active in research (N= 37)

Percentage of research active teachers	*None*	*1-20%*	*21-40%*	*41-60%*	*61-80%*	*81-100%*
Absolute number of students	2	1	4	16	14	0
Percentage of students	5%	3%	11%	43%	38%	0%

Table III: Distribution of students' perception of the research involvement of their own teachers in comparison to the other teachers at the university (N= 38)

Is the research activity of your own teachers in comparison to other teachers at the university …	Less	Equal	More	No idea
Absolute number of students	3	16	11	8
Percentage	8%	42%	29%	21%

Junior students seem not to be fully informed about the variety of research activities of their own teachers (Table IV). Two out of three students know that their assistants prepare a PhD-dissertation. About half of the students know that their teachers engage in financed research. They are less informed about professors guiding their assistants than about professor coaching master students in their research work (respectively 39% and 47%). Only 24% of the respondents know that their teachers write research papers.

Table IV: Students' aware of specific research activities undertaking by their teachers (Percentage positive answers, N= 38)

I know that teachers who teach me are:	*Percentage of students who answered positively*
1. Preparing a PhD	68
2. Undertaking non-funded personal research	8
3. Undertaking privately financed research	55
4. Preparing publications	24
5. Supervising students in their scientific work.	47
6. Supervising assistants and project members in their scientific work.	39

B) Experience and appreciations of the teaching-research link

After one semester at the university students report infrequent involvement in research (Table V). The most manifest contact with research is the discussion of research results by the teacher during classes (63% of the students have experience with it). Some students listened to a guest speaker about his/her research (18%), read a scientific article written by their teaching staff (16%), or participated as respondents in a study (16%). Students report having hardly or no experience with attending seminars or research days, with conducting a research project as part of a course, or with preparing research papers or projects. None of the students have been active as a research assistant, prepared a thesis, contributed to scientific advice or was involved in the preparation of a research paper. Despite that laboratory sessions are fully part of the curriculum, none of the students report to have developed research skills.

Table V: Students' experiences with research aspects (Percentage of positive answers, N= 38)

Which situations have you experienced?	*Percentage of students who answered positively*
1. A professor or assistant discussed during a seminar his/her own scientific work.	63
2. A guest speaker discussed his/her scientific work during a lecture of seminar.	18
3. I read a scientific article or report written by one of my own teachers.	16
4. I attended a research seminar that was not part of my regular classes.	3
5. I participated at a conference or research day, organised at the K.U. Leuven.	0
6. I participated as a subject or respondent in a scientific research (e.g. a medical experiment, a research on learning attitudes).	16

7. I developed my competencies in research techniques (e.g. taking interviews, analysing data from laboratories, statistical techniques).	0
8. As part of a lecture of seminar I did a research project.	5
9. I prepared a thesis or research paper.	6
10. I was actively engaged in the practical preparation of research project.	3
11. I was active as a research assistant.	0
12. I contributed to the scientific advice.	3
13. I contributed to the preparation of a paper or poster for a scientific conference or study day.	0
14. I contributed to the development of a scientific research article or an other form a scientific output.	3

The respondents have no pronounced opinions about the relation between teaching and research (Table VI). The respondents argue that it is very important for their teachers to be actively involved in research (mean: 3.91), and reaffirm that many advantages are connected with this involvement (mean: 3.48). Nevertheless, they hardly know the research interests of their professors (mean: 2.53). And at the time of their registration at the university, students were not fully aware of the scientific reputation of their future teachers (mean: 2.94).

Table VI: Students' opinions about the relation between teaching and research (N=38)

Indicate the extent to which you agree with the following statements.	*1*	*2*	*3*	*4*	*5*	*Mean*
1. I know the research interest of my professors.	5	13	12	1	3	2.53
2. When I registered, I was aware of the scientific reputation of the staff working in the department of my study.	3	10	11	8	3	2.94
3. I think it is very important that my professor and assistants are active in research.	1	1	8	15	10	3.91
4. There are many advantages in the involvement in research of my professors and assistants.	1	1	15	16	2	3.48
5. Professor and assistants who are not active in research, spend more time in helping students.	1	11	20	2	1	2.74
6. I learn most when I am involved in a research project.	0	3	16	14	2	3.42
7. I think it is important that my professors and assistants report on their own research during their classes.	1	5	13	12	3	3.33
8. In my programme too little time is	0	7	18	8	2	3.14

	devoted to the development of research competencies.						
9.	I would like to be actively involved in the research of my professors and assistants.	0	6	13	13	3	3.37
10.	The most effective teaching is when the teacher gives us research tasks (e.g. exercises on problem solving, development of a research project, giving a presentation of own research.)	0	2	10	18	4	3.71

(1 = totally disagree, 2= disagree, 3= neutral, 4= agree, 5= fully agree)

Students assume that teaching is most effective when the teachers ask students to perform research tasks (mean: 3.71) or when students are involved in a research project (mean: 3.42). The enthusiasm to be actively involved in the research of their teachers is a little bit less pronounced (mean: 3.37). Discussing research during classes is perceived as important (mean: 3.33), though less than active involvement.

Students do not think that teachers who are not involved in research spend more time on their teaching (mean: 2.74). And they are neutral to the time devoted to develop research competencies in their programme (mean: 3.14).

Although students think there are advantages of their teachers being involved in research (Table VI), respondents only indicate a limited number of the advantages previously identified in other research (Table VII). Some students state that they are more motivated and enthusiastic about their discipline (11%) and know more about specific research issues in the discipline (11%) because of the research involvement of their teachers. 16 percent of the students feel more inclined to work in the discipline in the future. At the same time students do not report to understand the topic better, nor to have developed their research or methodological skills. They are not more encouraged to take an additional degree in the subject.

Students hardly seem to experience any disadvantages from teachers' research involvement found in previous research (Table VIII). The only disadvantage some students (11%) mention, is that professors and assistants are not fully capable of clearly explaining the content. Students do not experience a disinterest of their teachers for teaching, nor for student learning or students' scientific development. Students do not report that the learned content is inadequate.

Table VII: Students' opinions on positive influences of the research involvement of teachers (N=38)

Thanks to the involvement of my teachers in research…		*Percentage of students who answered positively*
1.	I understand the subject better.	3
2.	I can develop my research competencies better.	3
3.	I can develop my sensitiveness for methodological problems.	0

4.	I am more enthusiastic and interested in the domain of my study.	11
5.	I am more interested in getting an additional degree in this discipline.	3
6.	I am more aware of the issues in this discipline.	11
7.	I feel encourage to do research in this domain of study.	16

Table VIII: Negative experiences of teachers' involvement in scientific research (N=38)

Because of the involvement of my teachers in research…		*Percentage of students who answered positively*
1.	Professors and assistants are not available enough to support me in my learning process.	0
2.	Professors and assistants have a lack of interest in teaching.	3
3.	Professors and assistants have a lack of interest in my scientific development.	0
4.	Professors and assistants are not capable enough to explain the content in an comprehensible way.	11
5.	Professors and assistants are not teaching the proper content.	0

IV. DISCUSSION

THE results are generally in line with the results found by Healey and his colleagues [35]. Students' limited awareness of their teachers' research activities is in accordance with previous research ([31], [32]). An import difference however is that in this study junior students hardly mention advantages and disadvantages retrieved in previous research ([9], [28], [29], [31], [35]), although they mention that they find it important that their teachers are active in research. Explaining the difference by referring to the impact of the discipline is likely not correct because Neumann reported that in almost all interviews, across disciplines, the advantages and disadvantages were mentioned. A more valuable explanation might be the difference in data collection instrument and the junior-status of the students. Concerning the data collection, Coate and her colleagues, Neumann as well as Lindsay used interviews or focus groups. Healey and his colleagues had a combined approach of questionnaires and group discussions. Maybe students are more thorough in expressing their perceptions when talking than when filling out a questionnaire. This explanation is suggested in the results of Healey et al.

Concerning the difference in students' experiences, the Healey et al.-, Lindsay et al.-, and Neumann-studies investigate more experienced students, while this study is limited to junior students. The study of Lindsay and colleagues supports this possibility. In this study the year of study, in combination with the research output of the department influenced the perceived negative effects of research.

The limited involvement of students in research is not surprising because the subjects were only starting their second semester at the university. Jenkins et al. [29] even found that students in later years of their study do not feel to be stakeholders in the research of their teachers.

The results indicate a remarkable observation. Most students know that at the university scientific books and articles are prepared (Table 1, Question 6). They think, however, that not all their teachers are actively involved in research (Table II) and only one student out of four seems to know that their teachers write articles. This might indicate that students think that most research is conducted by other staff than their teachers. Maybe students think that there are different types of professors, those who do research and those who mainly teach and only do a little bit of research.

Another surprising finding is that although students report to have little experience with research or research activities, they report to learn most when conducting research themselves. Nevertheless their enthusiasm to get also actively involved in research is close to neutral.

The questionnaire could be optimised for future use. Some unclear formulation and double questions could be left out. The instrument needs to be adapted in order to explore the puzzling finding that students know research is conducted at the university but report only a part of their teachers to be active in research.

This study raises interesting future research questions. In the first place it might be interesting to investigate more students, from different disciplines. Secondly, following students throughout their study might shed light on the development of the perception on the relation between research and teaching. In addition, future research might also look at the development of students' perceptions in relation to their learning experiences. This could be related to the teaching methods used in one course. It could be investigated whether a more explicit focus on research and the use of authentic research articles affects students' perceptions, experiences, and appraisal.

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Chapter 3. How to Motivate Research in Students

Lorna Uden

Abstract— *Research is an important part of a student's university education. Students must be able to think for themselves and solve problems in their lives. Despite the importance of research in the student's curriculum, many find research difficult and have no idea where to start to solve a problem. They may have had the subject matter knowledge and skills taught to them, but they simply cannot look at a problem and solve it. This has implications in a student's final year work because they have to complete a final year project or dissertation as part of their degree. Year after year the author has to deal with students not knowing at the start of the project what to do or how to conduct their research. Students need problem solving, critical thinking and learning-how-to-learn in their employment. Because of the frustration faced by the learners, the author has had to look for ways to help students overcome this difficulty.*

To develop problem solving, critical thinking and learning-to-learn as well as communication skills are essential for good research. Problem-Based Learning (PBL) is often considered to be a good way to help students acquire the necessary skills. This chapter describes the authors' experiences of using the PBL to help students develop research skills. The results of PBL led to drastic improvements in students' research abilities and critical thinking skills.

The chapter begins with the problems facing research students. A brief review of problem-based learning is given, followed by discussion of our problem-based learning experiences and outcomes. The chapter concludes with long-term benefits to students and recommendations for further research.

I. Introduction

HUGHES [1] defines research as a process of learning whereby much learning proceeds. Research is conducted because we believe it is an integral part of the academic role and a central factor in academic promotion. Individually and collectively, we do research because research is part of a quest for meaning and improvement [2].

Training and skills development is an integral part of the research student experience. It is important to develop programs to support research students in the development of generic and transferable skills. Students need to develop generic skills necessary for completion of their research, as well as the transferable skills necessary for their

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future employability. We believe that teaching in higher education must be underpinned by a base of research or scholarship.
Graduates nowadays must have the ability to take control of their own learning by adapting, hypothesising, testing and evaluating solutions as well as possessing skills that can be applied to a variety of problems. This means that they need problem solving, critical thinking and learning to learn skills. These skills are what a good researcher should possess. To be effective in research, students are expected to perform investigation, analysis and solving of a real-world problem, using knowledge and skills they have learned in their studies. Even if they are able to conduct the necessary research for their problems to be solved, few were able to integrate and apply the research into their analysis and design. Traditional methods of teaching using an expository approach in higher education fails to develop students' abilities in reflection and research. To promote a research culture among students, it is important that we help them to develop research skills.

Research is an important part of an undergraduate's education. Our students won't be able to think for themselves if they can't query the world around them and see themselves as part of a vast conversation. Learning how to do that is central to their education. However, research is a complex and recursive process. It calls upon a number of skills: defining a boundary for research, finding information, summarizing and organizing sources, using appropriate conventions for using the sources and documenting them — it is no wonder that, given this mass of complex tasks, students found it very difficult.

Research offers several benefits to students: they are participating not only in a scholarly piece of work that will make a significant contribution to knowledge and understanding, but also in the development of research and other skills that will in many cases go far wider than the original research." [3].

Assisting research students to reflect on and plan their own skills development will help them develop their approach to research. This will also help research students to identify skills they need in the future. The research experience is designed to help them take responsibility for their learning and development. The Skills Profile will be useful when research students are applying for jobs or membership of professional bodies [4].

In addition, employers need graduates with a range of skills and those who complete the Postgraduate Skills Record will be able to describe and evidence the skills they possess. The experience of completing the Record will help underpin continuing Professional Development activities. Recognition of strengths and weaknesses along with the ability to plan for future skills development will prove useful to employers.

The learning of research skills has many implications for students. It not only has impact in their final grades, but students are also able to acquire what employers are looking for in prospective employees. Employers are currently looking out for graduates who have innovative skills that make them different from the other graduates. How do we inspire students to have an innovative spirit that would encourage them to look beyond the problem and think creatively? It is the author's experience that students should be encouraged to learn and think critically, this means to promote a culture of research among students.

It was obvious that students needed help with their projects. The author found that the main problem these students faced was their lack of problem-solving, critical thinking, metacognitive skills and self-directed learning skills. The learning of these skills required a departure from traditional teaching methods such as lecturing. Problem-Based Learning (PBL) was the solution to the problem that these students needed. This paper describes the author experiences of helping students develop the necessary skills through problem based learning. The structure of the paper is as follows. In the next section a brief review of PBL is given. This is followed by the discussions of the author's experiences of PBL in promoting research among her students. It concludes with challenge to colleagues to promote research in students.

II. Problem-based Learning

Many students have experienced that learning is difficult, especially when it comes to problem-solving. They have no idea where to begin, despite their familiarity with the subject content. These students can memorise facts and procedures, but are unable to explain observed phenomena, to solve real-world problems, or to analyse problems and to think critically. Many of these students may pass examinations, but be unable to *apply* the same knowledge to solve new problems. They have difficulty in utilising the knowledge and skills acquired via formal learning. It is clear from contemporary thought in the field of education that lecture style methods of teaching are not effective. It is necessary to change the way we teach and help students learn to solve problems and think independently [5]. That is to develop strategies that teach content in ways that also teach thinking and problem-solving skills.

These higher-level skills are termed metacognitive skills. This refers to knowledge and awareness of one's own cognitive processes and the ability to actively control and manage those processes. Considerable evidence has accumulated that suggests an emphasis on metacognition during training can result in significant improvements in problem-solving for the tasks, as well as in transfer of skills across tasks [6].

III. What is PBL?

Problem-based learning (PBL), according to Barrows [7] is, "... the learning which results from the process of working towards the understanding of, or resolution of, a problem." PBL is a way of constructing and teaching courses using problems as the stimulus and focus for student activities. The courses start with problems rather than the exposition of disciplinary knowledge. They move the students towards the acquisition of knowledge and skills through a staged sequence of problems presented in context, together with associated learning materials and support from teachers.

Barrows [7] describes the main educational goals as:

- To develop students' thinking or reasoning skills (problem solving, meta-cognition, critical thinking) and;
- To help the students become independent, self-directed learners (learning to learn, learning management).

The purpose of PBL is to produce students who will:

- Engage a challenge (problem, complex task, and situation) with initiative and enthusiasm;
- Reason effectively, accurately, and creatively from an integrated, flexible, usable knowledge base;
- Monitor and assess their own adequacy to achieve a desirable outcome given a challenge;
- Address their own perceived inadequacies in knowledge and skills effectively and efficiently;
- Collaborate effectively as a member of a team working to achieve a common goal.

PBL is a challenging and motivating way to learn because students take ownership of their problem and work in real-world situations. They perceive learning as important and relevant to their own lives.
PBL is centred on the learning that emanates from a real problem. In PBL, students spend time in learning – by identifying what they need to know, by finding out, by talking to each other and by applying their new knowledge. The primary aim is learning itself not the completion of the project – the project is the means to the end. Note that this is different from standard project work in that the ways in which the students are encouraged to tackle the problem are designed to encourage learning in a structured manner (albeit with substantial learner control). It is also different from apprenticeship and 'learning on the job' where the focus is on completing the work and learning as a by product. In short, the key ingredients of PBL are:

- the problem as the focus of learning
- learning as the purpose of the problem
- the problem as the integrator of concepts and skills
- commitment to self-learning

In addition, PBL is typically used in teamwork and small group situations as this encourages the development of reflective abilities. This can be achieved individually, but is often easier in a group situation.

The PBL tutorial process

There are many strategies for implementing PBL. The particular PBL model adopted was that of Barrows [7]. There are four phases to the PBL process, as shown in Figure 1. The tutor presents the problem 'cold' to the students who do not know what the problem will be until it is presented. The students discuss the problem, generate hypotheses based on experience they have, identify relevant facts in the case, and learning issues. The learning issues are topics of any sort deemed of potential relevance to the problem and which the group members' feel they do not understand as well as they should.

Figure 1. The four phases of PBL

	Activity	By Whom
Phase 1	present problem set hypothesis	tutor group (with tutor)

	identify learning assign tasks	group (with tutor) group (with tutor)
Phase 2	consult resources detailed study of issues	individual and group individual
Phase 3	evaluate resources re-examine the problem revise hypothesis and learning issues	group (with tutor) group (with tutor) group (with tutor)
Phase 4	present findings metacognitive critique reformulate further hypotheses	group to peers and tutor tutor and peers group (with tutor)

To help students to structure their thought processes, a four-column chart shown in Figure 2 is used (adapted from Duffy [8]). A session is not completed until each

IDEA (hypothesis)	Facts	Learning issues	Action Plan
Students' conjectures regarding the problem. – may involve causation, effect, possible resolution, etc.	A growing synthesis of information abstracted through inquiry, important to the hypothesis to be generated	Students' list of what they need to know or understand in order to complete the problem task.	Things that need to be done in order to complete the problem task.

Figure 2: PBL Tutorial Chart

student has an opportunity to verbally reflect on their beliefs about the problem, and assume responsibility for particular learning issues that were identified.

Starting a new problem

When the students have gone as far as they can with the problem, they determine what resources they will use (faculty experts, library, Internet, etc.) to gain the knowledge and skills needed. They also assign learning issues to different members of the group to work on. A time limit would also be set for the completion of the task. After the session, the students all engage in self-directed learning where they work independently of the tutor, consult resources and work collaboratively. The student group negotiates the length of this phase depending on the extent and depth of issues they have elected to pursue.

After self-directed learning, the students meet again. They apply the newly gained knowledge back to the problem, critique their prior thinking and knowledge, and refine their understanding of the problem and its management. They then synthesize what they have learned, relate it to prior problems and anticipate how it might help with future problems. They also evaluate resources - what is most useful and what is not so useful. This cycle may repeat itself if new learning issues arise. The students also assess themselves individually in the following areas: problem solving skills, knowledge acquisition, self-directed learning and support of the group. The last phase is the presentation of the solution by groups to peers and the tutor.

While self-directed learning is an important element, PBL is not an independent study curriculum. Each student works as a member of the tutorial group, and the group works together in resolving the problem. As a result, teamwork is an essential ingredient in PBL.

During the tutorial process, the tutor guides the students in reasoning their way through the problem. Significant findings are recorded by the group, along with their hypotheses and learning issues, knowledge needed to better understand and further pursue the problem. Using tutorial skills, the tutor facilitates student access to their own prior knowledge as well as the identification of the limitations of their knowledge. The tutor also guides students to articulate their knowledge of the relevant disciplines as they relate to the problem at hand. As students progress through the curriculum, they learn to reason through the problem effectively and efficiently. The need for information required in understanding the problem generates learning issues for further study

For the learning issues identified, an action plan, consisting of a list of activities that students need to do to achieve the learning issues, is worked out. The action plan lists the types of resources, which are needed to solve the problem. Resources may be books, journals, the Internet, etc. If the Internet is involved, students must work out exactly what they want to look for, based on the learning issues identified.

Each student is assigned tasks based on the learning issues to be carried out. For essential learning issues, all students would have to do these tasks. Once the tasks have been allocated, students go their separate ways to conduct their research. When they have finished their investigation they return to the next tutorial with the rest of the team and the tutor for another tutorial session. During this session, students are expected to present what they have found out and share with the rest of the team and the tutor. Also during this session, students are challenged as to what they have done, why they did the things the way they had, etc. Students must articulate their findings and critique them along with those of their peers. The tutor never volunteers any information except to help bring out students' metacognitive skills by asking questions. Students are not expected merely to present their findings, they must really understand and articulate their thoughts. Before the session ends, students have to reflect on their work and share with the team members and the tutor their own reflection of the investigation conducted. During the course of the session, further problems or issues will be identified. These will then be taken up for further research by students. The process continues until the problem is solved.

Benefits of PBL

Although PBL originated from the teaching of university students, it is increasingly being used in high schools, middle schools and elementary schools in many different countries. More and more tutors are taking on this method as a way of improving students' learning. It works well with educationally disadvantaged and minority students who traditionally have not done well in conventional educational settings. PBL provides an equal and exciting opportunity for learning to all students.

The PBL method is seen by many teachers as the answer to many of the problems of teaching in schools. It enables teachers to add many things to their traditional teaching, including problem-solving activities, critical thinking exercises,

collaborative learning and independent study, and to put these into context and give them meaning.
It is generally accepted by researchers that PBL offers many benefits to learning. Among these are:

- The PBL learning environment is more stimulating and human [9].
- Learning and teaching is more enjoyable for students and teachers in PBL [9], [10].
- PBL promotes interaction between students and faculty [11].
- Self-directed learning skills are enhanced and retained in PBL learning [12], [13], [14].
- PBL fosters self-directed learning skills [12], [13] [14], [15].
- PBL promotes interaction between different disciplines [11].
- PBL promotes collaboration between students [16].
- PBL enables reflection-in-action [17].
- PBL enables students to spend more time on self-directed learning activities using more information resources [10].
- PBL enables staff to have more contact with students [9].

There are also many studies conducted by researchers showing that PBL students performed better than traditional class students.

IV. Personal Experiences

Commonly stated benefits of PBL include: increased retention of data; integration of knowledge; life-long learning; motivation to learn; development of reasoning and critical thinking skills; development of communication and interpersonal skills; and development of the ability to work effectively in a team.
The author has been implemented PBL for some of her students since 1996. Her experience of PBL was very positive and encouraging. Evaluating PBL is difficult because many of those benefits only become evident over a student's lifetime. However, a post-module evaluation questionnaire revealed that students:

- Enjoyed the opportunity to learn things for themselves (90%);
- Felt that they had learned from each other (85%);
- Felt that PBL gave greater confidence in tackling problems themselves (90%);
- Felt that PBL helped them to develop their thinking and problem solving skills (95%);
- Developed project management skills (80%).

Of course, achieving those results required hard work for both the tutor and the students. The questionnaire results showed that over 98% of the students rated PBL as the best part of the course. In addition, students reported that they applied the techniques learnt in this module to other parts of their course. One student wrote, "When applied in other course modules which I have learnt, it helps me to remember what I have done because I know why I do it and how I can apply it when given a problem". Another student reported that he now applied PBL methods to all aspects of his life including managing his personal finances!

V. Long-term benefits

Now that many of the students in our case study have graduated and gained employment, it is possible to obtain feedback from them on how PBL has helped them in their current work. The author is continuing to receive e-mails and feedback from her students expressing their experiences of PBL. Below are selections of the comments received from graduates who are currently working:

Student A from Singapore wrote to say that he used PBL to apply for his jobs. In his current job as a SAP Consultant he says,
"Confronted with limited information, I use the various problem-solving techniques taught in PBL to provide consultation for my clients."
Student B wrote from BT (UK):
"The PBL module was very useful to me ... in order to build our two working prototypes in time..."
From Students C and D (both working as software engineers at National Computer Systems):
"As software engineers, PBL has equipped us to be better team players ... to master new languages and software tools."
Student E from Digital Equipment UK writes:
"I personally found the PBL module extremely useful, particularly the principles of Problem-Based Learning, which I still use to tackle day-to-day research problems."
Student F
"Overall I can confidently say that I have acquired a skill that I will use for the rest of my life. I knew that when I came to university I will walk away with many skills but not such a beneficial skill as PBL. The acquired skill has made me a confident, structured, well organised, constructive, and manageable human being. Without such a skill I could not have completed my final year, as this skill was utilised in all my modules.

Of course, this is only anecdotal evidence. However, it is rare to find graduates who are able to point to specific elements in their course and relate them to their jobs. This makes the above comments more substantial as an assessment of the course success. Even more important is the fact that the students felt able to make this an assessment - that is, they are clearly demonstrating critical evaluation of their own learning - a metacognitive skill that goes beyond the content of the specific module.

VI. Conclusions

Students found research difficult. Most have no ideas how to integrate the diverse ideas generated by the nature of the problems they were investigating. They often came with different attitudes from ours towards their learning. Many perceived learning as a means to external ends such as grades and status among their peers and tutor, and above all obtaining good examination grades. Because of this, they tended to focus on low level learning without having the need to be involved in higher order cognitive processing. When students have acquired the PBL skills, they found

learning fun and changed their whole perspectives about their learning. Many enjoyed learning for the first time and were keen to continue on doing postgraduate work after their encountered with PBL. Some have utilised the skills to help them having their work published within the first few months o their PhD work. They have also completed their PhD ahead of their peers.

It is the author's belief that PBL indeed helps students develop the necessary research skills they need. Her

desire and challenge to her colleagues is to join her in taking the task of giving PBL a go and seeing the results.

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Chapter 4. Innovative ways of knowledge transfer between Universities and Industry

Katrin Bijnens and Wim Van Petegem

***Abstract*—*In the relation between Universities and Industry knowledge transfer (in both directions) is a key issue. This could be done in different ways: academic programs, common research projects, internships, seminars, etc. The common meeting place (call it the 'knowledge market place') is often the university campus. Nowadays new ways of communicating through the use of ICT have become available and virtual communities pop up where university and industry could share knowledge and ideas.*

In this chapter we describe a few initiatives taken in the Leuven region to accommodate the constant demand for innovative ways of knowledge creation and sharing between the K.U.Leuven and its industrial partners. Examples range from support for individual spin-off companies, over strategic collaboration with well-known research institutes to (virtual) networking in Leuven.Inc.

In this way it is explained how a university could play an important role in regional development and how industry could participate in knowledge creation in the university, to the benefit of both.

I. The Leuven strategy

THE Leuven region's main future ambition consists of extending its position as an international renowned and successful 'knowledge and technology region'. Leuven aims to play a dynamic and leading role in the European knowledge economy of the 21st century. Just like the Cambridge region, the region around Sofia Antipolis in Nice, the Heidelberg region and other comparable regions, Leuven wants to contribute to the development and consolidation of the European innovation dynamism. [1]

In order to achieve this goal, the university, IMEC (the Interuniversity MicroElectronics Centre or the most important independent knowledge institution of Leuven), the city of Leuven and a number of managers have set up the Charter Leuven 2010, that functions as a platform of expertise and that clusters all the necessary stimuli for further development. It aims to find how the Leuven region has to evolve in order to achieve the goal of becoming the successful knowledge region as mentioned above. Participants in this communication platform are the major, the rector of the K.U.Leuven, the Vice-president of IMEC, the director of K.U.Leuven LRD (Leuven research and development) and a few local entrepreneurs. The idea is that a joint discussion of the challenges and bottlenecks of the area, enhances a better long term strategy.

Based on this Charter, the Leuven region structures its regional development strategy around four basic ingredients: knowledge, talent, innovation and entrepreneurship. More specifically, these key factors play an important role in the evolution from

knowledge creation towards market innovation.
The bottleneck in this process lies in finding an adequate way of allowing the knowledge developed by the talent in the research centers to find its way to the market. In order to overcome this problem, the process of innovation and development in Leuven evolves along established lines, that can be presented as a value chain. A first step in the value chain is the presence of knowledge institutions functioning as levers for the technological development of the region. Leuven has two such institutions, K.U.Leuven and IMEC that can be considered as centers of excellence. Their presence results in the regular creation of spin-offs and cooperation with specialized technology companies. Spin-offs are pure innovative companies. They are a crucial component for the market launch of new technological developments. It is only natural that other, so-called innovative companies will be based around these knowledge institutions and spin-offs. These companies apply and integrate innovative technologies, rather than being involved in the actual fundamental knowledge creation. [1]

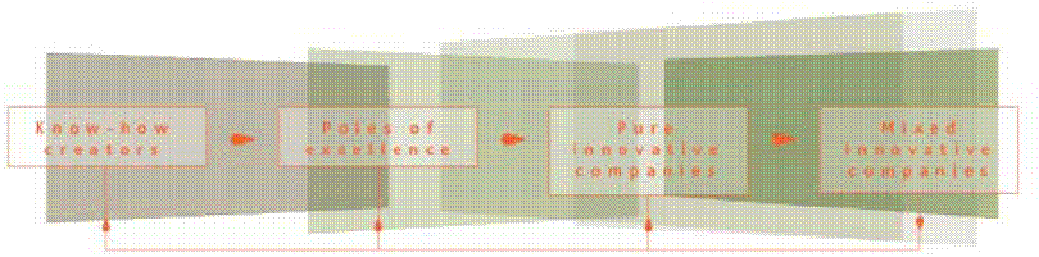

Fig. 1 The innovation value chain

In order to successfully enhance this transfer of created knowledge and innovation to the market, a knowledge region must promote and stimulate entrepreneurship. The process of academic entrepreneurship and new venture creation is to a large extent spontaneous and organic. However, universities, as incubators of entrepreneurial innovations, can create the context, structure and processes that facilitate new venture creations, as Koen Debackere states. [2]
In the Leuven region, the two main knowledge institutions mentioned above have indeed built the required structures to facilitate knowledge transfer to the market. They each use a blended mix of a classical and a more ICT-based approach in the promotion of entrepreneurship, and they will therefore function as case studies in this paper.

II. Helping knowledge find its way to the market

A. Leuven research & development (LRD)

Within the university, 'Leuven research and development' (LRD) was founded in 1972, as a separate entity. It's LRD's mission to promote and support the transfer of knowledge and technology from the university to the business world. Therefore, LRD mainly offers professional, legislative, technological and business advice. Its areas of expertise lie in contract research, intellectual property management and the founding of spin-offs.

Throughout the years, LRD has set up several forms of cooperation with the industry, ranging from the execution of tests and feasibility studies, over advisory tasks and building prototypes to actual research projects and consortiums, spanning several years and involving various partners. Furthermore, LRD pursues an active patent and licensing policy with respect to university research results. This allows for generating additional funds for further scientific research. [3] LRD's most growing task, however, consists of offering advice and help in the set-up of spin-offs as a direct link between university research and the business world. Over a period of 25 years, around 60 spin-offs have been set-up, of which 52 were still active in 2004. They have combined a total turnover of around 350 million EUR and they employ more than 2000 people. [4]

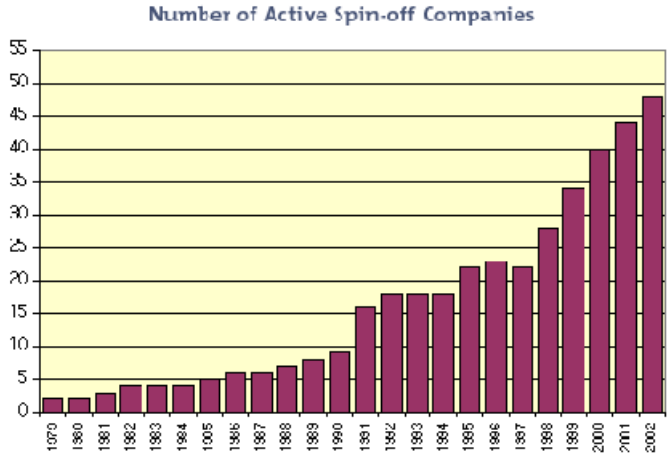

Fig. 2 The number of active K.U.Leuven spin-off companies in 2002.

The main goal of these spin-offs is to translate research results into commercial products and/or services.

LRD as well as IMEC use a spin-off policy that is geared towards supplying sufficient stimuli to those who want support and successfully extend the spin-off initiative. [1] According to LRD the highest failure rate occurs during the phase of spin-off creation. More than half of the projects never make it to the actual stage of spin-off incorporation. [2] Given these facts, LRD has developed several forms of help in order to provide starting spin-offs with the necessary information to become successful. This support covers the different steps in the beginning stages of a spin-off and is presented through a combination of face-to-face communication as well as online help.

Researchers are, for instance, guided step by step through the process of creating an efficient business plan. This is done through offering an online template for a business plan as well as through face-to-face meetings with the LRD staff to produce a business plan that will be an instrument to help convince investors and that also serves as an 'internal guiding tool' for the entrepreneurs themselves. The universities economic department offers a course on 'initiation in entrepreneurship', that is open to both regular students as well as starting spin-off entrepreneurs. The development of a business plan is one of the subjects that are being treated in this course.

A second example of offered support in the set-up stage is situated in the field of intellectual property management In the start-up phase as well as in the growth phase of a spin-off company, the protection and subsequent exploitation of knowledge is

crucial. This is why LRD has established an intellectual property management advisory group, to select those cases that are valuable enough to enter the university's patent portfolio. To this end, necessary mechanisms tools and processes have been created to screen for novelty and inventiveness, to do a quick scan of the inventions' economic potential and to assist the research groups in writing the patent and its claim structure. [2]
K.U.Leuven LRD also initiates a number of networking & clustering initiatives. Through help in finding an appropriate infrastructure for each spin-off, LRD seizes the opportunity to create vertical clusters of spin-offs in different Science parks along with other high-tech businesses and international companies, thus creating a real 'technology corridor'. To this extent LRD has access to an "Innovation & Incubation Centre" that is jointly owned and operated by the university and the local regional development agency. Moreover, LRD stimulates horizontal networking across sectors and technologies through the establishment of network organizations such as Leuven Inc. (Leuven Innovation Networking Circle) and ELAT.

B. Interuniversity Microelectronics Centre (IMEC)

The other large knowledge institute in Leuven is IMEC, the Interuniversity MicroElectronics Centre. IMEC was founded in 1984 and has grown towards a world leading independent research centre for nanoelectronics and nanotechnology. It is IMEC's mission to perform R&D, ahead of industrial needs by 3 to 10 years, in microelectronics, nanotechnology, design methods and technologies for ICT systems. Their main objectives are to:
(a) be an "international center of excellence", (b) reinforce the local industry, (c) cooperate intensely with Flemish universities and (d) provide industrial training in ICT. [5]
Via networking, policy support and overall communication, IMEC raises the Flemish companies' awareness of the potential of its technology. To this end, IMEC cooperates intensively with the Flemish universities and regularly organises industrial training sessions in the area of ICT.[1]
Similar to the K.U.L., IMEC also regularly starts up spin offs. At this date, IMEC has created more than 20 spin-offs.
During the first phase, the so-called incubation phase, IMEC supports its spin-offs through seed money and infrastructure. To this extent IMEC has set-up to venture capital funds, an IMEC Incubation Fund and an IMEC Technology Fund. Moreover the new companies can also relate on and seek help from IMEC staff. IMEC offers additional support to spin-offs when it comes to elaborating a business plan.
In order to optimise the technology transfer even further, IMEC has integrated its training division with the division 'technology industrialisation' in INVOMEC.
INVOMEC functions as an educational network, grouping all activities that reinforce industrial entrepreneurship.

III. (VIRTUAL) NETWORKING

THE K.U.Leuven as well as IMEC have both functioned as initiators in setting up horizontal networks with existing companies in the region. This evolution took

place in order to extend the sphere of influence and to establish the position of Leuven R&D outside it own region.

A. Leuven Inc.

In November 1999 the non-profit organization Leuven Inc. was founded by a group of five companies, Arthur Andersen, Fortis Bank, IMEC, KBC and LRD. Leuven Inc. wants to connect local enterprises, government and university in taking joint initiatives in order to expand the prosperity of the Leuven region. To reach this goal, the network wants to be a platform of communication that brings together local knowledge creators.
To this end Leuven Inc. continuously organizes and generates events, opportunities for informal networking and training sessions for members as well as for a broad audience, corresponding to all the aspects of the objective. At the same time, Leuven.Inc will build bridges between researchers, knowledge creators and technology entrepreneurs, and create out of these relationships a dynamic, future-oriented, and expanding prosperity in the region of Leuven. [1]
Membership is open to anyone, but it is clear that Leuven Inc. focuses on young researchers so that they can learn from experts. Therefore, one of the most important events of Leuven Inc. is 'The Café'. Each month, the president of a high tech company will host a meeting in his facility and talk about his own business experiences. The Café is the meeting place where young researchers and new entrepreneurs meet seasoned experts in the field of technology and marketing, sales and financing. [8]
Leuven Inc. wants to enable entrepreneurs to share their experience with other knowledge driven companies and to support young spin offs developing their company in various aspects: setting up research programs, protecting intellectual property, marketing high tech products, planning an international expansion, performing acquisitions, etc.
At the same time, Leuven.Inc wants to actively participate in the international network of the knowledge community, aiming to stress the advantages of the area of Leuven as an essential junction in the global knowledge and network economy. This is why Leuven Inc. has close ties to the Cambridge network. [2] Besides the more personal and informal linkages, the LRD and Leuven Inc. websites are formally linked to the Cambridge Network website.
At the moment, Leuven Inc. has about 300 members.

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B. ELAT

Recently, Leuven has also become part of an international network linking the knowledge regions in Leuven, Eindhoven (NL) and Aachen (DE). With this ELAT (Eindhoven-Aachen-Leuven) triangle, the tree areas want to achieve synergies in research and innovation.
Today, each region scores very well on innovation, R&D, spin offs and start ups. But for the future, the regional and local authorities of Eindhoven, Leuven and Aachen realized that strategic cooperation is necessary to pursue the ambitions. [7]

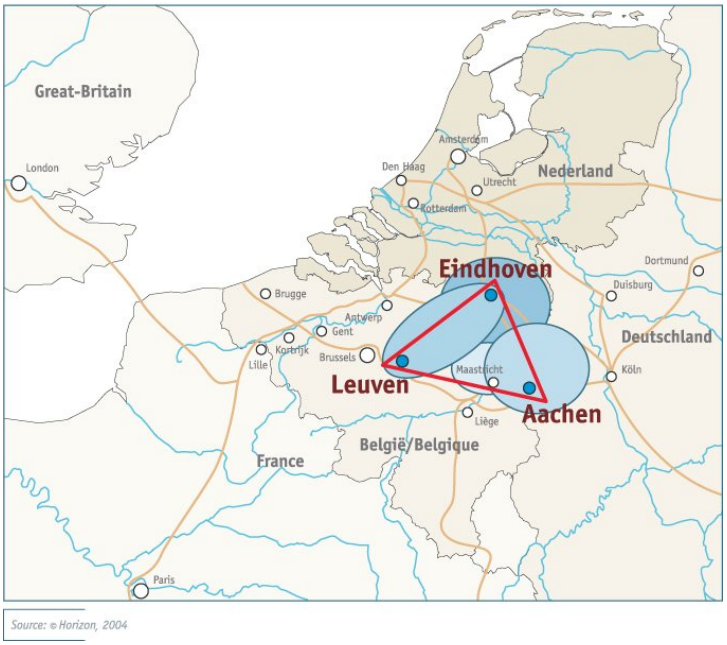

Fig. 3 A map of the Elat triangle.

Their goal is to evolve before 2010 as a European and worldwide top-technology region.
Koenraad Debackere states that the force of this triangle lies in the enormous pool of talent, when joining R&D capacity of KULeuven, IMEC, university hospitals, TU Eindhoven, Philips and ASML. He's convinced that with joined forces the triangle will have no problem to be put on the European map when it comes to R&D activities. [6]
With the set-up of the Holst Centre in Eindhoven, in which IMEC and TNO are active participants, the triangle has already achieved one concrete cooperative realization.

Transnational cooperation between Eindhoven, Leuven and Aachen means a larger economic base, a larger knowledge base, a larger urban scale and a larger urban diversity (four of the seven knowledge economy foundations, according to Euricur). This is why the triangle has the potential to become a Top Technology region, also because of the presence of 5 (top) universities and the institutions and business activities that go with them. [7]

IV. Conclusion

In this paper we have discussed how a university jointly with other research organizations could play an important role in the knowledge creation and circulation in the local region and far beyond. The K.U.Leuven is taken as an example, together with strong research partners like IMEC and well-established networks like Leuven.Inc and ELAT. It is their common ambition to share knowledge between universities and industry, and to foster innovation to the benefit of a whole region, now and in the future.

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PART II. Integrating Research Results in Teaching

Chapter 5. An Attempt of Merging in a Synergetic Way Research Work and Higher Education Activities in Computer Engineering by an European Programme Project

Ileana Hamburg, Oleg Cernian & Herbert ten Thij

***Abstract*—** *The continuous progress of technology implemented for the improvement of training/learning system, as well as the constant request for changing the old training/learning styles stirred the research work for merging the two trends. At present, there is ascertained a tremendous research activity for implementation of the most recent ICT tools into changing the traditional way of educational platforms, as well as the evolution of research in the pedagogical field to discover the needs and effects of the engaged learning. This chapter approaches a facet of this endeavour through an international co-operation materialized in an EU Project, "ViReC e-Initiative" run within MINERVA scheme. A brief description of the project and the main attained outcomes constitute the major topic of the present work.*

I. Introduction

TELECOMMUNICATIONS and computer technologies are converging to make e-Learning one of the fastest moving trends in higher education.

E-learning, especially for engineers and executives in technology industries, has evolved as a major mean of organizing education/training. At present, many courses, including degree and certificate programmes, are offered by universities and professional development centres. The global connectivity of the Internet and a new generation of hardware and software have pushed teaching of courses over the web. It is estimated that industry e-training will double its volume annually over the next several years, as well as that the academic on-line market will continue to expand its supply.

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From official American statistics it follows that the demand for e-Learning will leap from 5% of all students in 1998, to over 25% by 2005. Therefore no educator/instructor/professor can ignore this objective trend in the market.

The impact of industry requirements for refreshing courses stimulated already more than ever and will stimulate also in the future the development of adequate on-line courses. Some large companies now operate corporate universities on line by collaboration with academic institutions that deliver basic courses from their curricula or customized courses. There are offered also product-specific courses on particular topics as Linux, Windows NT/ 2000/ XP, Novell Netware, etc. It can be appreciated that, at present, the market in on-line learning has matured to the point where there is sufficient software available for designing, teaching and administering a web-based course. Typically, e-learning packages incorporate a database-centred syllabus with links to internal or external web pages, on-line time-monitored testing, discussion groups and e-mail. In our approach there where added other efficient facilities comprising tutorials and remotely accessible physical laboratories.

II. COMPARISON BETWEEN ON-LINE AND CONVENTIONAL CLASSROOMS

A thorough comparative analysis that was applied to on-line web-based and conventional classroom (on-campus) courses concluded that no significant difference was put into evidence, the students from both categories obtaining quite similar grades.

But experts stated that while on-line learning may add some value to an education, it cannot replace life on a real campus with face-to-face education; by attending classes and meeting professors and colleagues, the students gain more than just discipline specific or the core factual information.

Another point to be mentioned is whether logistical matters raised by accompanying on -line learning do need extra time by producing web-based courses and extra time to teach web-based courses. To these questions the answers are contradictory. Some professors found that the total time can far exceed a traditional classroom course, while others estimated that the amount of time consumed is similar in both systems, but that only the time is distributed differently.

However, the modern trend in academic institutions is to combine these both systems in such a way that all on-campus undergraduate courses include some e-Learning components.

Traditional engineering instruction used the classes on campus method, with little interaction amongst students, while at present professors are using web sites as classroom tools, especially, also, to improve the interaction between them and the students, as well as between the students themselves.

Obviously, using web tools forces professors to rethink their courses, so that the old on-campus style method could be improved significantly. In many universities seminars and web faculty colloquia were initiated, in which on-line features and tools were clarified outlining the digital accomplishments, as well as some uneasiness about virtual pedagogy.

Another important matter for on-line classes consolidation is the looking for funds in order to launch new programmes. In general, web professors would receive two types of fees, one for developing the e-courses, another for teaching it over Internet,

Additional administrative and technical staff is also needed to run web learning programmes, which must be kept up and running the entire day. There are additional costs for training, software licenses, e-commerce applications, web design tools and the maintenance of computer and telecommunications infrastructure. It is conspicuous that the enumerated costs led to a significant amount of investment, roughly about some millions of dollars.

With respect to the students, tuitions for web-based courses are comparable to those for conventional classes; savings in time by commuting from campus to on-line learning must be balanced against the costs of computer hardware and software and Internet services to access the courses on-line.

The intellectual property of e-learning courses is also a matter that yet has to be clarified in further detail.

Anyhow, at present, it is a generally accepted opinion that certain types of instruction will never go entirely on-line, as, for example, laboratory courses that require immediate access to as well expensive as also highly specialized equipment. Nevertheless, it should be mentioned that efforts are undertaken in many universities to use some real equipment in virtual laboratories, where students can run experiments and analyse the results remotely. The main target of such laboratories is to allow students to interact easily with a set of physical processes through Internet. This represented one objective of the developed project approached by the authors of this paper.

III. A BRIEF PRESENTATION OF "VIREC e-INITIATIVE" PROJECT

THE project "ViReC e-Initiative" was developed in the framework of European programme MINERVA between the years 2002-2005 by a Consortium formed of seven partners from Romania, Germany, Ireland and Greece. This project was clearly devoted to the development of innovative practices and services, having in view the setting up of a virtual resource centre composed of a Distributed Learning Environment (DLE), arising awareness of the impact of ODL and the use of ICT in education. One of the remarkable outputs of the project is creation, by carrying on applied research work, of virtual laboratories crossed with some real devices/equipment. By its structure, the virtual resource centre is reproducible, allowing integration of cross-curricular approaches; it fosters collaboration between learners and educators, as well as it stimulates multidisciplinarity. The main objective of the project was to set up a qualitative learning environment in an academic European network, ensuring an open access to improved methods and educational resources, as well as to the best practices applied in the partner teaching/learning institutions, by stimulating an innovative development of ICT-based educational products.

The following additional objectives were considered by the applied research work carried on by partner institutions:

- Extended use for educational purposes of new tools and methods incorporating features of the emerging ICT technologies
- Development of ICT-based educational products, in particular multimedia-type, by encompassing advanced pedagogical skills
- Evaluation of the impact level of new products on a target group of students.

The concrete aims foreseen from the incipient stage of the project were:

a) Raising the quality of the educational process by means of ICT tools
b) Improvement of learning processes at higher education level (undergraduate, postgraduate) as well as Continuing Education
c) Development and implementation of new advanced technological scheme improving learning process by incorporating real laboratory equipment into virtual laboratories, using ICT means and facilities
d) Promoting a better understanding among educational personnel, decision makers and the public at large of the role and importance of ICT in education
e) Development and integration of services and educational systems in different geographic sites across Europe in a global system providing information for teachers, students, administrators, decision makers, learners and new ICT educational developers
f) Setting up a superior interdependency between the learning processes and high performance technology, focusing on the engaged learning and high technology performance
g) Establishing an efficient interconnection by using ICT means between European universities allowing promotion of Distributed Learning Environment.

It could be appreciated that two major outcomes of the carried out project ensuring a qualitative student activity for several technical disciplines are setting up of mixed laboratory environments incorporating features of real and virtual laboratories and design and implementation of remotely accessible simulators.

Obviously, such approaches are very efficient for running the current lab activity as requested by syllabi at certain technical disciplines (from Computer Engineering area) without having locally a direct access at enhanced and sophisticated resources. It can be pointed out that such modern approaches, becoming feasible through ICT means, are beneficial for Continuing Education system as well.

The main pedagogical approach considered by the project promoters is dependent on the planned activities in synchronous section and in asynchronous section, in particular for the new styles of conducting laboratory activity, new approaches for evaluation, new shape of live courses delivered, new ways of writing and creating multimedia textboxes and tutorials, student testing procedures. In elaboration of the project there were considered also the learning management process mechanisms by scheduling and timetabling, assessment of learning styles, evaluation of learning level against criteria that are transparent, relevant, realistic, reliable and valid, etc.

As target groups of running "ViReC e-Initiative" project there were envisaged. students (undergraduate, postgraduate, long-cycle, short-cycle), participants in Continuing Education process from companies (updating, reshaping, requalification, etc), participants in Adult Education, teachers, trainers, school managers. Of remarkable usefulness is development of distance laboratory activity on real equipment for some disciplines from Computer Engineering curriculum, like Network Management, Data Communications, Logical Design, enabling adaptation to the curricula requirements in locations where specific complex and expensive devices were missing.

The entire project was structured on objectives, activities and outputs, synchronized by a rigorous planning scheme framed by a comprehensive monitoring and evaluation procedure.

The entire proposal was stirred by an objective trend ascertaining that traditional education has shifted towards new methods of teaching and learning through proliferation of Information and Communication Technologies and that the continuous advances in technology enable the realization of a more distributed structure of knowledge transfer. This becomes critically important for countries that lack resources and infrastructure for implementing modern technologies in education practice.

The correlation between technology performance and learning effectiveness led the identification of the following four categories:

A - engaged learning and high technology performance
B - engaged learning and low technology performance
C - passive learning and high technology performance
D - passive learning and low technology performance

The proposed and performed project belongs to the category C, where high performance technology can be used to improve the learning process. By engaged learning according to the general definition, it was understood use of computer – based technologies to help learners think through complex, authentic problems, take charge of their own learning and develop products for teaching or use in the real world. The engaged learning help students to develop advanced skills in reasoning, summarizing, high level self – questioning and reflection, provide sophisticated tools for learning complex concepts and procedures, adjust the level or adapt the sequence of problems based on student performance, etc.

This is an ideal that corresponds to the current accepted pedagogical approach to learning called the constructivist approach ,wherein the learning is student-centred ,that requires students involvement in the construction of knowledge and where they assume their responsibility for a particular style of learning.

Anyhow, at the present stage it may be ascertained that "ViReC e - Initiative" project belongs to the level of objectivist methods, where the content is presented in a dedicated form that students have to repeat it. The future work of promoters is oriented to redesign the entire platform to learner centred system based on problem – based learning approach, by developing a web – based information technology student support system, leading to the superior level, that of engaged learning.

IV. GENERAL STRUCTURE OF "VIREC" PLATFORM

THE overall developed system architecture comprises Web servers, Data base servers including also open source servers, run on Windows as well as on Linux operating systems, running on a physical structure formed of microcomputers and laboratory real equipment. The user makes requests to the main Web server via the "ViReC" portal. The main "server side" languages used on the portal that analyse the user requests are ASP, ASP.NET and PHP. Afterwards, the portal sends an appropriate response in the form of a web page, containing HTML which is mandatory, and, depending on the case, FLASH animations and/or JAVA applets as well. For instance, in case of Computer Architecture module, FLASH movies were used to present the main concepts in the tutorial section, whereas JAVA programs (applets) were implemented for the laboratory works. A simplified representation of the entire ensemble is given in fig. 1.

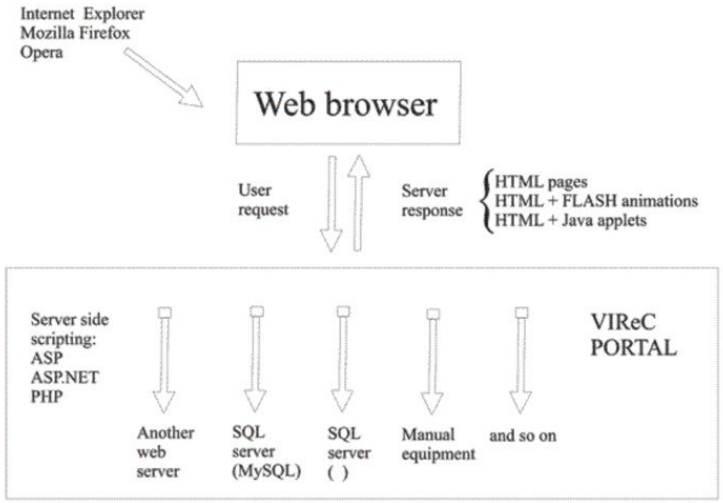

Fig. 1 System architecture

V. The Main Outputs yielded by "ViReC e-Initiative" project

The described project represents a complex approach involving an international collaboration and an efficient interaction between several expert groups responsible for different work packages. A tremendous amount of work was injected in this endeavour, finalized by a positive assessment by independent evaluators appointed by EU Commission.

The quality of the educational process can be increased by means of ICT initiative ensuring superior interdependency between the learning process and high performance technology, like ICT, focusing on the engaged learning and high technology performance.

At present, the integration of services and training systems placed in different geographic sites of a global system, providing information to all actors involved in educational system about the new educational methods and the most recent evolution of the available technology ensures efficient interconnections between European universities, thereby allowing promotion of Distributed Learning Environments. In many European universities there were created adequate ICT resources covering an inter-curricular area which are locally oriented.

"ViReC " project was clearly oriented to development of innovative practices and services, having in view setting up a virtual resource centre composed of a Distributed Learning Environment (DLE), arising awareness of the impact of ODL and the use of ICT in education. Among several remarkable attained outputs, creation of virtual laboratories crossed with some real devices/equipment is considered a challenging achievement. The project succeeded to set up a qualitative learning environment in an academic European network ensuring an open access to improved methods and educational resources, as well as to the best practice applied at partners, by outlining an innovative development of ICT-based educational products.

As a natural consequence of setting up the foreseen Distributed Learning Environment (DLE), the following collateral objectives were fulfilled as well:

a. Promoting a better understanding among educational personnel, decision-makers and the public at large ,of the role and importance of ICT for education;
b. Extended use for educational purposes of new tools and methods incorporating features of the new technologies specific to ICT;
c. Development of ICT-based educational products, in particular multimedia-type, by encompassing improved pedagogical skills.

To emphasize the importance of project monitoring and evaluation, a special activity called "Project management and monitoring" has been carried out. An operational and managerial structure of the entire consortium was elaborated by the general co-coordinator/promoter of the project. The consortium was formed out of seven partners of which three were German, one was Irish, one was Greek, two were Romanian, led by the Project Management Group (PMG)..

The main pedagogical and didactical approaches considered by this project were dependent on the planned activities to be run:

- In synchronous section – new styles of conducting laboratory activity, new approaches for evaluation such activities, new form of live courses delivered;
- In the asynchronous section – new ways of writing and creating multimedia textbooks, new methods of testing learners via quiz, exercises, simulators.

Besides this, it can be appreciated that pedagogical approaches were focused to ensure learning management processes encompassing scheduling and timetabling, assessment of learning, accommodation to learning styles, evaluation of learning against criteria that are transparent, relevant, realistic, reliable and valid. The importance of this facet is pointed out by the content of activity planned at the end of each year, where during the workshops debates on the pedagogy subject were initiated by inviting pertinent specialists.

The outputs were designated O1 – O9, each characterized by specific activities and products.

The Project Guideline (O1) was elaborated by the PMG as a result of discussions during activity A3 (PMG planning meeting for year one). It outlined the main co-ordinates of the project progress for the entire life of the project.

The Consolidated Study (O2) realizing a comparative analysis of the present stage in partner's institutions, including the model and organization, of the DLE was elaborated during the preparatory stage of the project, The first meeting of the corresponding Expert Team was aimed at analysing the achievements of each partner in ODL field as well as at elaborating the organizational model of the DLE. In order to achieve this output, there were identified the distributed hardware and software resources available at all partners (by running the Activity A5). At each partner there were inspected the following aspects:

- Hardware and software resources available to be used during the life project or integrated within DLE
- Experience in the field of ODL and ICT of the staff involved in the project
- Results of previous related projects carried out by the partner institution
- Level of the usage of ICT in the teaching/learning processes.

After data gathering, a comparative analysis and synthesis was performed in order to identify the complementary resources.

By dividing the DLE into sections and modules, the design stage, materialized by O3 , as well as the effective implementation were split between partners. In order to monitor and synchronize the activities, bimonthly videoconferences were carried out.

The Expert Teams informed periodically the PMG regarding the evolution of the tasks and the encountered difficulties.

The design and implementation of the Portal for content and services access of DLE, output O4,of the generic tool destined to assembling and editing multipurpose multimedia materials, output O5,of the DLE lectures, output O6, and of the DLE forum, output O7,were run by each partner through performing the tasks assigned by the PMG. The applied research work was performed by using the following well – known software tools: Visual Web Developer 2005 Express Edition Beta 2, Dreamweaver MX2004, Macromedia Flash MX Professional 2004, Macromedia Flash Player, FrontPage, MySQL Database Server. The implementation of tutorials was backed by multimedia facilitiers, including animations and sound.

In order to elaborate the Biannual Informative Bulletin, output O8, and the conclusive materials corresponding to the stage O9, each partner published in the " ViReC " Informative Bulletin synthetic and conclusive materials, articles on different topics, such as managerial aspects, technical solutions adopted during implementation, etc. Some of the published articles were an outcome of the PMG and Expert Team meetings. University of Craiova co-ordinated and supervised the entire publishing activity.

Summarizing the essence of the designed and yielded products, there can be ascertained the following items: Web – based services (Forum, E-mail), common tools (generic tools, assessment, tracking), multimedia products (lectures, tutorials, laboratory guides), reports (consolidated study, quality criteria, assessments, etc.), needs analyses, biannual informative bulletin etc.

By output O4 it was developed the "VIREC" portal for content and services access DLE, consisting of the Web server which represents the access point to DLE resources and consisting of the following modules: navigation system, VIREC presentation, links to VIREC's distributed resources, registration section and reservation section. The Web pages were written in English, having in view also the development of versions in the languages of each partner from consortium.

By output O5 it was envisaged a generic tool aimed at assembling and editing of multipurpose multimedia materials; this output was achieved as a result of activity A11. Based on this tool the developers were able to process multimedia raw materials to produce versatile tutorials for different disciplines.

With regard to DLE lectures, it must be pointed to the approached two sections:

- synchronous section: distributed training environment based on real laboratory equipment, integrated tool for live presentations, exercises on real equipment.
- asynchronous section, consisting of textbooks (Data security in computer networks, Computer architecture, Network management subjects), tutorials, quizzes. Tutorials consist in animations and at a more illustrative explanations of the main concepts included in the textbooks. The animations were implemented using Macromedia Flash 5.

  A set of efficient simulators was developed for several disciplines, like Data security in computer networks, Computer architecture, Robot control, using for implementation Java technology.

  A set of exercises representing laboratory works attached to different subjects from the treated disciplines.

The educational institutions participating in the project implementation can benefit of the DLE resources as an extension of their own assets. Based on the tutorials and

multimedia textbooks, the professors/teachers can use tools and methods incorporating features of the new technology specific to ICT in the teaching process. Each educational institution will promote the availability of, and improve access to, relevant high quality and innovative learning, in particular through the use of information and communication technologies. Based on DLE resources, each partner will be able to develop new educational and training programs, as well as new learning styles geared to meeting the specific needs of the learners.
Besides some regular common steps undertaken to implement "VIREC e- Initiative" project it can be appreciated that there were two innovative research outputs developed and experienced, namely:

a) setting up mixed laboratory environments encompassing features of real and virtual laboratories;
b) design and implementation of remotely accessible simulators for different technical disciplines.

Such new approaches are very efficient for running the current lab activities as requested by curricula and syllabi at certain disciplines without having a direct access to complex and expensive resources. By means of the foreseen techniques and tools it was allowed remote access to resources at the host institution, by connecting to a set of assigned equipment or simulators.

With regard to the evaluation activity the following methods were used:

a) a Forum was created allowing gathering of comments, observations, remarks, critics, proposals, concerning the facilities offered by ViReC platform. The Forum is consulted by an internal evaluator designated by PMG, who is informing ,in turn, the Expert Team and/or PMG;
b) an independent evaluator was appointed to analyse globally the main features of DLE;
c) the feedback of learners is surveyed by a questionnaire deployed on the Forum
d) by a careful analysis of the assessments of learners realized by internal evaluation where it is outlined the quality of the carried our work.

An extension of activity A17, entitled "Evaluation and validation of the efficiency of ICT based teaching/learning process within ViReC" has to be set at a later instant and therefore the following inner sub-activities emerged: forming student target groups, presentations of the DLE role, presentation of DLE user's guide, learning/teaching activities by using DLE materials and tools, design of questionnaires, feedback evaluation, global conclusion. This final change was required for an improvement of the global endeavour of "ViReC" by treating consistently the Evaluation/Assessment process on target groups of students/learners during one semester of academic activity.

VI. Conclusions

The applied research work performed by the expert groups from "ViReC e-Initiative" consortium should be continued in order to improve the present state of the set-up DLE, to extend the set of approached disciplines, to implement it in other higher institutions. A possible direction of development could be the customisation of the existing products. As mentioned in the paper, a new vision of this endeavour could be approached on a higher layer, by switching to the

constructivist method of learning. This implies a deeper review of the set up products and organizations in order to consider category A referring to the engaged learning and high technology performance. Obviously, such an approach could be tackled through new EU projects in the pertinent European programmes.

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Chapter 6. Research collaboration between universities

Lorna Uden, Kimmo Salmenjoki,Marjan Hericko and Gurumusamy Arumugam

Abstract— *Effective research is a very intensive process. It requires expertise and resources that are seldom possessed by an individual university. In order to pool experts and resources to maximize effectiveness in research, collaboration is needed. However, it is seldom possible for universities to be situated close to each other. Most universities are dispersed geographically. We have found that our research has been converged and we share similar interests in knowledge management. As each of us has different expertise that is all essential for the effective implementation of knowledge management systems, the best option is to collaborate. The Knowledge Management Organization (KMO) group was formed. This chapter describes the formation of our group and the ongoing development of the distributed knowledge management system using semantic web technology to support the collaboration.*

The chapter begins with the reasons why this group is needed, followed by a brief review of knowledge management systems. Distributed knowledge management system is then briefly reviewed. It is then followed by the functions and work of the various partners within KMO. The chapter concludes with how using distributed knowledge management system can facilitate research collaboration between universities through the use of technologies.

I. Introduction

We believe that knowledge is increasingly recognized as the most important asset in organizations and a key differentiating factor in business today. It is increasingly being acknowledged that KM can bring about the much needed innovation and improved business performance in many organizations. There are various kinds of classification of knowledge: formal (explicit) and tacit (expertise) knowledge; foreground and background knowledge; knowledge of business environment or knowledge for control activities [1].

Knowledge management is referred to as the process for creating, codifying and disseminating knowledge for a wide range of knowledge intensive tasks [2]. These tasks can be decision support, computer assisted learning, research (e.g. hypothesis

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testing) or research support. There are various methodologies that support the systematic introduction of KM solutions into an organization.

Knowledge management systems (KMS) are tools to effect the management of knowledge and are manifested in a variety of implementations [3] including document repositories, expertise databases, discussion lists and context-specific retrieval systems incorporating collaborative filtering technologies.

Knowledge management is a multi- disciplinary subject requiring expertise from different topics. This is particularly so when it comes to new trends in knowledge management. We believe that the following topics are important for the future knowledge management development.

Future trends for knowledge management

Web Services

According to Davies, Fense and Richardson [4], Web Services technology can be enhanced by the harnessing of Semantic Web technology to deliver a step change in capability. Web Services provide an easy way to make existing (or indeed new) components available to applications via the Internet. However, currently, Web Services are essentially described using semi-structured natural language mechanisms. This means that considerable human intervention is needed to find and combine Web Services into an end application. The Semantic Web will enable the accessing of Web resources by semantic content rather than just by keywords. Resources (in this case Web Services) are defined in such a way that they can be automatically 'understood' and processed by machine. This will enable the realisation of Semantic Web Services, involving the automation of service discovery, acquisition, composition and monitoring. Software agents will be able automatically to create new services from already published services, with potentially huge implications for models of e-Business. Semantic Web Enabled Web Services will allow the automatic discovery, selection and execution of inter-organization business logic making areas like dynamic supply chain composition a reality.

Semantic Web

Internet and the phenomenon of globalisation have resulted in many organizations and project teams being increasingly geographically dispersed. According to Yoke, Carlsen, Christiansson and Svidt [5], in order to cope with this paradigm change, the organizations require knowledge management tools that enable better understanding of the distributed organizational and project-specific digital knowledge and its corresponding containers, thus, enabling efficient collaboration as well as knowledge capture, representation and user adapted access. Most of the currently available knowledge management tools have limitations. The Semantic Web can be a very promising platform for developing knowledge management systems. Semantic Web enables automated information access and use based on machine-processable semantics of data.

Data mining

Knowledge Management involves acquisition, enhancement and utilization of organizational knowledge. Given the enormous quantities of data stored in

organizational data warehouses, it stands to reason that data mining approaches could contribute significantly to the Knowledge Management process at hand. A fundamental goal of knowledge management is to have a systematic process [6] that can capture and enhance such organizational knowledge over time. To address this goal, academic [7] and industry [8] work in organizational learning and knowledge management suggest leveraging data mining techniques, given the vast quantities of data that modern organizations capture and store.

It is generally acknowledged that Knowledge management research requires expertise from many different disciplines. It is almost impossible for small or medium universities to have the necessary skills to cater for all aspects of the research. Each university would have their own areas of interest that are not always compatible with each other. There may be areas of overlap of interests that a particular university does not possess. It would be good to have a network of research for institutions to work together. To address the effective management of Knowledge Management Research requires that we establish a network of knowledge researchers working together. We have decided, therefore, to form our Knowledge Management in Organization (KMO) research group [9].

Each university will address certain KM elements. However, none of them appears to subsume all of the others. The major contribution of this proposal is to present a more comprehensive and unified framework for describing the nature of KM research by drawing on the expertise of different partners internationally. The KMO group acts as a community of practice (CoP), which is institutionalised, informed networks of professionals managing a shared domain of knowledge [10].

The formation of KMO as a CoP enables us to foster knowledge development and creative innovations amongst highly specialised experts and help to channel our efforts to where they are most needed [11]. It is a key factor in helping us in sharing distributed knowledge as a learning organisation. To help in the sharing of knowledge and expertise between the various geographically distributed institutions, a structured process of knowledge management (KM) is needed to assure the efficiency of our activities and groups (CoP) [11].

We believe that KMO can serve as a CoP where people can interact socially for mutual benefits. One of the factors that can bind community members of practice for lasting interaction is some form of common space. This common space is defined by the organisational context in which we operate. How do we go about defining this organisational context?

We believe that it is important to construct an approach that would support knowledge management in the CoP. Our CoP group fosters knowledge development and creative interactions among experts and helps to channel efforts to where they are needed. To facilitate this, we have developed a structured process of knowledge management (KM) to ensure the efficiency of the group. The aim of the group is to explore the use of technology in knowledge sharing between the various partners. We would like to understand how a virtual team works together. Important research questions to be addressed are:

- How do the dispersed, cross functional and cross cultural teams engage in sharing knowledge?
- How do we use available technologies in sharing knowledge?
- What is the role of technology in such engagement?

Aside from the technical issues concerning our approach, we are also interested in providing a theoretical framework to the methodology. The role of context can be entered from the global and the local perspectives. Although much literature exists about KM in general [12] [13] there is little specific theory to be found about KM in communities of practice [14]. It is our belief that activity theory, a cultural, historical theory, can be used as a candidate for this study [15].

II. An overview of Activity theory

Activity Theory is a philosophical and cross-disciplinary framework for the study of different forms of human practices as development progresses, with both individual and social levels interlinked at the same time [16]. In Activity Theory, a minimal meaningful context for individual activities must be included as the basic unit of analysis. This entity is called an activity. An activity is undertaken by a subject (individual or subgroup) using tools to achieve an object (objective) thus transforming objects into outcomes [16].

An object can be material thing, but it can also be less tangible such as a plan, or totally intangible such as a common idea, as long as it can be shared for manipulation and transformation by the participants of the activity. It is possible that the object and motive themselves will undergo changes during the process of an activity. The relationship between subject and object of activity is mediated by a tool. An activity always contains various artefacts (e.g., instruments, signs, procedures, machines, methods, laws, and forms of work organisation). Activities are realised as individual and co-operative actions and networks of such actions are related to each other by the same overall object and motive. Participating in an activity is performing conscious actions with defined goals. An activity may be realised using different actions, depending on the situation. One and the same action can belong to different activities, in which case the different motives of activities will cause the action to have a different personal sense for the subject in the context of each activity.

According to Kuutti [16], activities can be considered as having three hierarchical levels: activity, action and operation, which can be individual or cooperative. They can be considered as corresponding to motive, goal and conditions. An activity (global) may be achieved through a variety of actions. The same action may be used as contribution to different activities. Similarly, operators may contribute to a variety of actions. Kuutti [16] uses a simple example of these levels to describe the activity (motive) of ‘building a house’ in which ‘fixing the roof’ and ‘transporting bricks by truck’ are at the action level and ‘hammering’ and ‘changing gears when driving’ are at the operation level. Every activity has an internal and external component with the subject and object existing as part of a dynamic and reciprocal relationship.

According to Leont’ev [17], Activity Theory does not accept a 'dualistic conception of an isolated, independent mind'. Cognitive processes are interdependent

and flexible processes. The subject will transform the object, which will itself affect the subject. This internal activity will have a corresponding external manifestation that will also affect the internal activity. This relationship inevitably leads to clashes and contradictions. Actions are planned in the conscious mind and are undertaken using a model consisting of orientation, resources and chains of operation [16]. Initially each operation is a conscious action, consisting of both the orientation and execution phases, but when the corresponding model is good enough and the action has been practised long enough, the orientation phase fades and the action will be collapsed into operation. On the other hand, when conditions change, an operation can again 'unfold' and return to the level of conscious action. An example of the action-operation dynamics is learning to use a manual gearbox when driving a car. In the beginning, each step in the process is a conscious action. But soon the conscious actions begin to transform into operations. The operations that make up the consciously performed goal-oriented actions are usually sub-conscious and automatically performed.

As the structure of Figure 1 is too simple to fulfil the needs of a consideration of the systemic relations between an individual and his or her environment in an activity, Engeström [18] extended the basic structure to incorporate a third component, community (who share the same object). Two new relationships are then formed: subject-community and community-object. Both of them are also mediated as shown in Figure 1. There are three mutual relationships between subject; object and community in Figure 1.

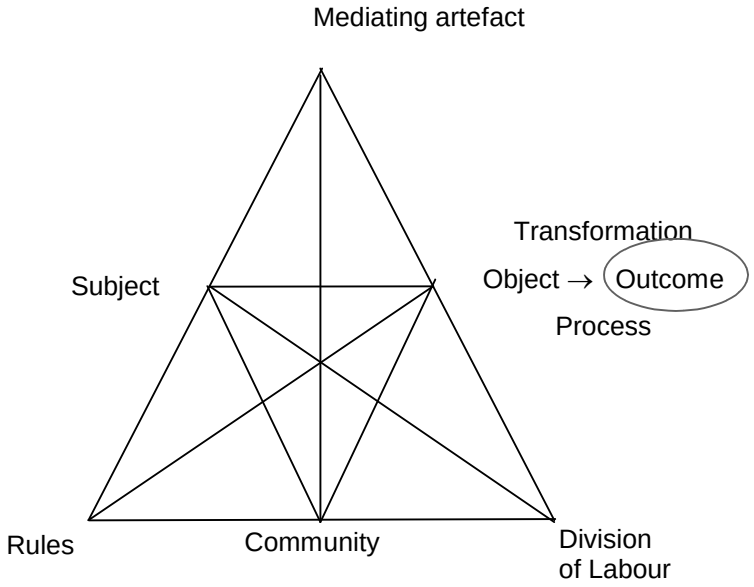

Figure 1: Basic structure of an activity

III. WHY ACTIVITY THEORY FOR KMO?

IT is our belief that cultural-historical activity theory (CHAT) is an ideal candidate to guide us in the development of the KMO collaboration. AT will be used as a theoretical lens to examine the questions of what key role processes play in the

development of KM in CoP and to apply it to a case study. What has motivated us to choose AT as the theoretical framework is our belief that there are several assumptions that guide us when looking for relevant theory. Firstly we believe that communities of practice are important to organisations because they are engines of knowledge creation. It is generally accepted that CoP typically produce innovations, give technical advice on problems and are used as general brainstorming platforms for new ideas. Secondly, that knowledge creation is continuous and expanding. As the community matures it accumulates and applies knowledge, resulting in an internal learning [14]. Thirdly, not all knowledge should be made explicit because many applications require human interpretation and background knowledge. Fourthly, KM processes do not take place in a vacuum, but in an organisational context. Effective processes require clear links to be made between processes, the knowledge sources and organisational goals and workflows. Lastly, since KM is continuously involved in the community, it is important to detect anomalies and interventions performed to refocus KM practices.

IV. Conclusion

KNOWLEDGE management research embodies multidisciplinary expertise. To support effective research among small universities, we have established a research network based on Distributed Knowledge Management (DKM). Each of the universities would act as a local node, with their own team working in their area of interest, but would draw on the other teams' knowledge and expertise when needed. The group would be coordinated by Staffordshire University. We believe that by working together as a group, we will also able to identify issues in knowledge sharing, the use of tools to support the collaborative enterprise using activity theory. Other objectives of KMO include giving support and synergy between the individual PhD researchers and their supervisors and attract the interest of various companies working on information service business and applications.

The development of effective KM systems is a socio-cultural activity. A technical solution is not adequate to address the complexity of the system. It is the authors' belief that a focus on KM technologies without consideration of the social processes is a recipe for disaster. KMSs are inevitably groupware systems that either connect people to people directly or indirectly through sharing knowledge. To support effective KMS, it is necessary to understand the interrelationship of cultural, technical and organisational elements. Although activity theory can provide a structured account of work and cooperative work to understand context and development, it is rather limited because of its descriptive role. While this is beginning to change, there remains a substantial research challenge in developing activity theory and tools to apply in the design of applications to support work such as knowledge management. Activity theory principles are ideal by making visible the structure and dynamics of work situations, especially with respect to contradictions. Contradictions provide a systematic way of modelling and reasoning about breakdowns and opportunities for KM design. The strength of the activity theoretical perspective is the recognition that work systems are inherently dynamic.

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Chapter 7. Tuning Engineering Education with Work Requirements: A Component of Synergy between Teaching and Research in Higher Education

Marcela Rodica Luca, Ph. D.

Abstract— *As a consequence of the technological progress, universities are facing new challenges in restructuring their curricula. The dynamics of occupations in the industrial sector and the continuous change in the content of engineering job requirements imposes updating and upgrading the content of engineering education. For the new members and candidates, joining the European Union triggers the necessity to tune the educational structures for engineering education with those of European universities.*

The EUI-Net research aims to analyse the way universities prepare engineering graduates for the world of work and to suggest improvements for the curricula. The research design has two dimensions: the former meant to define and update the generic and specific competences in the subjects relevant to the industrial sector, and the latter to define and update the generic and specific competences for the students' practical stages, following the already established TUNING methodology.

Putting together feedback on the engineers' competence profile, coming from employers, former graduates and academics, helps universities to tune their curricula to the present and prospective requirements of the industry. As an expression of synergy between pedagogical research and actual teaching, the results are used specifically to improve the educational structure and process. The paper presents the research design and some preliminary results.

I. Introduction

The dynamic changes in the economic and social field have brought about new competence requirements for engineers. For the universities, as educational services providers, it is of vital importance to identify the instructional and educational needs for the new work requirements, to re-design their curricula according to these requirements and to implement them. In the last decade, several European projects have tried to identify such requirements and have developed educational research and curricular designs in order to respond to the challenge.

The Transilvania University coordinated a Tempus CME project in 1997-1998, aiming to design complementary training for university students and graduates in order to meet the competency requirements unfulfilled by the university education. A training need analysis was achieved by questionnaires: academics, graduates and employers rated the level to which some transversal competences required by the labour market were developed by the universities [1]. The conclusions of the

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research were that universities provided good theoretical knowledge - general and topic-specific, but the level of practical skills was, in most of the cases, under the requirements of the jobs. In order to adapt, graduates need a longer period of on-the-job training.

The main competence needs which were identified as unfulfilled by the higher education were related to communication, entrepreneurship and work-related legislation. At that time, the complementary training designed in the frame of the project, as a result of training need analysis, was structured in a three-module summer school, implemented in 1998 in three Romanian partner universities. Each module consisted of 30 hours of interactive training during one week in each university, in turn. The distant impact of the project was the inclusion of some "transversal" disciplines, such as "Communication" in the curricula of several engineering faculties. Even if it was a small project, its influence at the level of Transilvania University was important and contributed to the change of the way the university understood to "tune" the education provided to the requirements of the labour market.

In 2000, the TUNING project adopted a coherent approach, at European level, of the "constant reflection within higher education demanded by the rapid pace of change in society", thus becoming a model of educational research for the higher education [2]. The European integrated economic area needed an integrated higher education area and the above mentioned project contributed to the implementation of the Sorbonne – Bologna – Prague – Berlin process. Among other objectives, the TUNING project aimed to develop professional profiles in seven areas (Business, Chemistry, Education Sciences, Geology, History, Mathematics and Physics), defined in terms of generic and subject-related competences and skills. Following the seminal ideas of TUNING, several other projects are now developing at European level, in different areas and at different levels of the higher education [3].

II. THE FRAME OF THE RESEARCH

THE continuing updating and upgrading of curricula and syllabi in engineering education, in order to make them compatible with the requirements of the labour market and across European universities, were two of the main objectives of the EUI-Net project, coordinated by Transilvania University of Brasov. Two special interest groups within the project – SIG-1 and SIG-2 are concerned with defining two categories of generic and specific competences in order to better tune the industrial and higher education structures in Europe. The former group deals with the generic and specific competences in those university subjects which are relevant to the industrial sector. The latter group deals with the generic and specific competences for student practical stages, as part of the curriculum. The design of the research follows that of the TUNING research. The outputs of the two SIGs will be two books that will be used by the partner universities as reference points for the curriculum design and improvement of the syllabi relevant to the industry. Thus, the EUI-Net project will contribute to the expanding of the TUNING research in the field of industrial engineering education.

There are two circles involved in the research: the inner circle, consisting of universities from EU member countries and from candidate countries, such as Romania, Bulgaria, Turkey, and Cyprus; the outer circle, consists of research

institutes, technological innovation centres, enterprises, regional and professional organisations and other stakeholders. Within the research, the role of the partners is to contribute to the establishment of the two competence profiles mentioned above by their expertise and local connections in the industrial sector.

The objectives of the research are to identify the basic engineering competences required by the industrial sector, their respective importance for the first (graduate) and second cycle (master) of higher education, as defined by the Bologna process, and the extent to which they are developed by the university. Technical universities from candidate countries are particularly interested in learning the actual competence requirements in the perspective of the European integration, in order to modernize their curricula.

III. THE RESEARCH METHODOLOGY

THE instruments used in the research are questionnaires addressed to three target groups of respondents: academics (A), graduates (G), employers, professional bodies and other stakeholders (E). The respondents are each asked to fill a three-part questionnaire, structured as following: the first part focuses on the generic skills and competences in engineering (GESKE), the second on the specific engineering competences (SPECOE), and the third on practical skills in engineering (PRASKE). However, there are some differences between the questionnaires addressed to the three target groups, in terms of content (type of information provided).

Measuring the importance of generic skills in engineering (GESKE)

The questionnaires on generic skills (GESKE) are meant to measure the importance of the generic skills and competences in the perspective of life-long learning. As education providers, the universities are concerned about the skills that allow graduates to continue their professional and personal development after entering the world of work, mainly by means of self-directed learning. In order to allow the comparison with other speciality subjects, our research used, as a common point, the original TUNING questionnaires on generic skills, in its two forms: one for the academics and the other for employers and graduates.

In the first form, for academics (GESKE-A), respondents are asked to rank the 17 general competences (the same as in the TUNING methodology), such as: "*Ability to work in an interdisciplinary team*", "*Capacity to put knowledge into practice*"; "*Capacity to learn*"; "*Knowledge of a second language*"; "*Capacity to analyse and synthesize*"; "*Ethical commitment*" etc.

As for the other two target groups, employers and graduates, the same form of questionnaire was used for both groups (GESKE-E and GESKE-G), as in the TUNING research. This form of the GESKE questionnaire consists of 32 items describing generic skills and competences. Examples of competences from the list, other than those common to the questionnaire for academics: "*Ability to communicate with non-experts (in the field)*"; "*Information management skills*"; "*Interest in cross functionality and additional qualifications for career self management*"; "*Teamwork*"; "*Leadership*"; "*Concern for quality*"; "*Will to succeed*". Two positions were left to be filled by the respondent himself/ herself, with other competences than those listed above.

The respondents are asked to evaluate (a) the importance of the competence for the work in the employer's / graduate's organisation, and (b) the level to which the competence is developed by the university degree, on a four-step scale. At the end of this part, G and E respondents are asked to rank five of the most important competences from the list above.

Measuring the importance of specific competences in engineering (SPECOE)

The questionnaire on specific competences (SPECOE), the same for all target groups (A, E, G), was constructed by the research team starting from the main competences required by the engineering work in the industrial settings, using as landmarks the life stages of a product. After selecting from a wider list of competences, 53 competences were chosen as relevant for engineering education. Specific competences are meant to define the competences that are common for all industrial engineering topics, as they are considered the basics of the profession. Two positions were left to be filled by the respondent himself/ herself, with other competences than those listed above.

This part of the questionnaire is the same for all groups. Some examples of items: "*Systemic approach of engineering problems*"; "*Ability to analyse and establish the product quality requirements*"; "*Ability to carry out functional design tasks for technical systems*"; "*Understand existent and new technology and its impact for new / future markets*"; "*Knowledge of metrological standards in the field*"; "*Skills in presenting scientific material and arguments, in writing and orally, to an informed audience*" etc. For each competence, the respondents are asked to evaluate on a four-step scale the importance of the competence for the first (undergraduate) and second (postgraduate) cycle, as defined in the Bologna process.

Measuring the importance of practical skills in engineering (PRASKE)

For the assessment of the practical skills and competences, a 21-item questionnaire was organised in two parts: the former required an assessment on a four-step scale of 13 items describing practical skills to which other two positions were left to be filled by the respondent himself/ herself. Examples of practical skills and competence items: "*Understanding the industrial flow*"; "*Ability to use professional terminology*"; "*Understanding of job requirements in terms of job performance*"; "*Ability to use company-specific language and acronyms*"; "*Skills in self directed learning and information research in order to solve practical problems*". The remaining 7 questions, with open answers, deal with opinions on different issues of the practical placement.

IV. EXPECTED OUTCOMES OF THE RESEARCH

IN offering universities a list of competences that are considered as being essential for the engineering education, our project attempts to contribute to the integration of the research results into the continuing restructuring of curricula, as well as in restructuring teaching itself. All project partners agreed during the discussions that the curricula in engineering education must be renewed, but the main questions our research tries to find some answers are: Which are the main directions of the change?, What are the competences to be developed in the perspective of

restructuring the engineering education in two cycles?, What are the common trends in engineering education at European level? and others.

At the end of this research we expect to have a panoramic view of the opinions of the three groups on the way universities react to the requirements of the labour market. We are aware of the variety of situations from one engineering field to another, in different countries. The specific research objectives are the following:

- to identify the most important present requirements of the industrial engineering professions in terms of generic, subject-specific and practical skills and competences;
- to build-up a competence profile for the industrial engineering field;
- to differentiate the competence requirements in terms of importance for the first and second cycle of higher engineering education;
- to identify the discrepancies between the competence requirements and the curricula, at general level and in different engineering fields;
- to identify common problems that universities encounter in adapting their curricula to the requirements of the labour market;
- to offer partners some landmarks for changes of the curricula.

In order to achieve these objectives, the 360º feedback provided by the three target groups is essential: it gives information about the actual requirements of the labour market in terms of competence and the utility of the competences given by the higher education at present. In designing new curricula for engineering and restructuring the old ones, it is a matter of crucial importance to take into account what the beneficiaries of the educational services offered by the university (i.e. the graduates and the employers) have to say. These two groups are directly connected to the reality of the engineering profession and are the most competent to indicate which training needs are important now and in the future. This "customer oriented approach" to engineering education is vital for the survival of the universities in a rapidly changing world of work.

The research data will be statistically treated in order to highlight the general trends, the correlations and the differences in point of assessment between the three groups. The research report will include the results of the statistical analysis, presentations of the engineering education system in each country and the particular issues related to challenges universities confront with in adapting the curricula to the changes in the structure of work requirements and restructuring the engineering education according to the Bologna process. The competence profile resulted at the end of the research should be used by partner universities and by others as a frame of evaluation of their actual curricula in engineering education and, as stated above, as reference points in restructuring their curricula.

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Chapter 8. Designing the Curriculum - Transmitting Research Based Academic Knowledge

Silvia Fat

Abstract— *In recent years there has been considerable discussion on the new approaches to the relationship between research activity, teaching and professional practice of students, including structural tensions between them.*

Curriculum development design and delivery is where the teaching/research/practice link is implemented. This is where it impacts on the end-users, the students. The curriculum is seen as a product of different aspects, including supporting student learning out of class; changing external quality requirements; theories of student learning; available resources, including time. Actually, curriculum means: diagnosis of needs, formulation of objectives, selection and organization of content, construction of learning experiences, and evaluation.

The processes of effective teaching and learning are closely related to the processes of effective research and professional practice. The academic studies offer students the chance to learn within a research and a professional practice environment stimulating creation of knowledge. The predominant perspective in education today is constructivism, which is based on the notion that learners actively construct their own knowledge on the basis of prior experiences and knowledge.

The research implies knowledge in practical situations and using a knowledge base to derive solutions to new problems, rather the internalising world of knowledge itself. Experience of research enables teacher to develop curricula which are informed by knowledge of their disciplines, often drawing on outcomes of their own research.

For learning to take place, reflection is crucial. It is the link between research and practice and between experience and practice. It is important the ability to be reflective in the midst of action and active in the midst of reflection, developing the capacity for reflexive learning from experience and a rigorous approach to making sense of experience.

Research-based courses are intended to engage students in real research projects that ask lab or field-based research questions and whose outcome is not known in advance by the teacher or the student. These courses implies: a guide to the planning process, including guideline questions, skill-building activities, assessment techniques for finding out how students are doing, resources such as peer evaluation guides.

Curriculum design and delivery, teaching materials, and approaches to teaching, learning and assessment, can improve the experience and the capabilities of students. For designing a curriculum that is research based, it is necessary to consider: a critical engagement of student conceiving research literature, understanding of the relevance of research in the development of disciplines, the existence of research-process and problem-based methods of learning, performing research skills and ethics taught and practiced, aspects of analysis and synthesis data, testing validity.

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I. INTRODUCTION

WITH respect to curriculum development, a changing "knowledge society" suggests the need for a new curriculum.

Curriculum development design and delivery is where the teaching/research link is implemented.

The curriculum is seen as a product of different aspects, including supporting student learning out of class; changing external quality requests; theories of student learning; available resources, including time.

Actually, Curriculum means:

1. *Analysis of needs*
2. *Formulation of objectives*
3. *Selection and organization of content*
4. *Construction of learning experiences*
5. *Assessment*

In recent years there has been considerable debate on the new directions to the rapport between research activities, and teaching of students, including structural tensions between them.

Just as research can no longer be seen as only discovering or creating knowledge and teaching is more than minimally transmission of what is already known, there are a number of different associations between research and teaching. Ron Griffiths provides an interesting division between:

a. *Research-led*: the curriculum is planned and structured around subject content;
b. *Research-orientated*: the curriculum put stress as a lot on understanding the processes by which knowledge is shaped;
c. *Research-based*: the curriculum is mostly designed around investigation based activities;
d. Research-informed: providing data for teaching and learning processes.

We find a few ways in which teaching and research are connected:

1. *Outcomes*: Research outcomes informing the curriculum with stress on research-based learning.
2. *Process*: Research-based curriculum: gathering data and integrating results of research and practice into the curriculum; developing the curriculum to explain the core concepts, knowledge and practices of the realm have developed through research;
3. *Context*: Developing an inclusive research culture. Providing instruction in relevant research//knowledge, possibly using the students' own potential in the university.

The three areas named provide a structure for the detection of ways in which research activity surfaces in the curriculum and teaching cultures.

The processes of effective teaching and learning are directly related to the processes of effective research.

II. JUST 'TEACHING' IS PAST

JUST teaching" is past. The academic studies offer students the possibility to study within a research environment motivating creation of knowledge. The main position in education today is *constructivism* which is based on the conception that learners actively raise their own knowledge on the foundation of prior experiences and knowledge. We need to move the stress from content and product to much more focus on the process of doing research. It means transforming all knowledge into "personal knowledge". It means helping them become "legitimate participants" in the research discourse community of the discipline, not just passive consumers of a "canon" of knowledge.

Research-based learning opens a door to discovery and innovation, even takes an enormous quantity of time; (this time will mean more time on our teaching and less student learning). More important, teaching and learning acts with this research-based approach necessitates a new approach to assessment. In addition, this new research-based learning requires planning. Phrase "research-based" may also imply one-dimensional notions of linear causality – the idea that teaching causes learning and those linear improvements in teaching will generate linear changes in learning. These views are simply artificial.

The research implies knowledge in practical situations and using a knowledge base to obtain solutions to new problems, rather the internalising world of knowledge itself. Experience of research enables teacher to expand curricula which are informed by knowledge of their disciplines, often illustrating on outcomes of their own investigation.

Research, which is finest prepared in tandem with teaching is the process by which facts, concepts, hypotheses and theories are examined, revised, and built upon for a more complete understanding of the universe, nature, culture, society and the human mind and body. Students are engaged in an inquiry based curriculum, opposite to a transmission based curriculum. The learning context is designed according to research on how to teach and learn effectively.

In research-based learning, research is regarded as a topic which underpins teaching at a series of levels. As well as incorporating outcomes of research into curricula, it includes developing students' consciousness of processes and methods of enquiry, and creating an inclusive culture of research involving staff and students. We can analyse a few dimensions of research of students, like:

1. Research activities are associated with the learning outputs?
2. Learning activities practised are perceived by the students as agreeable?
3. Specific skills (e.g. team work, data analysis, time management,) are acquired during these activities, practiced and assessed?
4. Extent of effort or commitment set into.
5. Upgrading of understanding of the subject.

For learning to take place, reflection is crucial. Critical reflection becomes the basis for the search of improved outcomes. In teaching, the outcome is student learning and critical reflection seeks to improve that learning by successively refining teaching approaches. It is the link between research and practice and between experience and practice. It is important the ability to be reflective in the middle of action and active in the middle of reflection, developing the capacity for reflexive learning from experience and a precise approach to building sense of experience.

Research-based study want to fit into place students in real research projects that inquire lab or field-based research questions and whose result is not known in advance by the teacher or the student. These courses implies: a guide to the setting up process, including guideline questions, skill-building activities, evaluation techniques for evaluate students activity, resources such as peer evaluation guides.

It is always hard to quantify the impact of innovative teaching on student performance. It is useful comparing, for example, student performance and experience in traditionally taught courses and in practice placement and research-based learning ones.

The faculty views education in very broad terms, concerned with all methodical attempts to provide a suitable situation for learning and growth. Teachers also meet the requirements of those accountable with learning and development in places other than schools: health, business, social work, industrial training, the law, public service, and professional associations, so on.

III. Opportunities offered by research of students

These opportunities include experiential active learning such as group decision making on educational issues; field-based learning such as internships; peer instruction; and structured group experiences such as community service, international study. Practice and research help students develop articulate principles system, because learning communities are committed to ethical standards. Preparing for future profession, keeping information up to date, both of them develop problem solving capacity, group working skills, creativity, and time management. The students also perceived benefits for future employment from their participation in research and practice. In the same time, we can provide through research and practice high expectations for student learning, like academic achievement and social success. At a macro level, practice of students builds supportive and inclusive communities, encouraging debate.

To grow official recognition teachers must show how their practice is informed by ethics including: recognition of individual differences, dedication to scholarship, practising equal opportunities, and continued reflection on professional practice. Effective student practice is the key to student success.

In constructing association between teaching, research and practice, the study domain is an important intermediary. We notice in recent times the increase of the significance of holistic, multi-disciplinary and inter-disciplinary approach. The element they have in common is the process of learning, research is an act of learning or discovery, while teaching produce the act of learning.

A very important point of view is offered by the second way described.
Research-based curriculum implies instructional resources whose goal is to improve students' achievement through:

- Experiential learning
- Inquiry-based pedagogy
- Direct investigations
- Authentic assessments
- Application of their learning
- Consciousness of their own learning goals

- Opportunities for self-assessment and monitoring their own learning experiences.

Research-based curricula are in general characterized by the next components: Based on scientific principles which are validated by research; Present progressive information and skills at each grade level; resound with cultural values of students in relation to age, ethnicity, community values; Taught by educators well trained in the curriculum so that the program is taught with commitment; Based on cognitive-behavioural principles, such as modelling, behavioural and cognitive rehearsal, goal setting, coaching and feedback; Provide opportunities for practice of skills in realistic situations. Provision of constructed internships can turn inquiry-based learning into practical experience; internship opportunities need to be widely available.

IV. Action Research Approach

We believe that an action research approach can contribute very positively to this researched-based curriculum. Action research approaches to educational research were adopted in the late 60s and early 70s by the 'teacher- researcher' society. This methodology offers a systematic approach to introducing innovations in teaching and learning. No division need be made between the design and delivery of teaching, and the process of researching these activities, by this means bringing theory and practice jointly.

So, we find a few steps developing such a project.

1. Conduct action research to discover about recent resources and best practices.
2. Formulate an application proposal for integration.
3. Implement and observe the pilot program, with constant assessment of students and the programme.
4. Adopt a programme and continue to assess.

"Through systematic, controlled action research, higher education teachers can become more professional, more interested in pedagogical aspects of higher education and more motivated to integrate their research and teaching interests in a holistic way. This, in turn, can lead to greater job satisfaction, better academic programmes, improvement of student learning and practitioner's insights and contributions to the advancement of knowledge in higher education." (Zuber-Skerritt, 1982).

Action research has a number of further distinctive features, as offered by Zuber-Skerritt, (1982): it is a critical analysis (reaching critical changes), reflective (developing concepts and theories about shared experiences), accountable, self-evaluative, and participative (the researcher is not an expert doing research from an external perspective, but a partner working).

We hope to build a model based upon our experience which will be convertible to other curriculum improvement initiatives.

We aim to apply concretely the model offered by the action research cycle.

1. Identify a few objectives and formed initial working hypotheses, for example, to facilitate the development of transferable skills through an authentic learning. Strategies to develop transferable skills in areas such as, self-management, communication, group work and information management, are proposed to train students for work outside of the academic contexts.

2. *Plan a curriculum model* including a didactic strategy to support it: The teaching strategy we have determined upon experiential and constructivist learning principles, so students are engaged in a group-based team research project supported by the use of computer-mediated communication technologies. We can imply individually-based learning activities required by students to gain the most from their learning activities.
3. *Put these into practice* the module. The main form of evaluation is by coursework (the group project), supplemented by individually-produced learning activities.
4. *Made observations* on our practice and evaluated its effects.
5. Preparation for *modifying our practice*.

We need research that helps with making decisions in curricular development, taking into account all constraints (see Bakker et al., 2005),

Research is needed in the following areas:

1. Research into professional development should be a main concern.
2. The connection between resources, professional development, and assessment is interactive, so relationship among interdisciplinary teams is vital.
3. More suitable assessment tools are needed.
4. Research about curriculum help developers make concrete.
5. The practice of curriculum development shows that research in the strict sense is only one of the many resources from which curriculum developers can profit.

Curriculum design and delivery, teaching materials, and approaches to teaching, learning and assessment, can improve the experience and the capabilities of students. For designing a curriculum that is research based, it is necessary to think about: a critical engagement of student conceiving research literature, understanding of the significance of research in the progress of disciplines, the existence of research-process and problem-based methods of learning, performing research skills and ethics trained and practiced, aspects of analysis and synthesis data, testing validity.

V. AN INTEGRATED CURRICULUM WITHIN RESEARCH ACTIVITIES

AN integrated curriculum within research activities has received a great interest in educational settings. A necessary definition of integrated curriculum is offered by Humphreys (Humphreys, Post, and Ellis 1981): “Skills and knowledge are developed and applied in more than one area of study”.

Within this structure of integrated curriculum there are a few levels of combination, as illustrated by Palmer (1991), who describes the next practices:

a. Developing cross-curriculum sub objectives within a given curriculum guide
b. Developing model lessons that include cross-curricular activities and assessments
c. Developing enrichment activities with a cross-curricular focus including suggestions for cross-curricular "contacts" following each objective
d. Developing assessment activities that are cross-curricular in nature
e. Including sample planning wheels in all curriculum guides.

Another term that is often used likely with integrated curriculum is interdisciplinary curriculum. These definitions support the view that integrated

curriculum is an educational approach that prepares students for lifelong learning, having some features:

- A mixture of subjects
- Emphasis on projects
- Relationships among concepts
- Thematic units as organizing principles
- Flexible student groupings.

Factors that need to be considered in an integrated curriculum are (Gehrke 1991; Jacobs 1989; Lipson 1993; MacIver 1990): Common definitions of terms (such as theme, strand, or outcome); Available resources; Flexibility in scheduling; Support services; Subjects and concepts that will be integrated; Links between integration and broader outcomes; curricular scope and sequence; How evaluation will occur; Parent and community support; Themes that promote the transfer of learning and connections; Team planning time that is used to exchange information about content; students, special areas of teacher expertise; and teaching methods.

Fogarty has described ten levels of curricula integration (1991) in her work ”*The Mindful School*”. The following chart summarizes some of her work. The ability to make connections, to solve problems by looking at multiple perspectives, and to incorporate information from different fields, will be an essential ingredient for success in the professional career.

Common planning time is needed to allow teachers to decide on themes, explore resources, examine student learning styles and needs, and coordinate teaching schedules. Based on an extensive review of the literature and discussions with teachers, Shoemaker lists the following as essential components of an integrated curriculum:

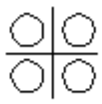
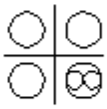
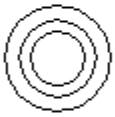
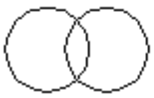
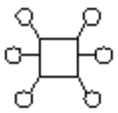
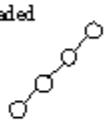
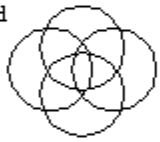
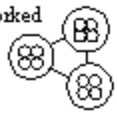
- Core skills and processes, as social skills and problem solving.
- Major topics. Each curriculum strand is further divided into major themes.
- Questions. Questions are used to further define major themes and imply activities.
- Unit development. From the major theme and the questions, knowledge, and skills related to the concepts, teachers plan activities that will lead to the development of knowledge and skills which will answer the questions. Teachers also collect resources and develop actual lesson plans and assessment strategies.
- Evaluation. Through an assessment of student progress the unit is evaluated.

The conclusions support the positive effects of curriculum integration. Lipson (1993) summarizes the following findings:

- Integrated curriculum helps students apply skills.
- An integrated knowledge base leads to faster retrieval of information.
- Multiple perspectives lead to a more integrated knowledge base.
- Encourages authentic learning.
- Promotes positive attitudes in students.
- Provides for more quality time for curriculum exploration.

Thus, an integrated curriculum within research area is a means, not the result.

It is necessary for each university to determine the best procedure to meet the needs of the particular student. Rather than move from a traditional, subject-specific curriculum to an integrated curriculum in one sudden remove, universities find more success when they make gradual changes. Best practices for initial and ongoing in-service teacher training need to be explored more fully.

Name	Description	Advantages	Disadvantages
Fragmented 	Separate and distinct disciplines	Clear and discrete view of a discipline	Connections are not made clear for students; less transfer of learning
Connected 	Topics within a discipline are connected	Key concepts are connected, leading to the review, reconceptualization and assimilation of ideas within a discipline	Disciplines are not related; content focus remains within the discipline
Nested 	Social, thinking, and content skills are targeted within a subject area	Gives attention to several areas at once, leading to enriched and enhanced learning	Students may be confused and lose sight of the main concepts of the activity or lesson
Sequenced 	Similar ideas are taught in concert, although subjects are separate	Facilitates transfer of learning across content areas	Requires ongoing collaboration and flexibility, as teachers have less autonomy in sequencing curricula
Shared 	Team planning and/or teaching that involves two disciplines focuses on shared concepts, skills or attitudes	Shared instructional experiences; with two teachers on a team it is less difficult to collaborate	Requires time, flexibility, commitment and compromise
Webbed 	Thematic teaching, using a theme as a base for instruction in many disciplines	Motivating for students, helps students see connections between ideas	Theme must be carefully and thoughtfully selected to be meaningful, with relevant and rigorous content
Threaded 	Thinking skills, social skills, multiple intelligences, and study skills are "threaded" throughout the disciplines	Students learn how they are learning, facilitating future transfer of learning	Disciplines remain separate
Integrated 	Priorities that overlap multiple disciplines are examined for common skills, concepts, and attitudes.	Encourages students to see interconnectedness and interrelationships among disciplines, students are motivated as they see these connections	Requires interdepartmental teams with common planning and teaching time
Immersed 	Learner integrates by viewing all learning through the perspective of one area of interest	Integration takes place within the learner	May narrow the focus of the learner
Networked 	Learner directs the integration process through selection of a network of experts and resources	Pro-active, with learner stimulated by new information, skills or concepts	Learner can be spread too thin, efforts become ineffective

VI. RECOMMENDATIONS

THE curriculum, as a vehicle for professional development and school reform, exploits the potential synergies between research, and student learning. There are opportunities to promote alternative content and methods because academic autonomy often gives individual teachers opportunity to do things in a different way

in their own classrooms, mainly in decentralised systems. One of the biggest challenges to the quality of higher education in developing countries is the absence, with a few notable exceptions, of a research culture.

Clearly relationship between teaching, practice placement and research in the curriculum has been little discussed in formal higher education literature. Our belief is that the linkage needs to be a much more persistent one in practice.

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Chapter 9. Enhancing Academic Research & Education Synergy – Transilvania University

Elena Helerea, Maria Popescu, and Claudiu Coman

Abstract— *Starting from the actual exigencies of the Higher Education, regarding the solving the society's problems, both by professional training and by research & innovation, the paper deals with the analysing the synergy concept and its application to the relationship academic research & educational process in order to establish the strategic actions at the institutional level, based on the sociological study realised at the Transilvania University from Brasov.*

I. INTRODUCTION

THE synergy represents a phenomenon with specific forms in many kinds of the reality. Basically, the term defines the behaviour of a whole system as an entity, which has new features towards the behaviour of the each components of the system. The synergy appears as a multiplication of the system properties, so that the outputs of the system where the synergy is developed are bigger than the sum of outcomes of its parts.

The concept was applied for the first time to the natural phenomena, and beginning with the 20-th Century it was valued in the socio-economic environment, at the level of working teams, organizations and partnerships /organization networks.[1] – [4].

In the paper, this concept is applied to the binomial system academic research & education, in order to increase the whole university efficiency and effectiveness.

The research and education represent the two essential sides of the mission of the higher education institutions: research – as a kind of the original investigation capable to bring in the scientific field a new and valid knowledge, and education – as a teaching and learning process for the development of the competences and the skills of the students and other professional groups, in order to be competitive in an economic global world.

The research & education relationship is a flexible connection between the academic research and learning activities, with biunique effects. This relationship has been investigated in numerous scientific works, especially in the latest decades. The new exigencies for the universities in a global world of economy and knowledge regarding both, the training and the research and innovation activities, impose new managerial tools and strategic actions regarding the enhancement of the academic research & education synergy. In this perspective, the aim of the investigations is to improve the outcomes of the research and education activities comparatively with the independent approach of the two domains. In Romania this requirement is stronger in

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the EU integration perspective, for the harmonization of the academic research and education to the European area of knowledge.

Generally, the strategies promoted at the institutional and national level approach distinctly the two domains. The present paper is focused on the development of coherent actions in order to ensure their simultaneous rising by synergic effects.

II. APPROACHES REGARDING THE ACADEMIC RESEARCH & EDUCATION RELATIONSHIP

THE conclusions of the studies regarding the academic research & education synergy and its results are polarized on two perspectives:

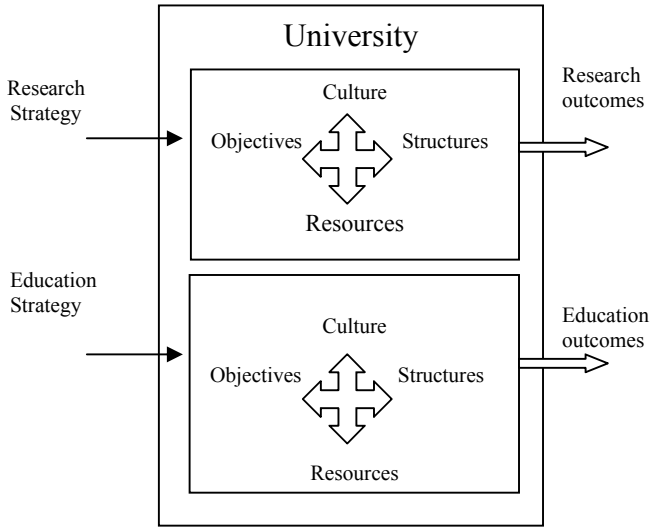
- the teaching-learning activity has no interactions with the research;
- the research has a benefice effect to the university education.

According to the first approach, there is no scientific proof to demonstrate a strong connection between research and education. The supporters of this version consider the connection research & education is most an academic myth, used to justify the affinity of more teachers, from the numerous universities, for research activity. They affirm:

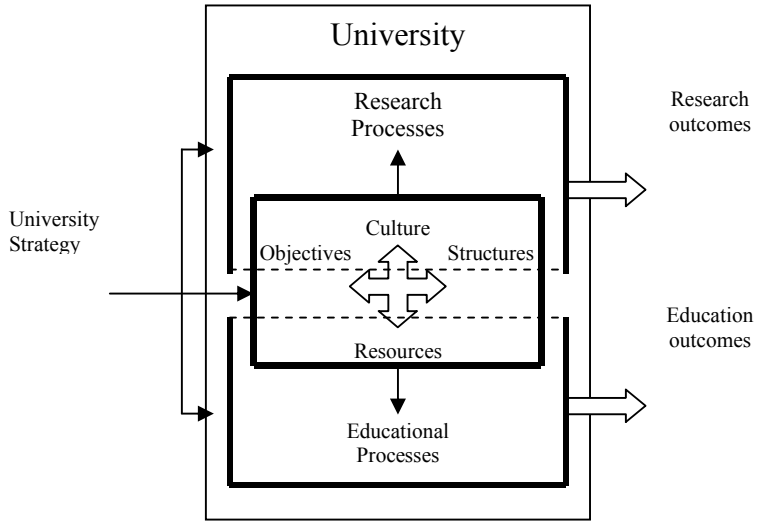
- there are insignificant correlation between research and education process [5];
- there are no arguments in the favour of the functional influence of the research on the efficiency of the didactical activities [6] - [8];
- there is a part of academic staff especially involved in the teaching-learning activities, although the research and the scientific publications are the most important means to reach the academic status;
- the focus of the effort on the research could lead to the teaching process depreciation and the decreasing of the courses quality;
- the differences between the features of two domains make difficult the investigation [9].

According to the second approach, the evolution of education in the universities depends on the existence of the research & education relationship synergy. Some arguments are presented:

- there is a favourable perception of the students which appreciate the results of the academic research and the enthusiastic presentation of the new knowledge by the teachers-researchers [10]- - [12];
- research is considered as an appropriate way to enhance the teaching-learning processes, which stimulates the modern active learning and facilitates the acquisition of the new information and knowledge and development of skills;
- the research-education models are more efficiently if the teachers-researchers have the appropriate didactical competences [13].



a. Research and Education as independent domains.



b. Research and Education relationship, synergic effects.

Fig.1. Relationship between academic research and education.

In figure 1 the two conceptions regarding the approaches of the academic research & education relationship are presented. The research and education as independent domains involves the existence of the distinct structures and strategies (Fig. 1.a). The research and education as interconnected processes involves common structures, strategy and actions with synergic effects (Fig. 1.b).

III. SOCIOLOGICAL RESEARCH – CASE STUDY

THE aim of the sociologic research is to analyse the perception of the team – teachers and students – involves in the research-education regarding the connection between R& E activities.

The target group was the students of master studies and the teachers – responsible of the specific research directions of the university. The research tools were the questionnaires and Group Delphi.

The questionnaire was applied to 120 students from master studies, with 95% confidence level and ±3% error delay. The basic hypotheses of the investigation are:

- Research improves the quality of didactical activities (i.e. teaching-learning processes) in university system;
- If research is used in teaching activity, the interest of the students for the course increases;
- Student perception on the relation research & learning process is positive.

The items are grouped by their signification, as follows:

- items 1 and 2 are introductive with the role of "ice breaks" in report with respondent;
- item 3 points out the modality in which the students imagine the components of the two processes, R&E;
- items 4, 5 and 6 have the role to inform about the student perception on the connection between the didactical and research activities;
- items 7 and 8 have a similar role informing about the student interest degree for the courses where the research and teaching are complementary;
- item 9 tries to show the classification made by the students when they could chose between research and education and the relationship R&E;
- items 10-17 are socio-demographic.

The student questionnaires data were processed with SPSS program. The analysing and interpretations of the data confirm all hypotheses:

- 72.5 % of the participants sustain that there are a relationship between research and the quality of didactical activities;
- 67 % of the students affirm that their interest to participate to the course is bigger, when new knowledge based on research are integrated;
- 43% of the student respondents appreciate the development of the professional skills by their participation in the research projects;
- 67% of the students consider that the course quality is improved;
- 48 % of the participants sustain that the research motivate them. The students take over the teacher-researcher enthusiasm regarding the scientific discoveries.

Group Delphi technique was applied to 10 teacher- researches – responsible on the specific research directions in the university. It was organized as an exploratory unstructured interview. The aim was to analyse the perception of this target group regarding the R&E connection.

The results of data proceeding show:

- There is a direct connection between the outcomes of the research and teaching-learning process;
- Among the elements which compose the research process were mentioned the material and time resources - an inverse connection regarding the time of work in these processes was underlined;

- All the participants consider that the research-education system is a true "nervous system" of the university, and the improvement of the synergy between research and didactical activity (accepted to be real for all experts) is a necessity, having in view the educational models based on research, promoted by Bologna process;
- Many teachers tend to develop the activities in a single domain, identified with their teaching subject, and this generate difficulties in the inter-disciplinarily approach. It was put the accent to the development of the common research-education laboratories and informatics' networks, interconnected in order to improve the communication;
- The role of the teacher-researches is underlined and some proposals for a good profile design were mentioned.

The study underlines a positive perception of the academic staff and of the students regarding the benefits of the research on the education, a university without research is a non-perspective institution.

IV. MODALITIES TO IMPROVE THE RESEARCH-EDUCATION CONNECTION. MODALITIES TO IMPROVE THE RESEARCH-EDUCATION CONNECTION

THE perspective of this chapter is in connection with the new management processes, methods and tools, which are developed in the university for enhancing the synergic system of research-education.

In the frame of a common strategy, the actions are directed to the management of the research and education resources, both material and human:

- Development of the appropriate tools for a systematic analyses of the research-education synergy effects;
- Sustaining the new education program studies and courses in direct connection with the priorities of research activities and the outcomes obtained, using the feasibility studies and other analyse tools;
- The accent to the development of the common research-education laboratories and informatics' networks, interconnected in order to improve the communication and to enhance the quality and efficiency of the didactical activities;
- Promoting the new methods of the academic staff selection and recruitment, based on the creativity tests and other evaluation tools to put in evidence the creative potential of the participants;
- Development of the research skills of the academic staff by training courses and doctoral studies;
- Promoting the modern teaching-learning methods like problem-based learning and project-based learning, to contribute to the increasing the research skills of the students and academic staff too;
- Implementing a system of evaluation and the rewording of the human resources of the university;
- Change of the organization culture in which the accent to be put on total quality of the research and education processes.

These actions are included in the complex programs of the development of the university and are coordinated by the top management of the university.

V. CONCLUSIONS

THE purpose of the university is to provide the advanced knowledge through research, to disseminate this knowledge, to train people for professional employment and to serve the aspirations and aims of prevailing society. Thus, the connection between research and education is very complex and requires developing the appropriate tools for a systematic analysis of the research-education synergy effects.

The Transilvania University case study underlines the positive perception of the academic staff and students regarding the importance of the research for the university and the connections between research and education: the research stimulate the learning and education performances contribute to the increasing of the quality research.

The paper presents the main actions promoted by top management of the university to develop the relationship of R&E . Having in view that the teacher-researcher academic staff has the determinant role in the university performances, the promoted actions refer especially to the human resources management, as: recruitment, research training and continuing education, promoting the new interactive methods for teaching, learning and assessment.

APPENDIX A- QUESTIONNAIRE

Good day! My name is Mihai Burlacu. I am master student of the Law Faculty and Sociology and I make an investigation for a project of Transilvania University of Brasov. I want to put you some questions. We are interested in perspectives, intuitions and your modality to think about binomial system research and education.

1. Do you think there is a connection between the research and teaching-learning process?
2. Which are the modalities to acquire the research skills in the faculty? Arrange in descendent order:
    a. printing support;
    b. classical lecture;
    c. research project;
    d. problem solving;
    e. practical stages;
    f. others, which?
3. Could we include the research and teaching – learning process in an integrated system?
4. Do you consider the research activity of the academic staff is benefic for the education process? Argue the answer!
5. The results of the research developed by the teaching staff (choose):
    a. increases the interest for the teaching subject;
    b. motivate you to learn;
    c. bore you;

d. determine to regard with no interest the lecture;

6. What do you think about the connection of research with education?
   a. very bad;
   b. bad;
   c. ambivalent;
   d. good;
   e. very good;
7. Note as false or true the following enounces:
   a. I have trust in the professors who present their outcomes of the research;
   b. Consider the connection between research and didactical activity rather a mistake;
   c. The master students should participate more in research projects;
   d. The didactical activity should not be in connection with research;
   e. There is no direct connection between the research and learning;
   f. Using the new knowledge resulted from the direct research has improved my learning outcomes.
8. What do you think about the following affirmation?: The future of our university depends on the relationship between the academic research and learning process.
   a. total disagreement;
   b. partial disagreement;
   c. nor/nor.

APPENDIX B – INTERVIEW - GROUP DELPHI

Good day! My name is Mihai Burlacu. I am master student of the Law Faculty and Sociology and I make an investigation for a project of Transilvania University of Brasov. We are interested to know your perception concerning the relationship between academic research and education.

1. Do you think, in your opinion, there is a connection between research and teaching-learning?
2. Which could be the elements of the research process in one hand and of the teaching process on the other hand?
3. Could we think about an integrated system of research & didactical activities at Transilvania University?
4. What do you think about this system comparatively with an object or an organism?
5. Could you describe the synergic behaviour of the research-education system?
6. Which is your perspective regarding the relationship regarding academic research and teaching-learning process?
7. What is your perception about the relationship research-education as cybernetic system?
8. In our opinion, what is more important for our university – research or didactical activities?
9. Could you propose the strategy and methods for enhancing the synergy between the research and education?

10. Could you synthesize your opinion about the synergy between the research and education?

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PART III. UNIVERSITY INDUSTRY COOPERATION MODELS

Chapter 10 The Relationship between the University and the Business Community in an Ever-Changing Society

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Abstract— *The modern relationship between universities of technology and society as represented by its industrial and entrepreneurial actions is analysed and presented from the point of view of the Romanian experiences with rapid international changes and the growing into the dimensions and responsibilities of the European Union.*

I. INTRODUCTION

CONCEIVED as "closed cities," the first universities were meant to instruct trainers for society and to gather men of ideas who were trying to explain environmental phenomena and to maintain certain states of mind. Later on, while new preoccupations, especially technological ones, developed in society, a non-traditional formative side beside the classical one started to take contour in universities, which acquired an intense significance in a great variety of scientific fields of research.

The end of the XIX-th century and the beginning of the XX-th century marked a decisive step in the evolution of universities.

As scientific and technological achievements occur and alter so fast, due to the frequent changes in socio-economic life and to the globalisation tendencies of the forthcoming world, universities will have to be conceived of as being in a close interdependent relation with society and their degree of flexibility and adaptability to the social changes should considerably increase.

II. GLOBALISATION AND INTERNALISATION – TENDENCIES IN THE CONTEMPORARY WORLD

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THE demographic evolution, but especially the great discoveries in science and technology, has led to a powerful exchange of raw materials, products and information among different regions of the world. As a consequence, nowadays we witness the foundation of a global society, with an international liberal market.

Unfortunately, this phenomenon of globalisation, with major economic and social effects, is more difficult to be supported by countries with a less developed economy, with populations that are not able to adapt rapidly to the great changes that marked essentially the end of the second millennium.

The major effect of globalisation is internationalisation, which is characterised by the establishment of international institutions and companies and inter-cultural education. The globalisation and internationalisation have a very strong impact on higher education, universities facing a rise of educational demands.

In their turn, universities have to create a management which needs to confer an adequate instruction from a national, regional and international point of view.

Although modern universities are characterised by a high rate of autonomy at the national and regional level, for example in Europe, common strategies and compatible performance criteria are necessary to facilitate the mobility of labour force and unlimited access to new discoveries in science and technology.

In future, neither the national factors of decision nor the regional or international institutions will be able to neglect that the society of knowledge will be at the same time the society of instruction.

III. AN INFORMATIONAL SCHEME OF INTERDEPENDENCE BETWEEN SOCIETIES AND UNIVERSITY

THE university (U), conceived as an organisational structure having, as a rule, a training mission on one hand and a scientific research mission on the other hand, may be considered a dynamic system (that is, evolving in time!). As inputs, this system has a series of operative managerial programmes (OMP), as outputs, a series of resulting performances (RP) and it is submitted to certain disturbing factors (D) due to society's influences (fig. 1).

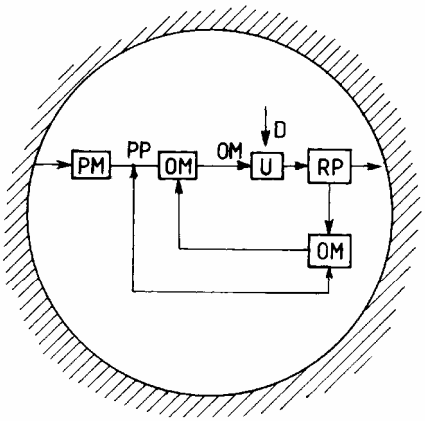

Fig. 1

The Predictable Management (PM) has to encompass information as precise as possible on the "state" of the society at a certain moment, as well as on its tendency

of evolution. Subsequently, using an appropriate organising structure that might be conceived of even at a national level, it is necessary that PM should provide university data as accurate as possible about:

- the need of manpower according to social-professional categories, both at a national level and at a geographical area level where the influence of the university is mainly exercised;
- the domains of major interest for the evolution of social economic life;
- the graduate's stock of knowledge so that one could integrate relatively fast in a certain place of work but also, so that one could easily adapt to change of work place;
- the need for professional reconversion;
- the scientific and technological discoveries that may lead to the supply of new places of work.

The set of resulting performances (RP) define the public role of the university. It may refer to:

- professional performances of the graduates;
- the degree of absorption of graduates in the labour market;
- the contribution made by the university to reconvert the manpower;
- the scientific achievements in fields of both local and general interest (environmental protection, creation of new enterprises etc.);
- the co-operation between the university and other social structures and mechanisms.

In order to carry out the role it has undertaken, the university has to project and to activate a management and an adequate managerial structure. As the general scheme shows, in Fig. 1, the management has to be achieved both at a predictable level (predictable management, PM), and the operative level (operative management, OM).

On the basis of some data processing mentioned above, MP has to establish a set of fulfilment programmes of the provisional performances (PP), which are supposed to have in view the following:

- setting up curricula allowing the graduates to attend competitive professional performances (estimated, at least in the first phase, by means of real chances of getting a job);
- developing a continuing education system which could allow the graduate a "migration" from the professional domains that lack interest, to those that provide greater chances of getting a new placement;
- developing scientific research, creating new laboratories in accordance with new technological and scientific achievements;
- establishing some precise measures of co-operation with society, in those fields joined with the educational system itself: organisation of scientific meetings, participation in specialised surveys etc.

The difference between the predicted performances and the real ones is due to some internal disturbing factors (which arise from the university and develop within it) and also to some external factors, such as diminishing budgetary allocation, unpredictable changes that may occur in society etc. Consequently, through a proper flexible structure, the university management has to include the component MO (fig. 1). This one has to realise a series of corrections (the modification of the curricula and / or of the syllabuses, modification of the university's organisational

infrastructure, etc), so that the performances attained should correspond as much possible to those predicted.

IV. ENTREPRISES AND SOCIETY

ENTERPRISES may be seen as organised structures in interdependence with society and with well established objectives. Informatively it can be conceived as in fig. 2 in which we have used the following symbols:

S	-	society (considered in local regional or international context);
EO	-	the block (structure) of external optimisation;
IO	-	the block (structure) of internal optimisation;
F	-	enterprise (firm);
XIS	-	the initial information taken from society;
XII	-	the initial planned information;
XIO	-	the total initial information necessary for launching the products in fabrication;
XI	-	the total initial corrected information;
Xps	-	the disturbing factors of society which appear during the fabrication of product;
XPf	-	internal disturbing factors of enterprise unanticipated during the launching of product in fabrication;
Xei	-	the information referring to the finite product;
Xes	-	the external information (from society referring to the finite product);
Xri - Xre	-	corrective information;
CI, Ce	-	blocks (structures) for correcting information;
IL	-	the internal logistic of the enterprise;
EL	-	the external logistic of the enterprise.

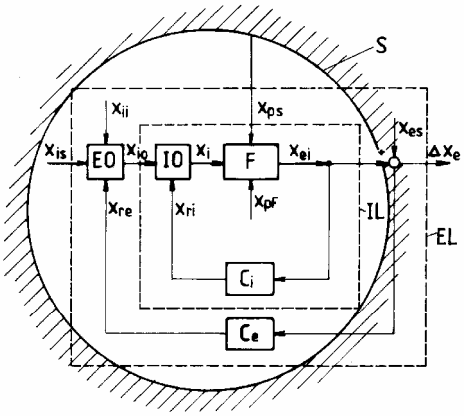

Fig.2

Society (the environment) S is characterised at the moment $t = t_o$ by a series of items of information referring to:

- the stability of the world economy
- the scientific and technological level of products similar to the product which is going to be produced by the enterprise
- The demand on internal and external markets for products that are going to be produced in F (firm)
- The competition in the specific domain
- the sell prices of products similar to the product that is going to be launched in production
- The costs of raw materials, electrical and thermic energy
- The enterprise infrastructure costs and the capital costs
- The amortisation costs
- The existent wages on the labour market
- The internal and international transport costs
- The legislation concerning production and sale

All these items of information, quantified or not, represent the information Xis which is indispensable for the launching of a certain product in production and then on the market.

The information Xii is established by the board of enterprise within the frame of external logistic, which needs to specify a series of elements, such as the following ones:

- the volume and the rhythm of production
- the pre-established performances of product
- the estimated cost (for production and sale)
- the estimated profit
- the market of interest for that product
- the modernised or new infrastructure
- the structure and size of personnel
- the volume of wages

The block (structure) of external optimisation E O is made of the specialised departments of the enterprise. These departments have to compare information Xis and Xii, the result Xio of this analysis constituting the input dimensions of the enterprise. It is used for establishing the enterprise organisational structure (referring to the product that is going to be launched in fabrication), for all managerial activities, investments, personnel, production cost and the performances of the product. The mentioning of the Xio information allows, practically, the launching of the product in fabrication, the block of internal optimisation having no role in this phase.

The Xps disturbances appear during the entire period from the launching to the sale of product and they represent a consequence of the dynamics of the transformations, which have taken place in the human society. These transformations may refer to:

- the new achievements in science and technology
- the changes on the free market
- the changes of the raw materials, energy, services and transport
- the local, regional and international disturbances of the social-economic life.

Disturbances Xpf represent a measure of the lack of anticipation concerning to all data which are necessary for making the product at the desired parameters. For example if within the frame of Xio information the acquisition of some equipment is estimated at certain performances and costs, and for financial reasons another type

of equipment, with other performances, is acquired, productivity and production costs will be influenced considerably.

If the use of certain software is not the best solution the acquisition of another one will influence directly the production costs.

Information regarding the finite product Xei

It means the global indicator of the product's performance from a technical point of view.

Xio and Xei – only accidentally could be equal. Only occasionally the technical performances of the product are identical with the planned ones. Consequently, through the monitoring departments (the CI block), within the internal logistic frame, enterprises need to prove a great flexibility and to correct as fast as possible the data Xio using Xri information, so that the difference between planned performances (Xio) and achieved performances should tend towards zero. It is obvious that this process of operative corrections should have a certain delay, a certain "constant of time".

The Department which compares the Xio and Xri information, makes up the block (structure) of internal optimisation OI, and within the internal logistic of the enterprise, it has a major role in preserving the technical performances of the product.

"Confrontation" on the free market confirms or doesn't confirm the technical and economic performances of the finite product.

As a rule, an enterprise obtains many important data for its external strategy (logistic) in this phase.

Consequently the comparison of the technical-economic information Xei of the product introduced on the market with the similar products to which it is in competition Xes leads to a series of correction data DXe. These are processed by the Ce block (structure) (the specialised departments of enterprise) and are sent to the block of external optimisation (Eo). In this stage, within the frame of external logistic, modifications occur in the general strategy concerning the projection and launching of the product in fabrication.

V. THE UNIVERSITY AND THE ENTERPRISE LOGISTIC

MODERN universities are totally open towards society. Although they have been maintaining, at least partially, the tradition of the classic universities, in which fundamental research is developed and the unexplained phenomena are explained, nowadays, academic communities are required to lead to scientific and technological progress, to support the development of new products and enterprises through scientific research.

After 1990, in Romania, we have witnessed a reducing in national institutes of research.

In the past these institutions received themes of research from the central level, which was not a real support for a free market economy. In these circumstances, universities have to be able to support small and medium size businesses, continuously training their faculty and offering the research potential in applied sciences.

A few forms in which Universities could be involved in the internal and external logistic of enterprises are the following ones:

The continuous training is a wide spread form of supporting the internal logistic of enterprises. In most Romanian Universities, there are centres for revaluating the higher educated human resources. Using the experience of the Universities of Western European Countries (for example the Polytechnics of Turin), University Transilvania of Braşov offers courses in advanced technologies, projection on computers (in co-operation with AUTODESK, the powerful American firm) the enterprise management (in co-operation with IBM). The specialist's preparation in Economics and Foreign Languages is of great interest.

The foundation of new firms near University campuses is at the moment a major national preoccupation.

There are a lot of legislative initiatives to create incubators and centres for scientific and technological transfer, and the local communities ensure the necessary infrastructure for entrepreneurs to start up their small businesses.

Co-operation between Universities and great international firms is another tendency of the economic reorganisation in Romania.

Firms as Siemens, Motorola and ABB have been accepted in the campuses of the Transilvania University of Brasov. Using the intellectual potential of the academic community, these firms are developing new products, and at the same time they are good examples to be followed in internal and external logistic of the modern enterprise.

The interference of the trans-national enterprises is also facilitated in Universities. Big companies choose their collaborators from among students in the last years of university studies, taking into account not only their professional training but also their professional interests.

Mediation in business is another major role of the Romanian Universities in the transition to a free market Economy. Universities alone or in co-operation with Commerce Chambers and other local and regional institutions organise a series of meetings with businessmen from Romania and abroad.

A good example is the traditional meetings organised by the University Transilvania of Braşov with businessmen from the central part of Romania and from Baden Württemberg County of Germany.

The preparation of the specialists in the modern logistic field is offered by Universities through postgraduate (master) programmes.

Romanian and foreign teaching staffs, specialists from prestigious firms, present the novelties in firm management and international marketing, and Romanian and foreign Universities confer diplomas acknowledged at least at the European level.

VI. CONCLUSIONS

THE rapid international changes due to globalisation and the creation of a European space of knowledge impose great changes in higher education. Both at the national and institutional level, new managerial structures will have to be created which could adequately collect and process the data provided by society.

The entire society, together with universities and enterprises, will have to increase their responsibilities, to focus on their flexibility and adaptability, so that the future

will be marked by a general prosperity, the diminishing of the unemployment rate and by more and better work places.

In the context of these responsibilities, both university and enterprise should be conceived of and managed in interdependence, at least for the European countries which have been recently accepted in European Union, or are going to be accepted, this being a sine qua non condition for reducing the economic discrepancy between us and the countries with a developed economy.

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Chapter 11 A University-Industry Partnership to serve for an Innovation Pole in Western Greece

Socrates N. Kaplanis

***Abstract*—** *Partnerships between the University and Industry sectors, either at national or European level, were given policy priority in the E.E.C. since more than 3 decades. The target was to liaise the Universities and their courses to the socio-economic needs and regional development strategies.*
The University potential in collaboration with market or industry staff, in the project to be described in this paper, is expected to contribute to regional development and high Quality Education and Training, through various innovative efforts and initiatives, planned by this partnership.
The paper describes a new effort by the T.E.I. of Patras, based on its previous experience in European collaboration projects, to establish a partnership under the title: Energy Management for Intelligent Buildings with Incorporated Renewable Energy System (EMIRES), at a rather regional level, with a European-wide component.
The partnership is funded by E.C., Community Structural Funds by 75% and the rest, 25%, by private funds, i.e. the partners funding the project.
The partnership has 12 partners. 5 from the university sector and 7 from the economic-production sector, while 2 of the partners are based outside Greece.

I. Introduction

From the early 80's the E.C. encouraged the establishment of University-Industry partnerships and networks, which proved to build a clear European context and targets [1]-[6]. The targets were Technology Transfer and Training, joint ventures, cohesion between societies, competitiveness, development of human potential etc. The issue was to switch the University management towards the concept on how to liaise with the socio-economic and regional development [7]-[10].

The experience in European networks was an asset for planning further initiatives with stronger local or regional impact [11]. The trend is either to join sectoral networks or inter-regional partnerships, which both bridge Industry and Higher Education establishments.

The European Community support through the E.S.F. is highly appreciated by the University and the Industrial sectors, as it contributed to forge the European component of their strategies.

Such a strategy has two big components. To meet the market needs to satisfy students, parents, staff and consequently all state holders.

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A national plan to establish Regional Innovation Poles, (R.I.P.), in each one of the six regions of Greece, attracted the interest of the 12 partners, 10 from Greece and 2 from other European countries, to join efforts to design and develop innovation products in the field of Energy Management for Intelligent Buildings with incorporated R.E.S. elements (EMIRES).

The synthesis of the partners are 5 from the Universities and 7 from the economic-production sector. The 2 non-Greek partners are: Siemens PSE in Brasov and the European Thematic Network of Universities-Industries, EUI-Net [12], based in Brasov, too.

It is very important for the viability of this partnership and its impact to the economic-production improvement that 2 of the partners are the Chamber of Western Greece with 20000 members and the Agricultural Cooperatives of Olympia and Pyrgos city in W. Greece.

II. THE ESTABLISHMNENT OF THE EMIRES PARTNERSHIP A SHORT DESCRIPTION

THE above mentioned partners, extensively discussed either in meetings or through communication by e-mails, about the profits of a common initiative, within the frames of the Regional Innovation Pole (R.I.P.), in the region of W. Greece. They all realised that an active interaction of partners from the Academic, Economic and Productive sectors, is necessary to be established upon the principles of Complementarity and Subsidiarity. Finally, they decided to co-operate in the field of Energy Management for Intelligent Buildings with Incorporated R.E.S. Elements.

Objectives: the development of innovations through transfer of research results and understanding the needs analysis, in the field of R.E.S. applications in Intelligent Buildings, Energy Savings, and Clean Environment.

The project, of 2 years duration, answers the Directives of E.U. on the Energy Savings in Buildings (2002/91/E.U.) and the Rationalization and Management of Energy Systems [13].

The above initiative, analytically, includes:

1. The establishment of the EMIRES Consortium: Founding members; Organisation & Articulation, Regulations of Operation. Responsibilities and Competences to be assigned to each partner.
2. Needs analysis strategy, concerning R.E.S. in buildings, like:
   a) Retrofitting planning or new types of buildings with R.E.S. elements in the nutshell.
   b) Management of the loads of buildings, based on microprocessor control systems and web services.
3. Planning Research and Development activities, based on Strategic Planning and particularly on the analysis of the requirements of the users-clients, the attributes or the specifications of innovative systems and/or products.
4. Technology Design activities;
   a) Teams of research will design, analyse, develop and manufacture prototype new systems that can contribute to the energy management of the buildings and energy saving, even with tele-management (Basic Research).

Research and testing will be at the Solar Campus of the T.E.I. of Patras.

b) Industrial Research: this part takes place for concrete applications for energy savings, based on the R.E.S. technologies.

Standardisation tests will follow the development phase.

c) Demonstration projects of the EMIRES consortium. It is planned that the products, such as energy roofs and facades, PV combi systems etc. [14] will be demonstrated in partners premises, where will be monitored.

This stage will be promoted after the basic and industrial research stages. Examples are: Energy Roofs and Facades. Combined PV systems, solar thermal engineering systems and electronic control systems to manage the energy behaviour of R.E.S. systems integrated into the buildings.

Certification procedures.

5. The adequately equipped R.E.S. Laboratory to function for testing and certification of the innovative products.

All the above issues, staff and final year or pg students will play a significant role.

III. EMIRES: METHODOLOGY, ORGANISATION AND COLLABORATION BETWEEN PARTNERS

THE following fundamental activities will make up the EMIRES profile in the regional development.

1. Initially, it is drawn up and signed the EMIRES statutes, organisation and operation details. Partners are assigned competences and obligations towards the Consortium.
2. Policy details about basic research, industrial research and demonstration projects to be developed in EMIRES, will be outlined; the viability of this Consortium depends on the success of these three modes of RTD.
3. The partners in the frame of this cooperation, will establish a team with experts, in order that, within three (3) months, concrete market requirements asking for resolution, via new systems / appliances / products / services / software etc., will be presented.
4. A mixed team of experts will determine the specifications using a Q.F.D. analysis[15]. Determination of the added value for the proposed innovation projects and the competitiveness of each project's product(s).
5. A research team, mainly from the Laboratories that collaborate within this Consortium, but also, from technical and scientific personnel of the other partners, will be the heart for the innovations design.
6. Tests facilities for products performance and standardization, validation and certification.
7. Training of the technical staff and clients and finally technical documentation.

Keeping in mind, the objectives of the proclamation of the Greek Ministry of Development about Regional Poles of Innovation in the frame of Competitiveness, the Consortium promotes the reciprocal collaboration and potential cooperation of

the two spaces; that is to say, the Academic & Research world in one hand, with the space of Production-Services, on the other.

For the achievement of all the above, special concern, via this Consortium, will be for:

1. The creation and operation of a space of interaction, between the academic potential and executives of the production world, or the users themselves, aiming at:
    a) The ascertainment of needs (Needs Analysis) in the field of R.E.S. applications in the buildings sector for energy management and savings.
    b) The specification, standardization and certification of the products to continuously meet the requirements.
    c) The further development of Strategic Planning activities, towards innovations in fields to be specified by the Needs analysis.
2. The centre of activity and concretisation of all those innovation efforts will, mainly, be in the Campus of R.E.S. of the T.E.I. of Patras. The same holds for tests and initial demonstrations.

The Consortium will host annually according to the plans, 10 final year projects of graduates. All those projects will be part of the innovations and the needs analysis policy.

3. The development of a Management team towards the development of innovations via Quality Function Deployment.
4. An expert group that will determine the specifications of the products to be market competitive.
5. The innovation efforts will follow the stages of basic research, industry research and the optimisation of the energy performance of buildings, based on the management of R.E.S. integrated on the shells.
6. Training of professional and technical teams, about service and maintenance of technology products developed and certified by EMIRES.
7. Meeting the requirements of the Directives of E.U. eg. 2002/91/ Directive 2001/77/EK on the Energy Attribution of Buildings, the Saving of Energy and the Management of Industrial Energy [16].

IV. TECHNICAL DESCRIPTION AND DELIVERABLES:

THE objectives of the R.E.S. team, which is the heart of EMIRES Consortium, spring from a research project funded by the Hellenic Ministry of Education [17], as well as from the European collaboration with other Universities [site: http//:solar-net.teipat.gr].

The deliverables are specified below:

1. Design and development of products or special constructions, that will be incorporated in the nutshell of buildings, to exploit the solar energy and the conditions of environment, so that comfort is created indoors, with the minimal consumption of conventional fuels.

Products:

a. New types of buildings, design of bioclimatic buildings and buildings of zero energy.

b. Standardization of building designs, to meet requirements for energy savings and clean environment.
c. Standardisation of materials to meet the new requirements, i.e. components, form, special properties.
d. Techniques and technology for the incorporation of materials or R.E.S. elements in the building shells.

2. Planning of intelligent buildings: new materials, micro-controller systems, web based services, too, for loads management; optimising buildings energy performance.

Product: on-line loads management for buildings, based on the prediction of the daily solar energy to be absorbed.

3. Planning of hybrid energy systems /innovations, where the R.E.S. play the main role, linked with other R.E.S. systems or conventional ones for the buildings, as well as, for rural or industrial applications.

Innovative Products:

Development of a B.M.S system, such as the one of Siemens. Also, codes and protocols for decision-making management systems.

4. The design of customised solutions on R.E.S. applications for isolated regions (islands, mountains etc.) and the installation of prototype models, there.

Product: Installations of R.E.S. and hybrids, for application in solar refrigerators, automated greenhouse operation and other rural applications.

5. Long-term storage of thermal energy in the ground and its recuperation for heating of spaces, e.g. buildings, greenhouses, premises etc.
6. The design and construction of prototype energy roofs and facades.

Products:

a. Technology of incorporation of PV-Systems in the facades for co-production of power and heat.
b. New designs and constructions with incorporated elements in facades, roofs, solar chimneys: prefab structures or wooden frames to host energy roofs or facades.

7. Intensive short training courses for technical staff and clients; as well documentation for each innovation product.

V. DISCUSSION

THE planning of the preliminary stage to establish EMIRES took 6 months of contacts, discussions, documentation and other administrative actions. It was a serious effort based on the assessment of the previous experience on European projects for Technology Transfer and Training.

The preliminary group meetings held in main cities in W. Greece, along with the clear commitment to share private funding by 25% at least, provided a clear evidence of real investment on regional development. A self-confidence, to meet market requirements with cooperative innovative products, finally was build by the EMIRES partners.

The EUI-Net and Siemens PSE contribution to EMIRES establishment was welcomed, as this partnership resembles to a very successful pattern, the UETP [1], [10], funded 15 years ago by the E. C. This new pattern provides a special added value of the European role and profile of the R.I.P. of W. Greece.

The series of activities envisaged the R.I.P. described in this paper, provides changes to the departments of Mechanical, Electrical and Electronic Engineering of the T.E.I. of Patra to enrich their cumulation content with updated objectives and case studies.

It, also, provides students and staff to be involved in RTD activities of high level, whose outcomes are to be real products for the market.

This fact has a strong impact to the employability of the graduates, the competitiveness and department's effective funding.

Finally, R.I.P. activities act as a platform to transfer RTD know-how to the University teaching and learning sphere. This is an impact issue in the check list of the EUI-Net project for the Evolution of the European Universities.

VI. ACKNOWLEDGEMENT

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Chapter 12 Interlinkage of University Research Activities and Firms´ Practice: a case-study

Drahomira Pavelkova and Adriana Knapkova

Abstract— *The goal of this chapter is to show the possibilities for interlinkage of university research activities and firms´ everyday working practice. The chapter contains a case-study describing the creative academic research and other activities of the research team and its connection to business life - on the basis of solving research projects dealing with companies and clusters´ competitiveness and performance. This case-study also shows the possibilities for mutual cooperation and ways in which the research results can be transferred into working practice.*

I. INTRODUCTION

COLLABORATIVE ventures between universities and working practice are an unavoidable component of their success as well as of their meeting their set aims – i.e. the breeding and training of graduates needed in the business world, and which could best use their knowledge and skills and abilities to benefit their own success and growth. For these reasons, it is essential to look for a variety of possible ways in which to interlink university-level education with entrepreneurial working practice.

At the same time, it is necessary to create the conditions for the transfer of results of academic research activities into working practice – by the creation of communication paths, mutual information-sharing about results and needs, and the establishment of appropriate mechanisms for such forms of collaboration. The following text shows ways and means (opportunities) as to how the above can be put into practice.

II. CASE-STUDY

THE case-study describes an example of interdisciplinary research and the linkage of university research with entrepreneurial working practice. Tomas Bata University (further only TBU) has several faculties – the Faculty of Technology, the Faculty of Applied Informatics, the Faculty of Management and Economics, the Faculty of Multimedia Communication, and the University Institute (future Faculty of Humanities - with study programmes of a pedagogical, philological and health care provision orientations). The faculty orientations create a solid basis for interdisciplinary research.

In 2003, the small academic research team at the Faculty of Management and Economics (further only FaME), TBU in Zlin was granted grant project supported by the **Grant Agency of the Czech Republic (GAČR)** entitled "Factors Influencing Economic Value-added in the Plastics and Rubbers Processing Industries".

Within the framework of the resolution of this project, a wider team was created especially from academic staff at FaME, domestic and international experts from the

Both authors are with the Tomas Bata University, Zlin, Czech Republic

field of working practice, and including the participation of students of the Master's and Doctoral Degree study programmes.

Representatives drawn from the academic staff with a share in the resolution of this grant were deliberately chosen from a variety of economic fields with a significant influence on enterprises` performance (i.e. the fields of finances, accounting, statistics, enterprise economics, etc.). Other important members of the research team were experts drawn from domestic and foreign working practice fields.

Equally, a significant share was provided by students, who – within the context of their diploma theses and dissertations, devoted their attentions to research into the ways and means of measuring and managing the performance of enterprises with an especial orientation on the concept of EVA in a variety of enterprises engaged in the plastics and rubbers processing industries in the region. This research also allowed a number of students to gain a range of experiences of the practical day-to-day running of such enterprises and, in turn – the enterprises gained inspiration for improvements to their systems for the management of performance.

Within the framework of the research, the most significant factors for the performance of the plastics and rubbers processing industries – which have a strong representation within this region, were identified. Within the university itself, there is a strong representation and orientation of research into, and educational programmes for, this sector, especially at the Faculty of Technology (the oldest faculty of the university). Young doctoral students of this faculty were also involved in working on this project.

The results and outcomes of the project resolution were – apart from their diploma theses and dissertations, also a range of articles published in professional magazines, conference proceedings from both domestic as well as international conferences, and a monograph which summarised and acquainted the professional public with these outcomes and results. A significant component of the publication is the case-study of a concrete enterprise with which the research team worked in close collaboration.

The final phase of the project saw the organisation of a seminar, in which representatives of the plastics-processing industries of the region, the academic community, the regional self-government organs and CzechInvest took part. The seminar was divided into two parts. The first concentrated on presenting and discussing the project research results and outcomes. The second set out to familiarise participating enterprises with the "Cluster" initiative which has begun to develop within the region.

In 2005, the University in conjunction with the Zlin Region, founded a new company - **Technologické inovační centrum (Technological Innovation Centre – or TIC)**, and one of the key activities of this centre has become the initiation of so-called cluster projects.

In view of the strong representation of plastics-processing enterprises in the region and the research potential and background for this industry, these plastics-processing enterprises were addressed as regards making use of these initiatives.

The project, oriented on the performance of enterprises (with an orientation on EVA), ended in December, 2005. In spring 2005, the research team applied to the GA ČR agency for support of a new project entitled: "Clusters Performance Measurement and Management". This project was accepted, and its solution is planned for the 2006 – 2008 period. Thereby, the project links onto the results and outcomes of the preceding research study.

The young team continues in its activities and endeavours, new students have been recruited – who, within the framework of their work, will orient their attention on the possibilities for increasing the performance of individual enterprises through their engagement and involvement in the cluster.

At the same time, continual collaboration continues with the cluster initiative through the intermediary of the TIC in the form of mutual exchanges of observations, knowledge, and experience with the managers of the clusters and the participation of students in seminars organised for the enterprises in the clusters.

Within the framework of the project resolution, an extensive benchmarking study is planned of experience with the management of clusters and the possibilities of increasing the performance of enterprises participating in the cluster – especially as regards foreign plastics-processing clusters. The results and outcomes of this study will then be handed over to the plastics-processing cluster operating within the Zlin Region.

On the basis of a study of the Theory of Clusters, benchmarking studies, and observations upon the management of the performance of enterprises, a model for the measurement and management of the performance of clusters shall be elaborated, which shall be applied to and verified on the plastics-processing cluster in the region.

The team working on the resolution of this project is all experienced representatives of the academic and working practice spheres of cluster initiatives. Students will thus be able to draw on these experiences and at the same time, to participate in the resolution of the practical problems of the contemporary globalisation tendencies of the world of business, in which clusters represent one of the most significant possibilities for maintaining and even increasing the competitive abilities of enterprises and whole regions.

This case-study also demonstrates the possibilities for exploiting state-support (grants) with a synergetic effect in the form of support for research endeavours (e.g. GA ČR) and cluster initiatives (i.e. structural funds in the form of OPPP - Operational Programme Industry and Enterprise).

Scientific/Academic research activities in the field of polymers are concentrated at the Faculty of Technology within the framework of the **Centre for Polymer Materials**. The centre represents a cutting-edge worksite, which collaborates with many enterprises both at home and abroad. It is a potential source of research background and support for the newly created plastics-processing cluster.

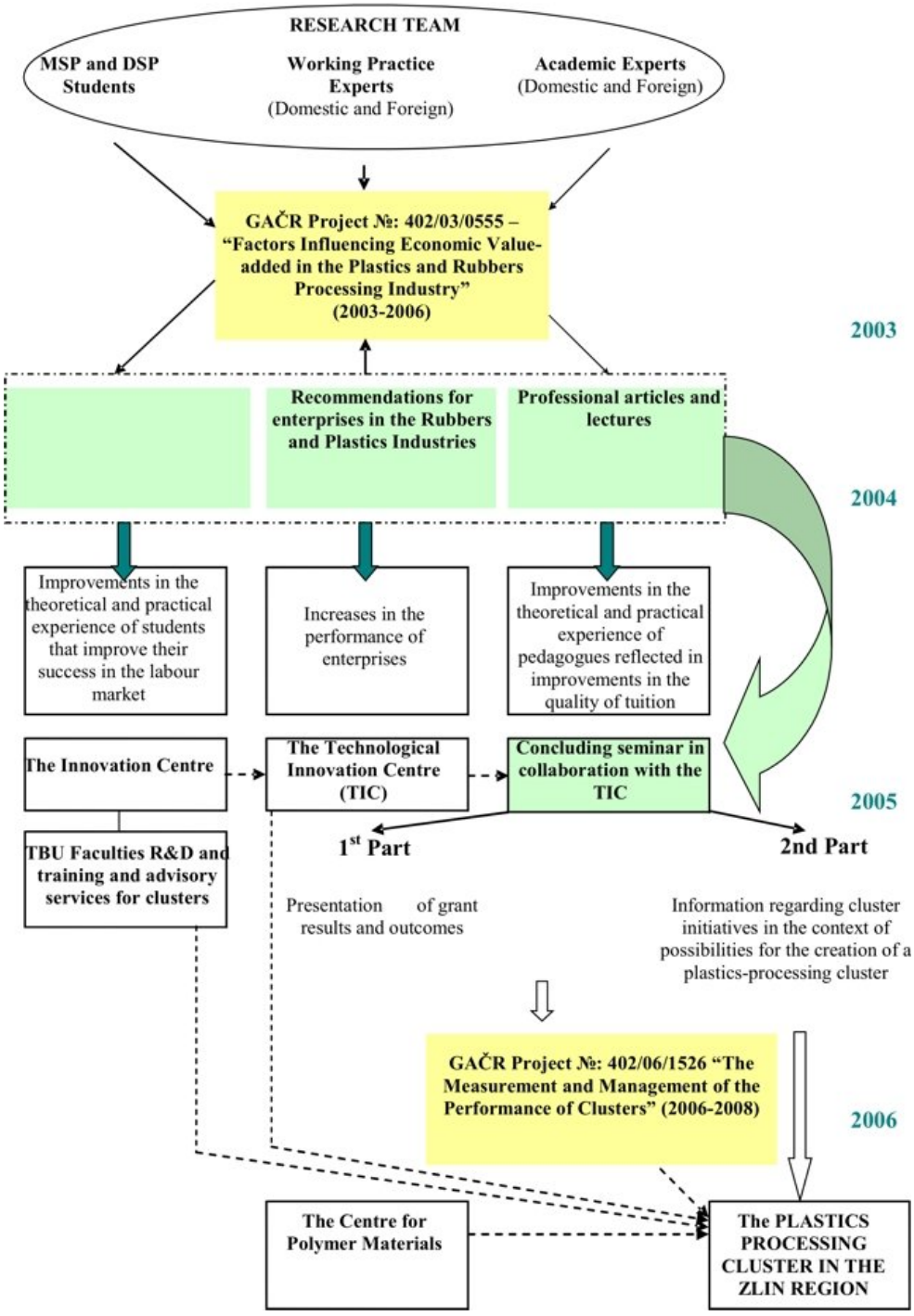
In the field of **innovation**, the collaboration of university research and working practice is realised through the intermediary of the so-called **Innovation Centre**, which inaugurated its activities at the beginning of 2004 under the name of the Regional Innovation Centre. During 2005, a change occurred in that the name was changed and the Technological Innovation Centre Ltd., founded by TBU (50%) and the Zlin Region (50%), was spun-off.

The **Innovation Centre's activities are concentrated on**:

- The creation of a system linking basic and applied research at TBU with industry.
- The creation of the conditions for the origin and development of small and medium-sized innovative enterprises oriented on the realisation of new technologies, and the competitive abilities of products and services.
- The promotion and increasing of the possibilities of applying the results and outcomes of the research realised at TBU in Zlin.

- The ongoing offer of possibilities for collaborative ventures with TBU in Zlin, and especially in the fields of applied and industrial research.
- Applied and industrial research in the fields of polymer materials and nutritional supplements.

Fig 1: Collaboration between Selected University Research Teams and Enterprises.



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- The ongoing offer of possibilities for collaborative ventures with TBU in Zlin, and especially in the fields of applied and industrial research.
- Applied and industrial research in the fields of polymer materials and nutritional supplements.

The foundation of the **Technological Innovation Centre** is a communal project between Tomas Bata University in Zlin and the Zlin Regional Council. The company was founded by two entities who have significant standing and positions within the region, and which play an important and indispensable role in the support and development of innovative business dealings within the region. Tomas Bata University in Zlin prepares the human resources and conducts the basic and applied research.

The Zlin Region, in its role of a higher territorial self-governing body, is responsible for the development of the region as a whole. This conjunction of both partners serves to create the conditions for the fulfilment of the goals placed on them by society-at-large.

The key aim of this company is to fulfil the strategies for economic development of the Zlin Region, to create the conditions for the development of innovative business in the region, and for the exploitation of the results and outcomes of research in entrepreneurial working practices with an emphasis on high-tech technology and for the development of new branches and sectors, technologies, and services.

Further, to create the instrumentaria in support of innovative activities which enable stimulation of economic growth and prosperity in the region, increase the competitive ability of local enterprises, and which contribute to the origin and maintenance of highly-qualified employment opportunities.

Among the core activities of this company are:

- The operation of an entrepreneurial incubator and technological park.
- The assurance of the centre's activities for the transfer of technologies.
- The creation of conditions for the creation and strengthening of clusters.
- The support of creative and innovative activities within the region.
- Cooperation in the preparation of the Zlin Region's Regional Innovation Strategy.

The whole course of the collaboration between the university's research ventures and local enterprises is clearly set out in Fig 1. (previous page).

III. CONCLUSION

THE aim of all of the above-mentioned activities should be the strengthening of the three elements of the knowledge triangle formed by: research, education, and

innovation – and this should be assured by the best experts, the creation of a world-class model for education and research, and also by the forming of a partnership between the academic community and local entrepreneurs.

ACKNOWLEDGEMENT

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Chapter 13 Comments about University-Industry relationship: the case of Operations Management

Carlos Ochoa Laburu and Arantxa Tapia Otaegi

Abstract— *The aim of this chapter is not so much to give conclusive answers to the problem of University Industry relationship but to present the current state of this controversy related to the field of Industrial Engineering and particularly to Operations Management, to make some comments based on our own experience about it and to raise some questions about the feasibility, even the need, of introducing changes in the current requirements for the development of academic careers.*

I. INTRODUCTION

UNIVERSITIES all over the world exist to fulfil three main goals: educate future leaders of their communities, promote the advance of knowledge in every academic field (research), propose an offer of continuous education to practitioners. I think that there is no need to document these three purposes, we can see them in the statements of the Mission of our institutions as well as in the introductory chapters in Universitary Laws in every country.

Since the de decade of 1990 there has been in Europe (EU) a reinforcement of the role that research must play in universities and research is becoming an increasingly important task for university teachers. This is true in every academic field and also in Industrial Engineering and in Operations Management as a branch of it.

Anyway, there is a controversy, an old one indeed but each time more important, about some issues related to research and university-industry relationships. This relationship is important in many academic fields but especially in Industrial Engineering and so in Operations Management.

The core of this controversy is that it seems to be a faint relevance of university research results for industry and that actually they are becoming two different worlds each time more divergent. What, if true, would be a dramatic paradox of important consequences.

We have to remark that maybe this debate does not affect all the academic fields but it is very important in fields close to everyday business practice and less related to the development of "basic theory". Such is the case of Industrial Engineering or Business Management and Operations Management as a branch of them. In fact these are fields where there are very few universally accepted laws, theories, authors, institutions, publications and fields where in the last thirty years we are witnessing a

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tremendous revolutionary change in concepts, systems, techniques and, for sure, authors.

It is also interesting to remark that this debate is concentrated more in the role of University (supply push) that in the role of Industry (demand pull) or even the role of Public Administration (funding, incentives, etc.).

The structure of the chapter is:

- The evolution of Operations Management: the milestones in the science and its incorporation to the teaching
- The debates: the research agendas in Operations Management and its relevance to industry, the education process
- Conclusions

II. THE GENEALOGY OF OPERATIONS MANAGEMENT

In the field of "academic" Operations Management there is quite an old debate that affects its very essence:

- Do we exist or not?
- Are we "scientific" (that is academically respectable) enough?
- Do we change our courses programs as fast as the practice is changing? That is, reflect they accurately the reality?
- Do we change our teaching methodology as fast as the new information and communication methodologies change and as fast as the sociology of our students change?
- Do we properly train our faculty for the challenges they are going to confront in the 21st century.
- And finally, are we relevant to industry?

We go to have a look at them.

There is no doubt that the function of Operations Management exists in the Business Management practice. It exists, it offers good job opportunities, it changes through time (Burcher et al. 2004), but it seems to generate doubts about its academic position.

We can trace back the origins of Production and Operations Management as a scientific field to :

- H. Towne and his paper "The engineer as economist" (1889)
- Penn State University. The grade of Industrial Engineering (1908)
- Taylor's "Scientific Management" (1915)

Up to the 1960s what was taught in university related to Production and Operations Management was mainly Motion and Time Study, Lay-out distribution, Statistical Process Control and basic techniques for Production and Inventory Planning and Control. And the innovations in this fields were dominated for consultants as Bedaux, Maynard or REFA.

From the 1960s on, it is the time of "systems theory", Operations Research and Management Science. This techniques seem to be more "scientific" and more appropriate to develop academic career (research projects and research papers) and it

seems that it is in this moment that the divergence between academic and industry interests in the subject begin to grow. (Alvarez Gil 1996, Slack 2004).

In the 1970s, there is an attention call to Operations Strategy (W. Skinner 1969, 1974).

In the 70s and 80s, in parallel to the big crisis in the manufacturing activities of western countries (the "Oil shock") arrives a big wave of manufacturing new practices, systems and techniques. A true revolution and among them some methodologies that by now have become mainstream practices such as: MRP (Materials Requirement Planning) (Orlicky, White), Toyota Just In Time (Monden, Ohno), Theory Of Constraints (Goldratt) all of them developed by practitioners in the field or consultants.

At that time arouses the first debate about the divergence University-Industry. Since then a substantial amount of literature (Andrews C.G, Johnson (1982), Amoako-Gyampah K, Meredith J.R. (1990), Voss C. (1995)) try to define what is the field of Production and Operations Management (POM) as separated from Industrial Engineering, more related to Decision Sciences the latter and to Operations Strategy the former, (Slack 2004).

As well, there are several intents to design what was called the "research agenda" for Production and Operations Management: Buffa (1982), Miller J G, Graham M.A.W. (1989). Some later reports concluded that the academic research in POM during the 1980s had followed the "research agenda" recommendations and had focused in new subjects, (Amoako-Gyampah K, Meredith J.R. (1989)). But some other reports concluded that the distance with industry interests was not reducing (Malhotra et al (1994)).

III. A DEBATE ABOUT TEACHING AND RESEARCH IN OPERATIONS MANAGEMENT

ANYWAY, the flow of new concepts and techniques coming from the "world of practice": manufacturing companies, consultants or "management gurus", continue to appear at an even greater speed. TQM (Total Quality Management), ISO 9000, EFQM (European Foundation for Quality Model), Malcom Baldridge, 6 sigma, Supply Chain Management, BPR (Business Process Reengineering), Benchmarking, Agile Manufacturing, Knowledge Management, etc. All of them were new concepts that very few of the PhD graduates from 1990, or even closer, were familiar with (Hayes, 1998). The worries in Academy evolve to the feasibility to master all this stock of new stuff that once again come from outside and, first of all, the debate about if it is worthy to teach and research such things.

Many of the new techniques are just fashion, don't resist the pass of the time. What university should concentrate is in develop a proper "management science" (Hopp and Spearman (1998), Lovejoy (1998)).

And in fact, the academic courses contents do not change so fast, they do not change at the same pace that industry practice does, not even at the same pace that academic research literature evolves. (Taj et al, 1996). Although some other authors (Chase, Zhang (1998)) find that actually the courses syllabi do have changed at least formally, offering many of the traditional issues and some of the new ones under modern frames and, most of all, with new methodologies: games, case studies, team

work and in general much more qualitative than quantitative issues producing a neat differentiation with operations research and management science.

And what about the knowledge produced in university and not used in practice? Resources and capacities theory, transaction costs, real options theory, OR algorithms; etc. Will them be used in a future middle term, so academics must persevere in them? (Slack 2004). The study of Slack is much broad and deep, he also concludes that the subjects that academic researchers are addressing are not so different, with some exceptions, to the ones that are common in practice but the way in which academics approach to them is quite different. He sees no wonder and defends it has to be so. The role of university is to create a "management science valid in the long term.

Some other worries come from the change that we are witnessing in economic activities, the decline of many of the traditional manufacturing activities and the rise of some others: "the new economy", the services, etc. Do the classical techniques conceived for traditional manufacturing activities (eg. Automotive) apply for the new activities? Probably not (Eloranta (1998), Meredith (2001), Hayes (2002), Hayes et al (2004, chapter 2)).

Probably the most important critic about management teaching and research and about the very essence of American business schools is someone so reputed as university teacher and management guru as Henry Mintzberg. His critics are concentrated on the contents of the syllabi, on the methodology of teaching (precisely he critics the superficiality of the games and cases) and on the methodology of research, he favours the observational method against analytical and empirical methods. He resumes his critics in a crude sentence like "God invented Americans to test theories but He never realized that there would be so many Americans and so few theories worth testing". (McCarthy, Mintzberg, Markiadis, (2000), Mintzberg (2004)).

Gómez Bezares (2005), remarks that since 1980s there are much more research publications, papers, authors and, in general, diffusion of research results than ever but the science itself (related to Business Management) does not grow at the same pace than the publications. He finds the reasons in: the "Americanisation" of research, that means a certain way of research patterns:

- Too much focus on mathematical formulation or in the empirical analysis of large data bases,
- Much less stress on hypothesis creation,
- Much less importance of case studies.

One last subject of debate is about the faculty. Who should teach Operations Management? How we train the future teachers in our field? Operations Management is each time and at very fast speed a more complex field in which converge knowledge of many other disciplines: information technology, sociology, finance, marketing, etc. So, we developed multidisciplinary faculty or either we create multidisciplinary teams (Hayes (1998), Miller and Arnold (1998), Chase (1998)). We are not training our doctoral students to be the kind of people that we would like to hire in our school and with whom we would like to work,: creative, polyvalent, with a deep knowledge and interest in business management, with interest and ability in teaching. We are training narrow specialist in analytical tools and very separated from both business reality and teaching.

IV. CONCLUSIONS

THERE are some facts difficult to document but intuitively easy to accept to demonstrate that certainly there are two worlds apart and each time more divergent not only in Operations Management but on the whole of Business Management: the divergence in professional and academic papers and collective events, the loss of relevance of University in professional postgraduate education, the increasing of the "business universities", that is universities or education programmes developed by business corporations.

Should it inevitably be like this? Are there some issues in which opinions from different relevant academics do converge? We resume some of the ideas:

IV.I. THE EDUCATION

WOULD it be interesting?:

- To demand some business practice to future academics?
- To integrate other disciplines and create multidisciplinary teams?
- To emphasize more the "hands on" learning (games, computer simulation) instead of the classical system of lecturing, reading, writing papers? Or the opposite: lectures and papers but on "real" issues.

In the last point it is interesting to remark that there is an alternative to "hands on" learning which training in company for practical periods or end of studies project. From our on experience (graduates access to the market labour survey in EUP D-SS 1995-2005) we can remark that this is a very powerful education system with big benefits for either student and company although it could be argued that the university lose some presence with no clear benefit for it, but the management of these relationship university-industry for practical training are clearly an opportunity for improvement.

IV.2. THE RESEARCH

SOME conclusions with strong agreement are:

- To expose the academic faculty to the real business world:
- To participate in projects with local enterprises, though it was considered more consultancy than pure research. Here there is another big opportunity for improvement
- To use in more extent case studies instead analytic or empiric research.
- To study some other activities different from manufacturing; services, NITs, etc.

Anyway, what we have presented in this chapter is an academic driven debate, there is not so much public debate about what should be the role of business towards academic education and research but they are doing things.

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Chapter 14 Business School-Industry Cooperation: An Analysis of Good Practice Cases

David Birchall and Jean-Jacques Chanaron

Abstract— *This chapter is based on a project carried out between 2001 and 2004 by a consortium of European vehicle manufacturers and business schools entitled ELAN2, standing for European Learning Automobile Network, and successor of the ELAN 2000 project. This chapter is restricting its scope to the following questions: how could long-term sustainable relationships between business schools and enterprises be created and developed to their mutual benefit? What lessons can be learnt from case studies of current practices? What are the critical success factors to build sustainable collaborative activities?*

I. Introduction

In economies where research-based innovation is seen to be a crucial element of competitiveness, the issue of university-industry collaboration has been raised by many scholars, industry analysts and policy makers.

Unfortunately the abundant literature in economics and management sciences[1] is mostly focusing on the issue of technology transfer between the academic and the corporate worlds, i.e. on the contribution to the innovation process initiated by the business community of basic and applied research and development (R&D) carried out by universities and public laboratories.

Such collaboration, however, is obviously not limited to commissioned research: it is developing on a continuum from knowledge transfer such as education and training up to basic knowledge generation through research.

This chapter is restricting its scope to the following questions: how could long-term sustainable relationships between business schools and enterprises be created and developed to their mutual benefit? What lessons can be learnt from case studies of current practices? What are the critical success factors to build sustainable collaborative activities?

The chapter is based on a project carried out between 2001 and 2004 by a consortium of European vehicle manufacturers and business schools entitled ELAN2, standing for European Learning Automobile Network, funded under the European Leonardo da Vinci programme2. The core partners for ELAN2 are listed in Table 1.

This work was supported in part by the European Commission by means of the ERASMUS Programme (sponsor and financial support acknowledgment goes here).

[1] All articles and reports quoted in this paper have useful lists of references. Readers are referred to a review of university-industry knowledge transfers by Agrawal (2001). This is an extensive literature review of academic inputs

Table 1: The Elan 2 Partnership

Vehicle Manufacturers	Other Industries	Universities/ Consultants
DaimlerChrysler (D)	RWE Thames Water (UK)	ACES-Lyon (F)*
Ford (D)	TRW (CZ)	Henley Management College (UK)*
Volkswagen Coaching (D)		Nijmegen (NL)
Volvo (S)		Skovde (S)
		Wende Consulting
* Authors' institutions.		

ELAN2 was organized around four topical work packages – e-learning, coaching, knowledge management and university-business relationships – selected for their importance and relevance to the core partners. Each work package was responsible for identifying good practice and involved the organisation of a series of workshops, including guest speakers from other industries, and for delivering a final report on the key findings and issues to be dealt with in the future.

This paper reports the study of university-business relationships. It is based on an analysis of four case studies selected from those presented. The cases reported here were selected as representing successful practice in relationships as in each case they had been in existence for some considerable time and had secured major resource investment from the parties involved. They also represented different approaches to building university-business relations. The cases were initially presented by the academic institution leading the work, but were then subject to cross examination by members of the project team and invited guests. The summaries presented here reflect that analysis. The write-up of these meetings was agreed by those making the initial presentation.

II. UNIVERSITY-BUSINESS COLLABORATION – PRIOR RESEARCH

2.1 Technology transfer

As already stated, most of the abundant literature is, de facto, dealing with issues associated with business-university collaboration on R&D and innovation. As emphasized by Chakrabarti & Santoro (2004), the literature is focused on a resource-based view of benefits that indeed tells us only part of the story, e.g.:

- Technology transfer: content, mechanisms, organization, experiences, funding, etc. (Claridge, 2004).
- Forms and types of collaboration: cooperative research centres (Adams, Chiang, Starkey, 2001), partnerships, incubators,
- Benefits of collaboration: impacts, barriers and success factors, innovativeness (Fontana, Geuna, Matt, 2003), clusters and geographical

agglomeration advantages (Caniëls & Romijn[2], 2001; Martin & Sunley[3] 2001).

At a theoretical level, the literature has obvious weaknesses. The main contributions come from:

- Economics of technological change and innovation, in particular its "geographical" approach dealing with communities of practices, clusters, agglomeration and science policy oriented studies looking at systems of innovation;
- Industrial organization and managerial economics, analysing relationships amongst economic organizations (or actors/agents), in particular researchers working on networks, learning and trust.

Whilst much research has been aimed at understanding the nature of the business environment and its impact on innovation within business enterprises, some researchers have focused on the processes of relationship building between firms and universities or other knowledge intensive organisations.

Dodgson published an important paper on trust in collaborative research in 1993. Dodgson (1993) pointed out that successful collaboration requires a high level of inter-personal trust between scientists, engineers and managers in the different partners. In particular, he stressed the key role of communities of interest, openness to external inputs, and inter-personal relations.

Chakrabarti & Santoro (2004) also emphasized the role of social capital based on trust, socialisation and member interaction within the university-industry relationship to make possible and efficient the sharing and exchange of knowledge as well as the learning capability. Laursen and Salter (2004) advocated that openness is a key success factor in innovation performance support. Ahuja (2000) pinpointed that firms embedded into collaboration networks are likely to have better innovation performance.

Cohen, Nelson & Walsh (2002) made an important contribution by analysing the links and impacts of public research on industrial R&D. The authors analysed in particular the various channels of knowledge transfer. They reported that publications and reports are by far the dominant channel, followed by informal information exchange, conferences and consulting. According to their survey, licensing and personal exchange are the least important. It is highly significant that non-market related "open science" looks much more efficient than private money-based exchanges.

The bulk of literature focuses very much on scientific and technological R&D collaboration strengths and weaknesses but largely neglects organisational and managerial challenges and the potential for cooperation with business and management schools and colleges.

However, the following managerial and organizational issues have been dealt with by researchers:

- Strategic alignment of technical and business goals (Johnson & Johnston, 2001)

[2] The consortium with more or less the same core members has been funded by a series of four consecutive projects since 1993, namely the FORCE Automobile Network (1993-1995), the Leonardo ACEA Learning Network (1995-1999), the Leonardo ELAN 2000 project (1999-2001) and the Leonardo ELAN2 project (2001-2004)

[3] The authors present an interesting literature review

- University spin-off firms within science parks acting as organizational incubators that provide a catalyst to transform pure research into production (Kitagawa, 2004; Löfsten & Lindelöf, 2001; Thorburn, 2000);
- Clusters and poles: a fair amount of literature is dealing with such geographical concentrations of competencies. Carrie (1999) sees integrated clusters as a key organizational approach for increasing the capability to be agile;
- Entrepreneurship: Hughes (2003);
- Intellectual property rights: they are to be analysed with different angles in particular economic, financial and legal (Hernes & Martin, 2000; Newberg & Dunn, 2002);
- Pricing: overhead charging in collaborative R&D (Cameron & Wallace, 2003).

2.2 The forms of cooperation

From a survey carried out in 2000, Schartinger, Schibany & Gassler (2001) found the forms of interactions between universities and innovative firms shown in Table 2:

Table 2. Interactions as recognized by universities and innovative firms

	Universities	Innovative Firms
Employment of graduates		□□□□
Supervision & financing of PhDs and Masters theses	□□□	□□□□
Lectures by firm members at universities	□□□	
Contract research	□□□	□□□
Joint research	□□□	□□
International research networks		□□□
Employment of university researchers in the business sector	□□□	□
Joint publications	□□	
Training of firm members	□□	
Spin-off formations of new firms	□	
Temporary movement of university members to the business sector	□	
Licence agreements		□
>40%: □□□□; 30-40%: □□□; 20-30%: □□ ; <20%: □.		

Source: Schartinger, Schibany & Gassler (2001).

There are forms that provide existing knowledge transfer such as through education and training and new knowledge, in particular through contract and joint research illustrated in Figure 1. (next page).

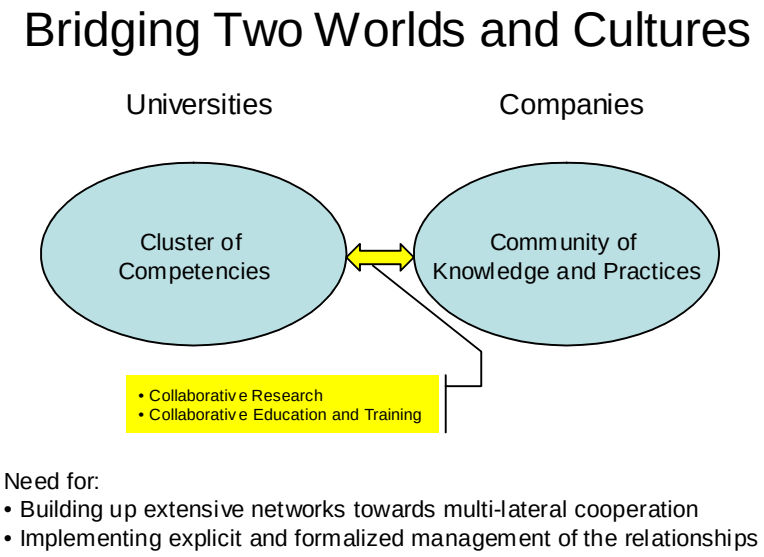


Fig. 1.

According to Burgoyne and James (2003), scholars suggest two types of cooperation in research or knowledge production:

1. "Mode 1" research equates to pure research or research developed in a separate context from that in which the problem or issue stimulating the research originates.
2. "Mode 2" research originated with Gibbons et al. (1994) and was brought to prominence for management researchers by Tranfield and Starkey (1998) and Starkey and Madan (2000). This type of research is developed by joint efforts between the various actors in the context of its application, solving some "live" problem for those for whom the research is produced.

Elaborating on mode 2 knowledge production, van Aken (2001A) points out that it could be applied in the field of management in order to increase the relevance of its products outside academia due to intensive interaction with application and "scientific" methods such as multiple case studies, action research towards tested and grounded rules, used in managerial problem-solving. Such an instrumental use provides the external relevance (van Aken, 2001B) .

Mode 1 and mode 2 research could be characterized as shown in Table 3.

Tranfield and Denyer (2004) build on such arguments and pinpoint that producing knowledge "in the context of application" should constitute a new and critical mission for management research in the 21st Century.

Table 3. Key Characteristics of Mode 1 and Mode 2 Knowledge Production

Key Characteristics	Mode 1	Mode 2
Context governed by	Academic community	Application
Discipline	Single	Transdisciplinary
Nature	Homogeneity	Heterogeneity
Organisation	Hierarchical	Heterarchial
Quality control	Less socially accountable	More socially accountable reflexive
Preferred research style	Single researcher	Collaborative research from different disciplines

Source: McLaughlin & Thorpe (2000).

The stylistic differences between Mode 1 and Mode 2 research are shown in Table 4 (Kelemen and Bansal, 2002).

Table 4. The stylistic differences between research targeted to academics and to practitioners

	Academic	Practitioner
Orientation of research	descriptive/predictive	descriptive/prescriptive
Focus of research	process	outcome
Attitude	reflexive	projective
Data collection/analysis	thorough	ad hoc, ambiguous
Data aggregation	high	low
Referential system	theory	practice
Rhetorical devices	narrow and institutionalized	wide and eclectic
Criteria of goodness	methods rigour	practical appeal

Kelemen and Bansal propose the dimensions of Mode 1 and Mode 2 shown in Table 5.

In an important article, Huff and Huff suggested to distinguish a Mode 3 research that would capture the human inputs to organizational activities or their human consequences.

Business executives are under increasing pressure to compress development times for innovation to secure future business. On the surface, Mode 2 research appears to give greater prospect of meeting their needs than Mode 1 with its long gestation period and detachment from the processes under investigation.

Table 5. Dimensions of Mode 1 and Mode 2 research

	Mode 1	Mode 2
Context	Cognitive	Social and Economic
Research boundaries	Disciplinary	Transdisciplinary
Aim of inquiry	Theoretical replicability	Gaining insights useful to industry, government, society
Stakeholders	Academics	Networks of academics and practitioners.
Research ideology	Elitist	Pluralist
Outcome	Basic research and applied research	Applied research
Type of knowledge	Codified	Tacit and codified
Theoretical development	Linear	Incremental
Knowledge growth	Homogenous	Heterogeneous
Chronology	Consumption subsequent to production	Simultaneous production and consumption
Knowledge dissemination	Institutionalized disciplinary channels	Embedded in the practical context
Methods	Bound by discipline	Negotiated within the specific context
Type of reflexivity	Method reflection	Socially and contextually bound
Criteria of goodness	Excellence defined by disciplinary peers	Social accountability

2.3 Cooperating with business schools

The literature dealing explicitly with the relationships of industry with business schools is indeed very limited. One of the key articles by Watling, Prince and Beaver (2003) emphasizes the changing dynamics of business education rather than the various potential facets of cooperation. The authors rely heavily on a report by the European Foundation for Management Development (EFMD, 2002) on the corporate university challenge. The major trends supporting an increase in collaboration are:

- Increasing awareness by corporations of the importance of their employees and of their development;
- Search for more flexible and individualized approaches to developing managers;
- Developing less structured and more context specific training and development interventions;
- Setting up stronger links to competence frameworks;
- Moving from open to "in-company" externally accredited programmes.

Such trends are seen as pushing towards developing corporate universities, increasing the use of new technology, increasing outsourcing of major HR functions and changing buyer-supplier relationships for true intensified and diversified partnerships between businesses and business schools.

2.4 The content of the cooperation

1. Knowledge transfer through education and training

It is quite obvious that industry needs the competence of universities to get access to appropriately educated and trained staff through degree awarding programmes or professional training.

Many authors deal with cooperation in higher education, e.g. for general undergraduate programmes and dedicated undergraduate programmes (Muskett, 1996), general MBAs: (Edwards, Vincent, Wareing, 1993) and dedicated MBAs (Birchall & Chanaron, 2004).

According to the EFMD Executive Education Meeting hosted by the University of Stellenbosch Business School on October 12-15, 2003 (Slater, 2003), the best partnerships in executive education are those which are set up to meet a particular need, which are therefore sponsored and co-organized with a designated institution. Needs-based partnerships are seen as the most efficient. As pointed out by Betts and Santoro (2003), four variables are determining the success of the learning and technology outcomes of the industry-academe cooperation at both initial and continuing levels: trust, intellectual property right policy, communication and champions. Concerning vocational training through collaboration, there are plenty of case studies reported in the academic literature. Another track for collaboration is indeed within corporate universities (Allen & Renaud-Coulon, 2002; Renaud-Coulon, 2002).

Leenamaija (1994) is considering industry-business partnership as the only available way to develop lifelong learning since, on the one hand, it is not the job and the expertise of employers to provide continuous education and on the other academic institutions need access to information about future working needs. In this view, implementing lifelong learning requires new strategies from both academy and the business community through partnerships.

2. Access to knowledge through consulting

There is a wide spread debate on the issue of access to up-to-date explicit knowledge through academic institutions. Ankers & Brennan (2002) consider that the managerial relevance of academic research is a topic of enduring interest. The authors point out the inherent divide between theory and practice. Rynes, Bartunek & Daft (2001) also qualify this misfit as the great divide.

Some scholars point out the irrelevance of knowledge produced by business school professors and researchers since many are driven by scientific assessment criteria for their careers (Tapp, 2003) as well as their income (Oviatt & Miller, 1989). Oviatt and Miller (1989) found many reasons for business professors to resist pressure from practical-minded excutives to make their research and teaching more applicable to current and future business problems. Rynes, Bartunek & Daft (2001) note that management researchers rarely turn to practitioners for inspiration in setting their research questions. A complementary weakness of academic institutions and staff is their poor communication skills (Tapp, 2003).

On the other hand, business executives are also suffering from their reluctance to reflect their own practices from theoretical inputs (Tapp, 2003) and their distance from theoretical models (Christensen & Raynor, 2003). Rynes, Bartunek & Daft (2001) point out executives typically do not turn to academic findings in developing management strategies and practices. Christensen & Raynor (2003) advocated very convincingly the absolute need for executives to care about management theory.

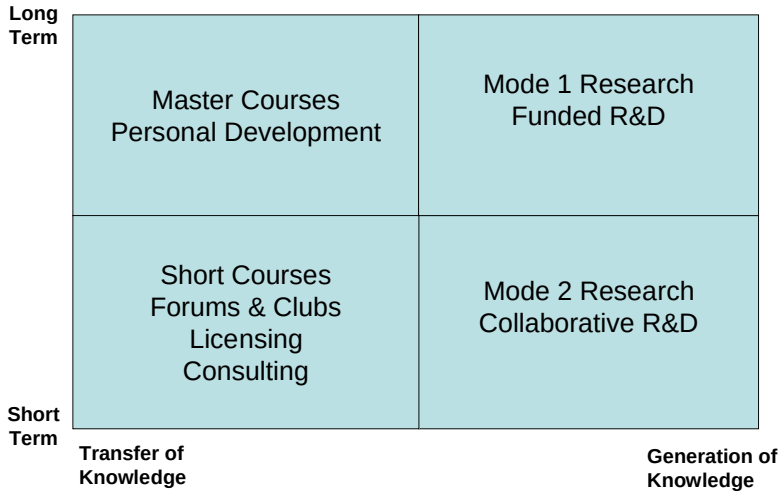
Starkey & Madan (2001) suggest the alignment of stakeholders in the future of management research to bridge the relevance gap through changes in the academic mind-set as well as in firms' involvement in the research process, in particular through appropriate collaboration in the knowledge creation and dissemination. Pharr (2001) emphasizes the need for cooperative research efforts between business schools and the private and public sector. As an example, Nambisan & Wilemon (2004) suggest that industry should help define the agenda for technology management education. This places further emphasis on the relevance of Mode 2

research. Such cooperation can combine the more conceptual from the academic with the action-orientation of the executive for the benefit of all parties.

III. TOWARDS AN INTERPRETATIVE MODEL

FROM the literature, the following matrix (Figure 2) can be derived inter-relating the time span of the cooperation between university and business with the nature of such relationships as far as knowledge is concerned: Then examples of practical actions can be classified in the four "boxes".

Figure 2. A Time-Nature of Knowledge Matrix for University-Business Cooperation



Acquiring-transferring knowledge in the short term is oriented to problem-solving and includes short courses, discussion forums and clubs, licensing and consulting. On the longer term, it is aimed more at personal and organisational development. But the production of knowledge is mainly of academic origin. This is, in the main, a one-way learning process.

This one-way transfer is also the case for producing new knowledge within a long-term perspective that is clearly Mode 1 research.

On the other hand, Mode 2 research tends to be confined in the short-term partnerships for generating new knowledge through a shared learning process as well as shared ownership. It is dedicated to practical application.

Table 6. Key characteristics of the relationships

	Objective	Ownership	Definition
Short term knowledge transfer	Practical application	Provider's ownership	Academic design
Short term knowledge generation	Practical application	Shared ownership	Shared problem
Long term knowledge transfer	Academic oriented	Provider's ownership	Academic design
Long term knowledge generation	Academic oriented	Provider's ownership	Academic design

The characteristics of relationships between business schools and industry are described in Table 6.

IV. CASE STUDIES

4.1 The multi-sponsor club – the TIME initiative

TIME, standing for analysing the impact of Technology and Innovation on the Management of Enterprises, is an initiative launched by Grenoble Graduate School of Business – Grenoble Ecole de Management – in 1993. It was initially created for raising sponsorship from local businesses and organizations and managing applied research and consultancy in the management of technology. At first, there were two clubs, one open to large organizations and one to SME's. Since 2002, the two clubs have been merged.

The interesting point with the TIME model is the search for synergies beneficial to all sponsors. TIME is feeding its sessions with knowledge inherited from its applied research and consultancy activities that indeed rely on experiences and practices of club members. The knowledge developed in such projects is also integrated into initial education, executive training and coaching activities carried out in different departments within the business school.

TIME is evolving along four parallel lines of action with an increasing extent of cooperation with its business partners:

1. Networking and exchange of ideas, concepts, methods;
2. Applied research;
3. Coaching and strategic marketing for SME's;
4. Initial education and vocational training.

4.1.1. Key success factors:

- The very nature of GGSB as a department of the Grenoble Chamber of Commerce and Industry whose missions are aligned and totally dedicated to local businesses;
- The pre-existing personal relationships and interactions between the school's management and local business representatives;

- The pre-existing demand by large-size corporations with local operations for exchanging ideas, knowledge and best practices in the management of new technologies;
- The large variety of topics dealt with during the various club sessions mixing business representatives and academic researchers.

4.2 The tailored Masters programme – The IBM MBA at Henley Management College

In 1988, IBM chose Henley Management College to design and deliver the IBM MBA programme with two strategic objectives:

- The education of high potential managers;
- The development of the company's leadership in the creation and delivery of e-learning solutions for the management development marketplace.

In order to build up the cooperation, IBM stated two primary aims:

- To deliver a broad based business education relevant to the current business environment;
- To develop virtual, distributed team-working skills within the IBM management body.

IBM was looking for a postgraduate degree – MBA - that would be able to:

- Innovate at the leading-edge of e-learning;
- Deliver a high quality academic teaching experience;
- Operate a large-scale management education programme across a wide geographic area (predominantly Europe and parts of the Middle East).

IBM and HMC agreed to develop "a learning partnership in which both parties provides constructive feedback and support at each evolutionary stage of the programme" (Symons, Rose, 2003).

The programme puts considerable emphasis on the processes of learning as well as an up-to-the-minute curriculum, relationship building using technology and independent and interdependent learning. The learning processes are based on blended learning including networked learning based on team-work. The aim is a "holistic learning experience".

4.2.1 Key success factors

Key aspects in developing the partnership have been:

- Developing a shared understanding: this has taken considerable time for all parties;
- Single point contact vs. multi point: both are needed for different elements;
- Managing through the cultural differences between a major global organisation and a small business school;
- Ensuring realistic expectations of all parties through open dialogue;
- Joint problem solving: no "hiding" issues but rather early confrontation;
- Maintaining relationships in a dynamic business where staff changes are inevitable.

- Innovation but in what? IBM is particularly interested in technology but Henley's main emphasis is pedagogic innovation.

4.3 Knowledge Management Forum

A forum bringing together academic researchers and business practitioners is a useful format to deal with up-to-date information in a fast changing discipline, e.g. an emerging one in the case of knowledge management. Henley Management College has experience over a three-year period in building a bridge between these two communities with thirty-two multinational corporations or government institutions involved in its Knowledge Management Forum.

The KM Forum initiative is based on "bench learning", i.e. sharing knowledge and know-how in knowledge management with people who are not at the same level of development in their organisation. In addition to regular forum meetings, sub-groups are formed to investigate specific issues. Research projects involve participants within a working group, two co-champions, i.e. one industry representative, one academic researcher, and based on an interactive research philosophy, a Mode 2 approach.

Each year research groups meet and develop new projects. Outcomes of research projects are business papers and white papers (co-authored). This can result in academic papers where theoretical and literature-based information is added (with cross quotation). Presentations result to the Forum's annual conference and to other international academic conferences.

4.3.1 Key success factors

1. The development of a common language of knowledge management between experts and academics not only for dialogue within the Forum but also for practitioners later in each organisation.
2. Coping with the multi-disciplinary context with theoretical inputs from Economics, Organisation Theory, Information Management and Political Science.
3. Reconciling the preference of academic participants for conceptual ideas and business practitioners for real-world applicable ideas.
4. Coping with a changing level of membership that has evolved down the traditional hierarchical lines. In the early stages most participants were chief knowledge officers, then the Forum was attended by the deputy or the next level down the hierarchy. In 2003, the Forum did welcome two members from each participating organization. It might be time now to open up a two-tier Forum – one with experienced leaders, the other for operational staff.
5. The leading role has clearly been taken by the academic institution. Business organisations were not seen to be in a position to run such initiatives. But there is an obvious requirement for the continuous commitment of a core team built of active representatives of both sides.
6. The quality and commitment of these leaders in building up trust and confidence.

7. There is a heavy dependence upon the personal relationships of a few key individuals.
8. Formalisation of working methods and a clear framework (aims and objectives, methods, tasks, etc.) for cooperation between the two communities – business and academia – are also key conditions for success.
9. Constant refreshing by new members but integration into existing networks needs careful planning; as well as a constant refreshing of themes and topics.
10. Concerted efforts are needed to ensure the delivery of benefits to all parties.

4.4 Model research – The Fraunhofer Gesellschaft

It is indeed very common practice throughout Europe (and elsewhere) for universities to seek corporate sponsorship for their research activities. Fraunhofer Gesellschaft is one of the most active institutions in Germany and is an interesting example of a specific industry-university relationship.

Founded in 1949, it has grown to 12,000 staff in 2002 for a research turnover of 1 billion euros. It is running 57 laboratories that are operating as profit centres. 50% of the turnover comes from government projects and 50% from industrial clients. Projects are sponsored either by one single client or by a consortium of clients.

It is worth pinpointing that Fraunhofer Gesellschaft is run as a business-oriented organisation even when dealing with European Union funded research projects. The goal is explicitly to make profit from research activities. Fraunhofer Gesellschaft takes advantage of:

- Accumulated academic knowledge
- Available university staff.

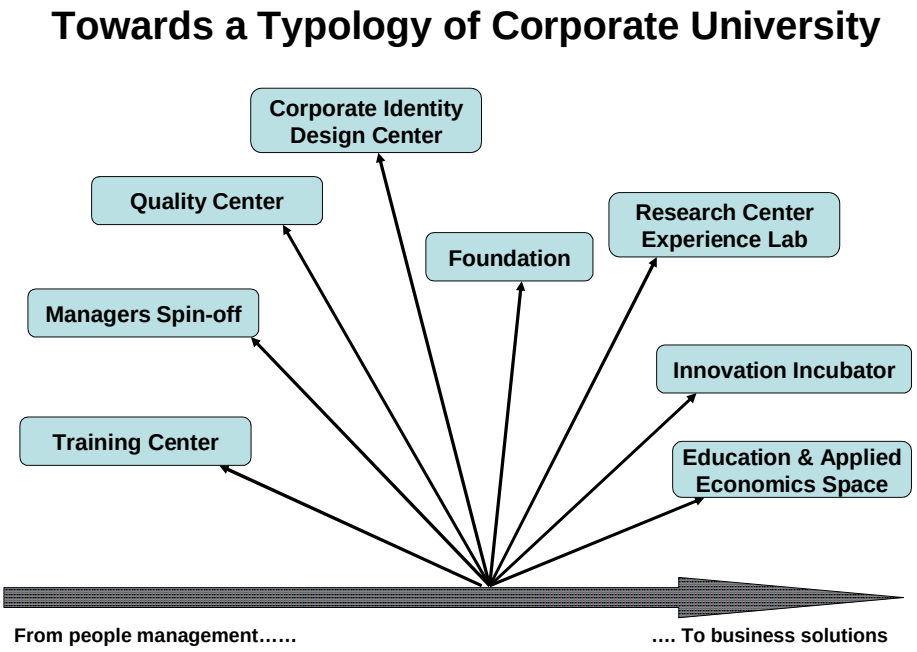
For its industrial partners, since it is operating strictly as a publicly owned consulting company, Fraunhofer Gesellschaft is acting in line with the real needs of its corporate clients in undertaking research assignments.

4.4.1 Key Success factors

- Commercial approach of research institute;
- Access to research expertise;
- Range of capabilities;
- Breadth and depth of knowledge;
- Responsiveness to industry needs;

V. CORPORATE UNIVERSITY

CORPORATE universities have various forms and objectives. According to Lewandowski (2003), their initial common philosophy was to be a tool for creating a meaning and a structure for corporate culture. Since then, corporate universities have aimed to improve the organization's performance through resolving transversal issues and problems, seeking to become true knowledge sharing platforms.



Source: A. Renaud-Coulon, 2002.

Fig. 3

There is neither a single model nor a one-best-way. (see Figure 3 for an illustration of the variation). But the corporate university may be seen as offering the opportunity to span the four segments in Figure 2.

The Mikado Minerals University is an illuminating example of a failed project of an innovative corporate university from which some key lessons can be learnt. Its aims were:

1. To transfer 'knowledge' to customers by providing expertise, competencies, integrated solutions.
2. To raise significantly the competency level of customer interface in products, processes, customer operations, management and economics.
3. To be able to develop real two-way partnerships with customers by understanding customer key levers and strategies, identifying best ways to assist customers, providing feedback on own business lines (R&D).
4. To develop an internal knowledge sharing management.
5. To support innovation by developing the innovation process.

Despite considerable planning, the Mikado Minerals University project was abandoned even before it was launched for the following reasons:

1. Cost in the context of a massive worldwide cost reduction programme;
2. Priority given to a huge e-learning project;
3. Managerial and organizational problems following a mega-merger;
4. Strong bargaining power of technical and departmental training managers;
5. Strong imbalance of power between HR managers and technical product line managers;

Many lessons for a corporate university strategy have been learnt from this project.

5.1 Key success factors

Partnerships with universities were seen as crucial key success factors in order to:

1. Use the best possible competencies for internal training.
2. Have enough training resources.
3. Benefit from their audience (e.g. include some of corporate materials to universities).
4. Develop joint programs focused on customers.
5. Develop joint R&D, joint Centres of Demonstration/Development.
6. Open the circle and be more in phase with world changes.

VI. ANALYSIS

IN this chapter we are suggesting a framework for representing possible relationships between firms and business schools. We saw these relationships as enabling technology transfer (technology being defined in a broad sense).

For the firm, the acquisition of up-to-date knowledge about business is seen as essential in developing management capability. Much of this transfer is of codified knowledge. However, at the other extreme, it may be in the interest of the firm to be involved in the generation of new knowledge in the expectation that its application can impact the firm's competitive position.

In accessing codified knowledge, the firm may use business schools for their short course provision. This may be a cost effective way of gaining access for individual managers to acquire new knowledge and skills. The firm may have several preferred suppliers. But in illustrating the nature of a shallower relationship, we used the example of a business which offers members a series of one-day events.

In establishing a closer relationship with a business school the firm in making a longer term commitment to having a business school provide more comprehensive development programmes. This was illustrated by the IBM MBA, a long-standing programme catering for intakes of 160-180 per annum. Here the firm is expecting more from the business school than would result from individuals being dispersed across many different MBA programmes. The business school is also in a better position to respond to the company's needs. This knowledge transfer essentially involves the acquisition of existing knowledge and its absorption into company operations.

We illustrated the short-term development of new knowledge by describing the Knowledge Management Forum. This Forum adopts a Mode 2 research approach to investigate emerging themes but over a relatively short period, e.g. 6 to 8 months. By researching in partnership, the academic knowledge base can be usefully combined with a practitioner perspective. Additionally, the firms, through their involvement in the process, get early access to the merging ideas and findings.

Mode 1 research, with its longer term horizon and hence greater commitment from the sponsor, was illustrated by the Fraunhofer case. This is the more traditional approach for firms to commission research. This research, unlike the model 2 case, has clearly specified deliverables (usually relating to technology development and application). It is usually assumed that the research institute has the expertise to deliver without heavy involvement of practitioners from the firm.

In looking again at Figure 1, we can summarise the key success factors. In Figure 4 we can see some clear differences. In Box 4, we can see the focus placed on the business school having an offering that is attractive to business and contacts with business. The transactions are of a short-term nature.

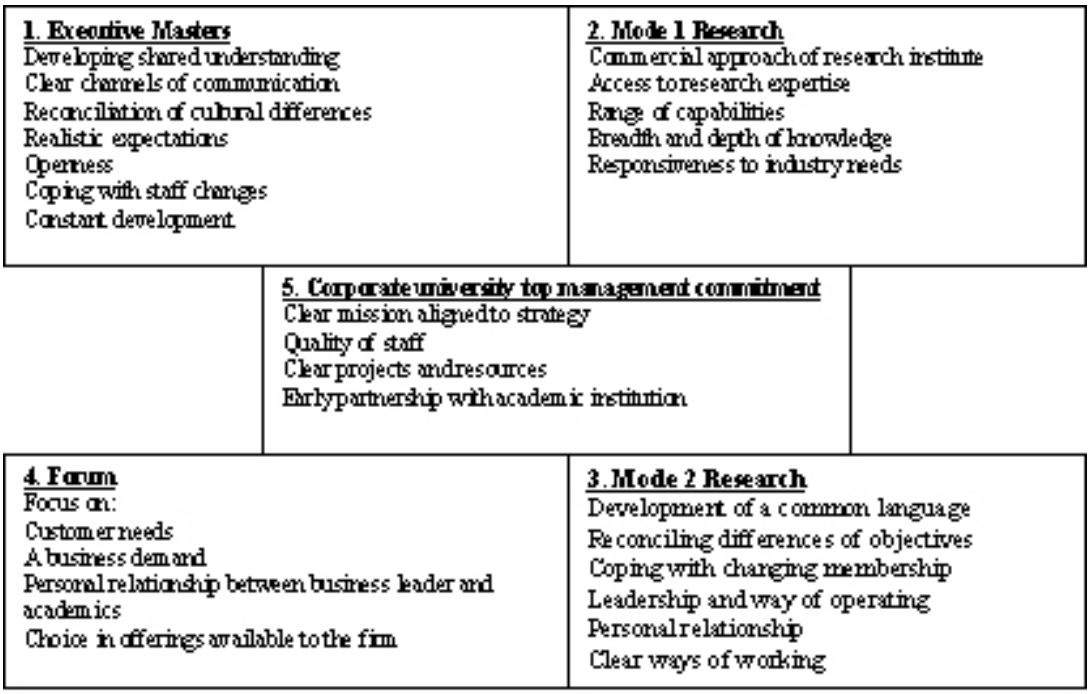


Fig. 4 The key success factors in the different forms of relationship

In Box 1, where a greater commitment is needed from both parties, development and maintenance of relationships is key as well as a constant emphasis on refreshing the offer.

In Box 3, where new knowledge is sought not in the form of fundamental scientific principles but rather as application knowledge. Developing shared understanding benefits all parties and good working relationships and methods are seen as key to success.

Box 1 involves more fundamental research where access to appropriate capabilities is key. But this capability has to be focused on the needs of the project.

The final area, Box 5, is the Corporate University. Here the firm is taking the lead, developing a solution to meet its own capability building. It can embrace the content of Boxes 1 to 4 but not necessarily. In Figure 3, we highlighted the range of aims embraced within corporate universities from basic training to knowledge creation. But the overall aim is to support the development of the business. The case presented here did not proceed beyond the design phase. However, useful lessons can be learnt. The degree of dependence upon strong business school links seen as important in this case, is not generally seen as essential. In some instances corporate universities have sought the right to deliver and award degrees, something which in many states is seen as the sole right of academic institutions. But corporate universities could choose to work in partnership with academic institutions.

We can see from this analysis that the key success factors in each Box differs depending on the time span for the relationship and the nature of the technology transfer. One would assume that the capabilities needed to sustain operations in each

area will vary. Also, the strategies of both business and business schools will vary. Some business schools will aim to secure relationships in different areas, depending on their business model and opportunities. Those schools able to operate in Box 2 are likely to be less subject to competition since the resources are relatively unique. Box 4 contains the areas most easily replicated by competition due to the codification of knowledge and hence opportunities for rapid commoditisation. The costs of moving from Box 1 are likely to be high since the capabilities needed are not readily acquired.

VII. CONCLUSIONS

BASED on an overview of the literature on business school-firm cooperation, we identified a range of business needs and business schools offerings.

In constructing a framework two dimensions were considered – the nature of the knowledge to be transferred and the intended time span of the relationship.

The case studies presented revealed some key success factors. This enabled comparisons to be drawn in relation to the framework.

It is felt that the analysis could prove useful to both firms and business schools in examining their current approaches, their future needs and then determining how they may then need to refocus their efforts.

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Chapter 15 Practical experiences with different cooperation schemes: University –Industry

Alexander Söder

Abstract— *The German (Bavarian) model of „University of Applied Science" offers several ways of cooperation schemes with industry. The author has practiced this since more than 20 years. So practical experiences with different schemes of cooperation will be shown:*
(1) Former students are employed by a company, but still work at university supervised by a professor on a common project
(2) Former students and foreign students are employed at university (job as assistant), work in a project for a company. Their salary is paid by the company.
(3) A professor and (former) students found a company (GmbH) which has close connections to university.
After discussing the preconditions - the musts and the chances - at university level this paper describes in some case studies

- *the motivation (how it comes),*
- *the pro and cons of the different schemes*
- *the result of the projects*

Main focus is on scheme 3 (university spin off). Because LOG-IT - which has been founded 1994 - is still acting successfully on the IT-market, serving important customers in central logistic applications and LOG-IT still has a close connection to University of Applied Sciences of Regensburg.

I. PRECONDITIONS AT THE UNIVERSITY LEVEL

1. Students

1.1 Must

In the German (Bavarian) model of „University of Applied Science" the students are obliged to make **2 practical placements** (1 semester each) at industry.
These placements provide the students (in most of cases) not only with useful practical experience but also with helpful contacts, when looking for a job.

1.2 Optional

In addition students may **work at industry** during holidays but also during a semester in order to make some money and also to learn something for their future professional life.

Unfortunately it happens very rarely that students get the chance to perform a **common project with industry**, that is supervised by a professor.

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Most of the students make their **diploma thesis at industry**. Usually they perform a small project at the company.

On one hand these points increase practical experience but on the other hand they reduce time for study sometimes dramatically, so that especially the theoretical background of these students is getting very poor.

2. Professor

2.1 Must

The prerequisite for being a professor at University of Applied Sciences for technical disciplines each professor at University of Applied Sciences is to have **3-5 years practical experience** at industry (the university is not considered as being industry!).

This practical experience is very useful, but of course it is loosing its value with the years.

So the number of years should be increased and also the sabbatical should be a must, especially in informatics.

2.2 Optional

Professors may **visit students** at their practical placements.

Professors may also **supervise a diploma thesis** of the student at industry.

If there is a **common project between university and industry** the professor is usually not involved very much (He will only be something like a „breakfast director“)

Every other 5th year the professor may perform an **industry semester/industrial retraining (sabbatical)**.

More important for cooperation between university and industry are the **„side-jobs“ of the professor**. This is usually the most efficient way to get contacts and budget.

The visits of students at their practical placement are usually not very efficient. The company not at all is interested in some advices by the professor, because he does not know the application, the environment and all the other prerequisites and preconditions. This is also valid for supervising diploma thesis and common project.

Side jobs are only useful for university when the side job is close to the university topics of the professor, so that the experience and results can be used in teaching at university.

But attention: A side job like teaching or supervising home works in a high school, is not very helpful.

3. Assistants/Employees at University/Competence Centre

In some cases **former students start their professional life** as an employee of the university or at a so called „competence center“. Their salaries are paid by industry (i.e. a consortium of companies) and they work in different projects at industry. The contracts are limited and there is a good chance to move from competence center to industry.

Currently there is a „Competence Center Software Engineering“, which is integrated in our department. It has ca. 15 employees which work for 5 companies in the area of Regensburg.

This approach sounds very promising, but it is still in the beginning.

II. THE CASES

1) Employees of a company work at university

1.1 Case

Company A employs 2 just finished students part time (half day). They have their working place in the lab for communication technique and work on a project for the company in the area of computer communication. The first project was followed by a second. But after 2 years company A went into financial trouble and disappeared from the market.

1.2 Motivation

There have already been relations between one professor and the company, i. e. a private cooperation between a professor and the company.

The company needs an add-on for one of their products, but did not want to spend much budget for it.

The professors had 2 assistants which they could use (part time) also for their university work (teaching, labs, etc.). The results of the project partly could be used in courses and labs.

1.3 Results

The company had cheap workers with a limited contract. There was no investment for working place and working equipment necessary. On the other hand the contact to the development department (due to the 300 km distance) was missing sometimes.

The professors had some additional support for their courses. On the other hand there was also some additional work, which has not been really honoured.

A testing environment for UNIX sockets, which has developed in one of the projects is still used in our UNIX courses and labs.

2) Employees of university work for an industrial project

2.1 The Case

A working group of university applies to RFQ of company B. The working group won, because they made the best offer with the cheapest price and the shortest time schedule. So company B made a „normal“ contract (including warranty and maintenance) with the working group. With that project budget the university could employ 2-4 assistants and also some students. They have their working place partly at the company and partly in a lab of university. In this case personal mostly was

recruited from foreign exchange students, which come in the frame of SOCRATES and other EU-projects.. The first project is followed by others and it is still running

2.2 Motivation

A former student reached a leading position in company B and remembered his former professors.

The company needed the results of the project in short time and did not want to invest much budget.

The professors had some assistants and students, which they could use (part time) also for his university work (teaching, labs, etc.).

2.3 Results

Company B received the expected results with good quality and with small costs. The professors got a lot of experience with project management and also with modern development environment. The results of the project partly could be used in courses and labs. The graduates and students which pass through these projects learn quite a lot for their future professional life.

On the other hand most of the project risks are lying upon the shoulders of the professors. There is also a lot of additional work like recruiting qualified personal, fighting with the university administration, etc. Due to administrative restrictions all this work can not really being honoured.

3) LOG-IT Company – a university spin off

3.1 The Case

In summer 1992 three students where just finishing their study. They made their diploma thesis somewhere at industry supervised by the same professor.

In parallel they were looking for a job. But at this time there was a „down“ in computer industry. As they did not found suitable jobs at industry, they founded some small (one man) companies and did some occasional jobs.

The professor knows the former students from courses, labs, student projects and last not least from the supervising of their diploma thesis.

The professor was asked by industry (a software house in Munich) for programmers, which have some skills in Microsoft Access. They had a project in warehouse logistics, but they also had only a very small budget. At that time IT-management believed that with MS Access even large projects can be implemented with little time and small budget.

As MS-Access was new on the market, mainly students had some skills with that environment. Also our students had some experience with it. So the professor decides to make that project with these students in a loose cooperation. That is the professor was the contractor and he employs the students as „freelancers“

The first project was hard, but finally it was successful. So the requests for the next projects came up. This was the time for a closer connection. So it was decided to found a common company G.A.S.S. GmbH (the company has been constructed from the names of the founders). The starting capital was the money earned in the first project. Then further personal has been recruited from the university. The company –

now named LOG-IT – is still existing and currently very successful in the area of „Forecast to Replenishment“ consulting and development. They serve huge customers like Vodafone, ATU, VENDEX, etc.

3.2 Motivation

The industry has a project, which they want to perform but they their own workers have been to expensive for the project. So they are looking for subcontractors.

The graduates are looking for work in order to establish their future existence.

The professor of course wants to help them both. But he is looking for interesting projects in order to keep himself up to date and to improve his salary, too.

3.3 Results

The graduates found work and income in a difficult time. They had a good start for their career. Some of them are still involved in the company.

For the professor it has been firstly some successful projects, secondly a permanent partner for gathering up to date practical experience. Last not least the professor permanently has examples and topics for student's project from real life. One product of the company is used for teaching (of course without costs for the university). If some small projects for university have to performed, the company makes immediately with "friendly" prices.

The company also was happy to make some successful projects. Moreover 2 years later the company gave up that logistic department, which carried out the first project. So again they have been very happy, to have a company which continues to care their customers, and makes maintenance and support for them.

III. SUMMARY AND CONCLUSIONS

THE experiences and the conclusions from the above cases are valid for the university/industry cooperation in industrial projects (not research!). They are presented in some thesis explained below.

(1) There must be a visible and a measurable benefit for the industry, the professor and the university.

Cooperation only will work, if there is a real interest by the persons, which do the work and which are responsible for the results. The benefit of industry usually is to reduce costs for necessary tasks, i.e. to save some money. In these cases their own workers have no time or they are too expensive. A second point of interest is the recruiting of new personal. There is no better chance to test the skills of young people.

The key role of successful university/industry - cooperation is given to the professor. He must see a benefit for himself and there should also be some measurable benefit for the university. University gives resources and also time and freedom to the professor. Another very important issue is that the professor is a real expert in the cooperation area. (Just having a title is not sufficient!)

Sometimes top management tries to organize university/industry – cooperation. But in the most cases that does not really work. In some cases the only result is a picture in the newspaper with smiling presidents and managers.

(2) Money, that is a gift and not result of own work is not worthy.

Sometimes cooperation is based on funds given by the state, the EU, etc.. Often these projects end, when the money ends. Foreign money makes lazy! If you had carefully read the cases above, you will notice that none of them is based on foreign money. All the money was earned or invested by the involved persons themselves.

(3) Do not spent money, which you have not earned before.

Like any industrial project also a cooperation project has limited budget and time. Usually they are made in order to save money. So you must be very careful with spending money. If you will run out of budget, there is for sure no second project.

(4) The project risk is to be covered by the professors.

Each project has some risk for the contractor, e.g. that the project is late, that it runs out of budget, that it does not work at all, etc. Usually university administration does not like risks. In the opposite they take 20% of budget as overhead, 20% as risk sum (an employee may get a child, which will increase his salary, etc), … So the professor – if he wants the project – is somehow forced to make a private contract, too. This way part of the project risk for the industry is covered.

(5) Professors at university of applied sciences should be obliged to do industrial cooperation.

In spite of the problems above any professor – especially in the area of computer sciences - should be obliged to do industrial cooperation. Today a lot of courses and also course books suffer on practical irrelevance. Mostly the focus is on didactical aspects, the knowledge is collected by reading other books. Course books are produced often via „cut and paste“. Very seldom the theories a verified in real life scenarios. You may find a lot of examples if you look carefully to the books, e.g. in the area of software engineering, databases, etc.

So it is very necessary for quality of teaching, to update the knowledge only from books or some trivial exercises, but also with experience from practical life.

Chapter 16 A use case related to the relationship between universities and industry (Transylvania University and Siemens PSE)

Paul Borza

Abstract— *This chapter presents a use case of the relationship between Transylvania University of Brasov and Siemens PSE, two actors involved in the Romanian county-level labour market.*

The chapter details the needs and resources, the formal frame, the experience and some outcomes accumulated along the four-year collaboration.

An important aspect underlined in this chapter is the way in which the balance between expectations and results prospected by both the universities and companies has been obtained, and how the frame created has stimulated the global improvement of the educational system.

The two sided approach of the chapter – both the educational system and industrial points of view being analysed - discloses the methodology (methods and parameters) followed by the two actors in order to achieve mutual cooperation and efficiency in their common activities. Starting from the needs of industry and the human resources trained by the university, the developed frame generates a mechanism that regulates the requests and expectations, in this way assuring the settled personnel growth for industry on one hand and stimulation of the continuous perfecting and adapting process of the educational system on the other hand.

The process involves: improving work force training; stimulating the continuous knowledge development in the case of students and young engineers; a rational financing, which assures the prosperity of universities; developing a common work frame by jointly broaching high risk themes in groups including experienced engineers from company, students and their professors; developing the material base of the university by building up laboratories; reciprocal visits stimulation; workshops and conferences planning.

The chapter proposes a metrics that takes into account several features: the level and opportunity of the know how generated by the university, the material investments made by the industry and their short, medium or long term returns, the common interest for research activities that involve high risk factors, and the social effects as a result of common activities, illustrated by the structure and occupation degree of work force.

The collaboration can be systematically cultivated by minimizing the distance between the current and optimal trajectory, the purpose representing useful and benefice results on every level.

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I. Introduction

The last sixteen years have been for Romania a long way of changes of the social and economical system, a transition from a centralized to a market-oriented economy that concerned the labour market as well. In the last years a lot of companies from the whole world have come in Romania attracted by the opportunities existing in the country such as highly trained work force, raw material resources and new facilities offered by the govern.

Siemens Program and System Engineering came in Romania, Brasov in 2001 with the intention to develop a company working in the IT domain. In the well known tradition of the company, Siemens established its headquarters in the university campus signing a frame collaboration contract with Transylvania University. The initial phase consisted in implementing four departments: mobile and fix communications, energy management and business solutions, of about 30 employees, forming the structure of the company. The last five years have brought the company a growth of the number of employees to 400, mainly engineers and mathematicians now integrated in seven departments. Being the result of collaboration with the university, this growing was well sustained. In the same time many research proposals (more than 10) and contracts (4) have been signed up and deployed in collaboration with chairs and faculties of the university.

These years represent also a period of changes in a good way for the university – a growth from around 200 graduates in electrical engineering and computers to more than 250 graduates and initiation of a new direction of study, respectively the Telecommunication specialization.

This evolution is the result of the stimulated synergies between the partners and some of them we will presented below.

II. Objectives, Synergies, and Advantages Offered by Statuated Collaboration

Siemens existence in Brasov represents to the University a challenge in the sense that young students orient themselves to the study of electronics and computers because of the opportunity to have a job in the domain afterwards, this being an important argument for choosing this university for their education. Also, they know that such companies offer them a professional environment.

Siemens has facilitated the University's material base update and development with didactic and research laboratories, materials, developing systems, instruments and programs, building up laboratories endowed with new and high tech instruments and computers.

Furthermore, this collaboration stimulates the synergies in the research and development fields by common collaborations using specialized teams. These activities solve specific problems enforcing the work for common proposal preparation. Thus, the two partners become more competitive on the market and the access to the money for the research projects from national and European institutions easier.

A joint collaboration between these two institutions has benefice consequences for the quality of educational process, offering specific and high-quality courses and

grants for students and professors, and enforcing the company's impact on the market, keeping it close to the new trends in technologies and science.

Siemens policy regarding grants comes to stimulate the students, graduates, masters of sciences and PhD students to finalize their diplomas or thesis.

By an appropriate policy Siemens facilitates and encourages the mobility of professors in order to assure their participation at conferences, congresses, workshops and experience exchanges, the add values resulted being shared with the company.

From the Siemens' point of view, the collaboration with the university has the following benefits:

- It assures the amount and appropriate work force needed for the development of company's activities;
- It influences the structure and the content of curricula used by the university for education of students, bring it closer to company's needs;
- The common cooperation in the field of research and development activities is easier;
- It assures the training in advance on specific technologies and procedures used by the company;
- It reduces the integration time of university graduates as new employees of the company;

For Siemens PSE, the main objectives sought through its policy adopted in the collaboration with universities are:

- to train in advance its future employees in accordance with the current and future needs;
- to develop common projects with a high level of risk in cooperation with universities (professors and students), with medium and long term benefits on the market;
- to incubate some innovative ideas that need pilot implementations before their application on the market;
- to enforce the company's research capacity especially on the field of European Research Area projects (ERA).

In order to reach these objectives Siemens has developed some procedures - structured on blades - that assure the implementation of the collaboration with universities.

These blades are:

1. Management of practice activities for students, graduates and master;
2. Management of research activities;
3. Institutional management of activities focused to help universities.

The schemes of each blade are illustrated below:

III. STUDENT PRACTICE

THE frame collaboration contract was signed by the representatives of both parts: university and Siemens PSE, respectively by the Rector and the General Manager. This contract assures the legal frame for all the actions realized by both parts, allowing for Siemens to allocate and spend funds coming from sciences grants for student, graduates and master, for the endowment of university laboratories and

research centres assuring the well definition of objectives, instruments and expected advantages for the both parts [2].

As it concerns the university, the contract allows for the chairs and departments to discuss and eventually to adapt the curricula taking into account the needs and request coming from the company, and to advertise the grants offered by Siemens. More, the contract stipulates which are the procedures used to define and negotiate the clauses of common research and development contracts.

In case of Siemens, departments send their periodic requests or needs of personnel (students) to the management board (MB) or KAM (account manager dedicated to supervise the relationships with university, faculty or department), issuing the standard request forms that contain: request title, department, work group or project, candidate's main skills, proposed solutions for the theme and objectives that must be reached at the end of the grant period, and other specific clauses.

These requests are analysed by the management board and if approved they receive priority status, being included in the annual collaboration plan with university.

The funds requested for planed actions are allotted at the human resources department disposal.

This department supervises along with productive departments the selection of students, grant allocation, the results following the grants, and the remarks on the students' activity after the completion of the practice period.

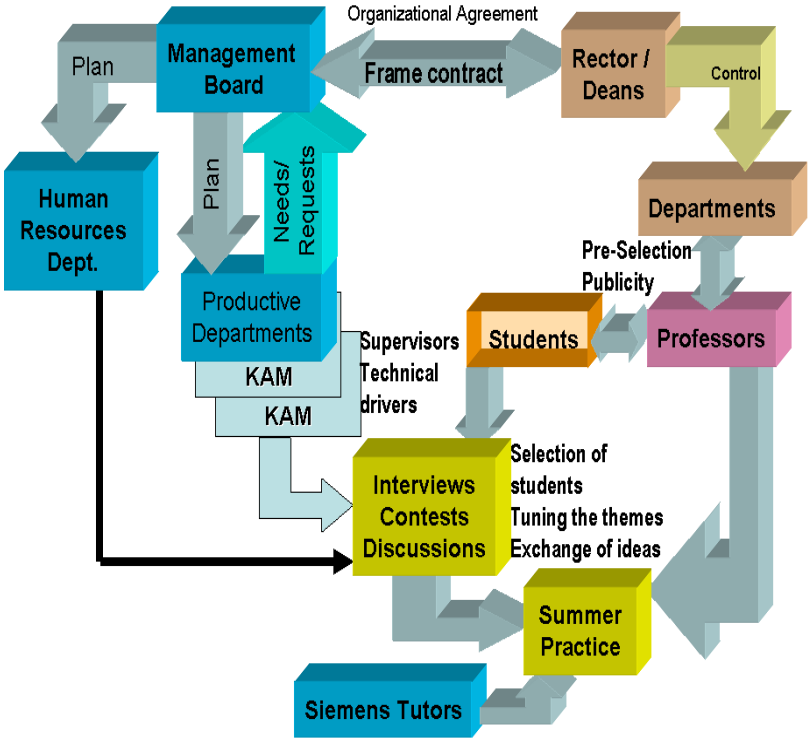

Figure 1. Summer and all-year long Students Practice

The human resource department representative will participate at the interviews for scholarship granting along with the interested professors and technical responsible. On this occasion, students have the opportunity to discuss with the people in charge, and apart from that, a tuning of grant themes is accomplished.

The practice is realized in the productive departments under the supervising of two persons: one from Siemens and the other one from the university.

The students will work in the same conditions like the company employees, carrying out all the specific activities under the supervisors' care.

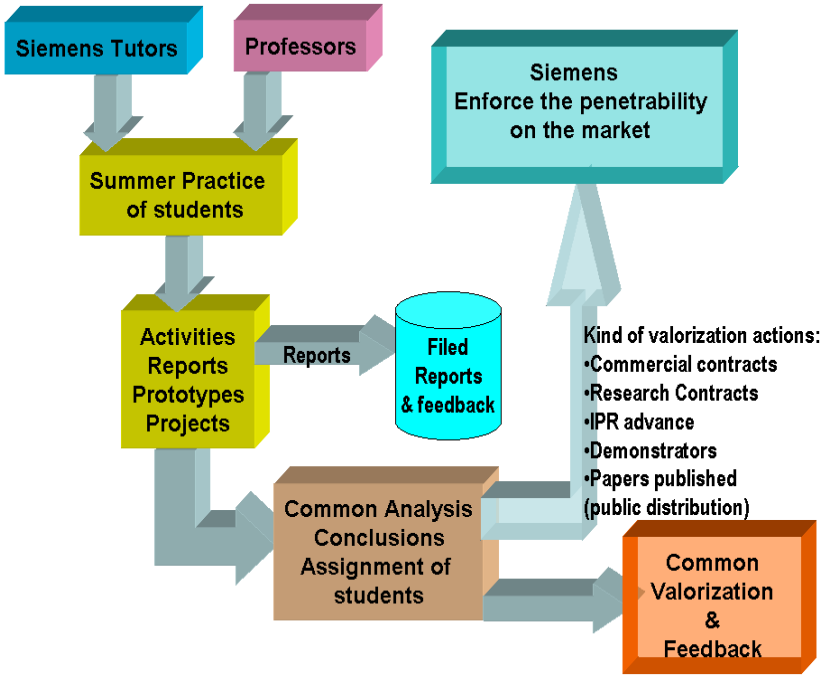

Figure 2. Diagram of actions for valorization and feedback

The final report and the results of students work are filed and analysed by the KAM dedicated by each department to supervise the activities realized in collaboration with the university, from the administrative point of view.

The technical results are analysed and filed by the technical tutor from Siemens with the professor from the University. The relevant results can be integrated in the research contract.

In case of original ideas these are filed and transmitted to the Romanian patent Office in order to protect them.

In figure 1 we illustrate the flow diagram that show the elements, relationships and results involved in this activity.

The results of these activities are processed by both parts: Siemens and the Transylvania University. In figure 2 we show the main steps followed in order to valorise this activity.

The feedback of these activities is periodically analysed at the management level and represents one of the items taken into account for appointing necessary corrective actions.

A special attention is given to stimulation the students' creativity, who is encouraged to try new solutions and to test them.

In the case of new ideas, the students are helped to valorise and to patent their ideas for the benefit of both parts [1].

The assignments received by students at the end of practice period generate their classification and represents the human base for further recruitment actions.

The questionnaires completed by students are useful for the continuous improvement of activities.

The metrics introduced in order to measure the efficiency of this activity includes:

- the number of students that participated in practice n_p and the number of graduates n_g hired by Siemens after graduation; (calculation is made after one or two years), because the majority of students that are admit in practice are from fourth and five year of faculty.

$$C_1 = \frac{n_g}{n_p} \cdot 100\%$$

- the second indicator reflects the financial effort made to implement the practice for each student reported at the average cost of training period for a new employee that is integrated on the same job. The first cost calculated is the financial effort per student that is calculated only for the students that are in the last two years of faculty (PS).

$$PS = \frac{F_s}{n_p} \cdot$$

where Fs are the funds spent for the students attired in the summer practice, or in all year long practice, and np are the number of students that are in the last two years of faculty.

- The third indicator Fe (financial efficiency) is calculated by introducing the difference of average costs for initial training of a new employee, the costs PS, the time spent for initial training of students that have a grant (t_s) and the mean time spent for a new employee (t_{ei}) weighting with the average cost of student (C_s), respectively average cost spent for a new employee (C_{ne}) for the training period at equivalent level of preparation (similar jobs).

$$F_e = t_{ei} \cdot C_{ne} - t_s \cdot C_s - PS$$

This efficiency has been calculated for similar jobs and per student, post factum, for students selected to be hired by Siemens PSE after their studies. For all studied cases these factors were positive, that means efficient. We must mention that a lot of other advantages can be disclosed: work force stability, high degree of work force fidelity related to Siemens PSE, possibility to use for high risk projects low cost work force formed by students within the practice period driven by tutors from both part Siemens and University.

IV ENFORCING OF COMMON RESEARCH

RESEARCH activities play for both parts an important role, reflected by the attention given in their collaboration, by the dedicated funds. A strong common effort is dedicated in order to participate together at the calls proposed in the frame of European Research Area (ERA) or at the calls proposed by the Romanian Research Institutions. The economical force and competence of Siemens combined with the creativity and high level competence of the University, assure a higher chance for gaining new contracts on the research market.

Figure 3 details the elements, the people and entities involved, the working flow followed in order to stimulate the research.

The direct interested department in the developing and facilitating of research are: technology management [3] and competence base along with the business developers from the productive departments. In collaboration with the staff of university these actors scan continuously the calls that appear on ERA and national research sites, and define the partnership and the proposals for common projects. These are submitted to the appropriate institutions and in the case of positive response the next step is to draw up and conclude the contracts. The consortium acts on the new common frame in order to reach the proposed objectives.

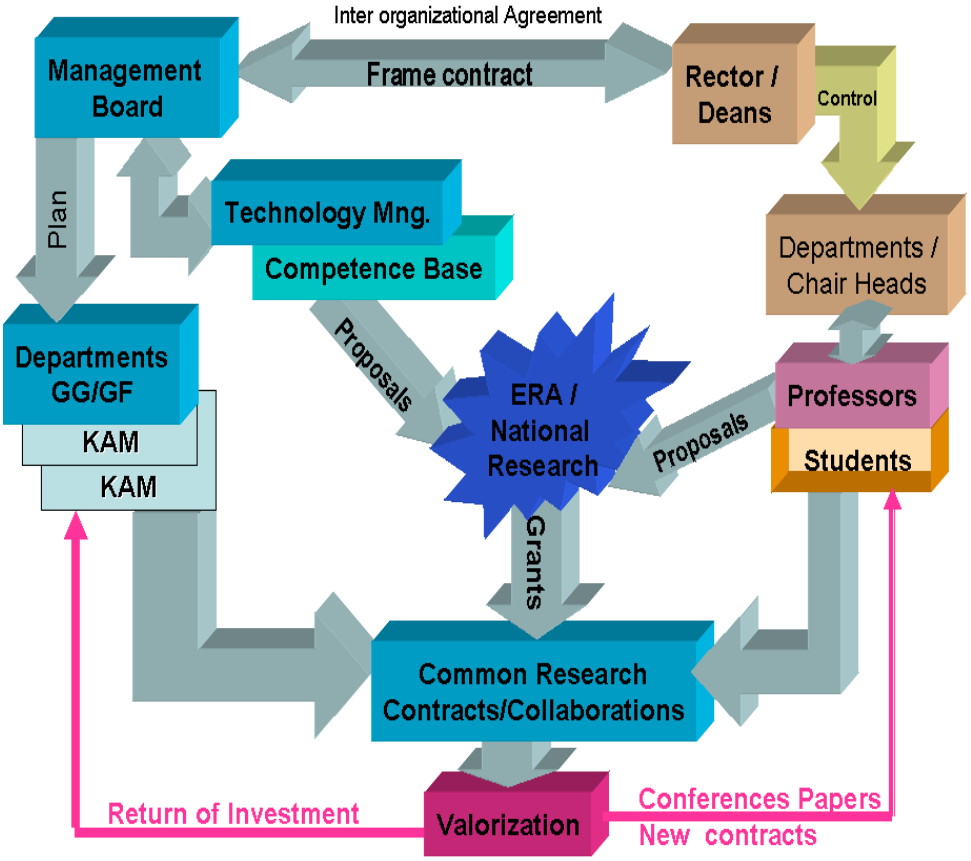

Figure 3. Research blade of Siemens - Transylvania University collaboration

From the university part, the staff formed by professors and researchers participates to the programs along with the technical staff from Siemens. For Siemens the main goal is to fulfil the objectives stipulated in the contracts. Secondary goals are: to obtain a fast return of investments, translated in benefits on the market, a positive financial balance, and new opportunities related to the development of new products or systems.

V. ENDOWMENT ACTIONS FOR UNIVERSITY

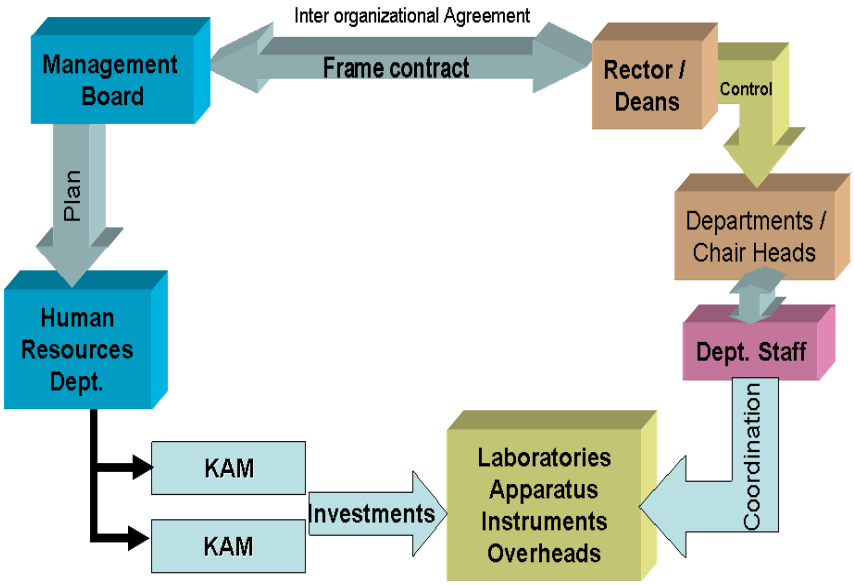

Figure 4. Endowment of University laboratories

THE material base: didactic –laboratories, libraries, current materials- and the research laboratories, is essential for the University, because only the development of the research can assure its survival. In this sense the frame contract allows Siemens to help departments and staff of the university in order to update the systems, apparatus, and instruments. From the technical point of view responsible for actions that are implemented are the KAM persons from each department. Siemens' human resources department manages the expenditures in the frame of funds approved. An image about how functioning this blade is presented in figure 4. Yearly, an amount of money is dedicated for University laboratories' endowment. In the limits of dedicated values the university staff can chose how to spend the money.

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Chapter 17 The Entrepreneurial University: a key factor for regional development in a globalised economy

Simona Lache

Abstract— *At a time when globalisation and multinational corporate activity seem to dominate economic activity, the Higher Education System in Europe has to respond to increasingly complex and varied needs of society. A solution in solving the problems the universities are facing nowadays may be their transformation from traditional research and teaching institutions into entrepreneurial university. This chapter discusses the concept, models and instruments of the entrepreneurial university and presents, as case study, the situation at Transilvania University of Brasov.*

I. Introduction

The beginning of this new century has brought radical transformations in the society organization. These transformations reflect, in the first place, into the social institutions, among which the university represents a major exponent. It is just that, for the university, change does not seem to me something new: along the centuries it has proved to be the most flexible of the social institutions, always open for improvement in order to serve in the best way to the society. As a standing proof, nowadays it exists under various shapes, from the traditional university to the virtual one.

Sebastian Pintea from UNESCO Chair, University Babes-Bolyai, Cluj-Napoca, Romania, asserts that the higher education systems are working these days on a market that faces some major trends [1]. Depending on the approach adopted, the trends may be seen as threats or opportunities. If the university approach is passive, waiting for them to disappear or to find solutions themselves, the new trends will represent threats, for sure. Contrariwise, if the approach is to search for solutions for the new challenges, to adapt to the market faster and better then the other competitors, to exploit the changes novelty features, it will lead to a proactive, entrepreneurial adjustment, for which the threats become great opportunities.

II. Premises for the entrepreneurial university

The literature identifies the major trends the universities are facing nowadays as follows [1]:

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– the mass higher education system;
– the public financing decline;
– the increase of the demographic, social and economic diversity;
– the request for adult education;
– the information technologies amazing and continuing development;
– the higher education market globalisation.

The mass higher education system. The latest technological development, the increase of democratic values, the new requirements of the knowledge based society have lead the transformation of the traditionally elitist higher education system towards the mass system [2]. This phenomenon represents a challenge, mainly when, and it is usually so, associated with the second trend – *the public financing decline*: the universities have to support a larger number of students while the governmental funds decrease. The only chance in the given conditions is to find alternative financing sources, from the private sector, in the first place, which are able to offer funds the universities may use freely, according to the identified needs. Burton R. Clark mentions this as a transformation direction of the universities adapting to the market requirements, namely: *the existence of various financing bases* [3].

The two new trends mentioned above ask for a new organizational model of the university, inspired from the private sector, based on efficiency, capital depreciation, profit.

The increase of the demographic, social and economic diversity. The request for higher education comes, nowadays, from various populations. The last years studies revealed an increased heterogeneity regarding the age, social and economic status, gender, race and ethnicity, physical and learning capacities of the students. This heterogeneity represents another challenge for the universities, which have to develop and apply new and various approaches regarding the teaching-learning process and style, study available time, students counselling, maximization of the access to the education system.

A special issue, in this context, is the increasing *request for adult education*, as direct consequence of the very rapid changes in the present economy, mainly in the technological field. As mentioned by Donald E. Hanna in [4], the higher education market is neither defined anymore as preparation for life and career nor cantered on a population of young students (as it happened during the 20th century). The development of the adult education system opens several opportunities for the universities. It is associated to the communication technologies, which ensure a large and low cost accessibility to education.

The information technologies amazing and continuing development. The new communication technologies influence to a great extent the higher education structures and practices, without destroying the traditional values. Their first advantage is the space and social barriers removal: practically people of any age and from any part of the world may access university programmes using the communication technologies. This offers great opportunities for the universities but induces new problems, as well. On one hand a gap on the education market is created, that can be very easily exploited if the university adopts an entrepreneurial approach. On the other hand, the gap can be covered by very strong competitors in the field, perfectly adapted to the virtual environment [1], which makes the under

universities to be frightened for loosing their students.

The higher education market globalisation. Globalisation represents nowadays a phenomenon that each of us is becoming aware of. It regards the spread of the economic activity and services, and of social and cultural issues, as well, through the multinational companies and the internet [1]. At the higher education level, this influence the university financing regime, the organizational and cultural structure, the new education means by using interned or by attracting foreign students. Speaking about globalisation also means the existence of a global higher education market which generates a global competition for the students, and eliminates any protection of these institutions against competition.

III. THE ENTREPRENEURIAL UNIVERSITY APPROACH

BESIDES the concepts of 'new management' and 'academic capitalism', developed under the influence of the latest transformations of the university environment, 'entrepreneurial university' approach describes the new type of university created as a reaction to the extra-academic environment changes. R.B. Clark presents in his book [3] the features defining this concept:

- the university performs an independent activity, based on its own risk;
- the university is involved in the economic and social development of the surrounding region;
- the university is flexible, uses the existing resources in a creative way, is reassign its staff according to the environment request;
- the university works strictly within the parameters of costs and profits.

The entrepreneurial university paradigm starts from the premises that the present hyper competitive environment subjects the university to a pressure that requires a reassessment of these institutions. As professor R. Dunkin (RMIT University of Melbourne) states, 'nowadays, for a university to be successful it has to be entrepreneurial, to be aggressively competitive' [5]. J. Ropke, professor at Philips Marburg University – Germany [6], reveals three categories of meanings for the 'entrepreneurial' university:

1. The university itself, as organization, becomes entrepreneurial;
2. The university members – academics, students, other staff – transform themselves, in a way or another, in entrepreneurs;
3. The interaction between university and the extra-academic environment is achieved based on a entrepreneurial model.

B.R. Clark [3] identifies five transformation directions of the university as a consequence of entrepreneurial approach implementation:

- *A strongly consolidated decisional pole*, which includes both staff of the university central administration and of the faculties and departments; it ensures the institution management in the sense of flexibility and efficient response to the extra-academic environment requirements.
- *An extended dynamic periphery*, consisting of entrepreneurial units that gives the university space boundaries a diffuse character; these flexible units ensure the knowledge transfer outside the university, representing the interface between university and the external environment.

- *A diversified financing basis*, able to ensure the funds for the institution appropriate functioning; this direction is of utmost importance since the state financing becomes lower and lower. It is achieved by applying for national and international grants and contracts, by identifying tertiary sources (industrial companies, local authorities, non-profit foundations, etc.), by valuing the intellectual property, by scholarship fees, campus administration, donations and so on.
- *A highly stimulated academic core*, represented by traditional academic departments (research and teaching centres) centred on certain subjects, old or new, as well as by interdisciplinary study fields.
- *An integrated entrepreneurial culture*, represented by a work culture in favour of changes. This kind of culture grows by passing through phases presented in Fig. 1:

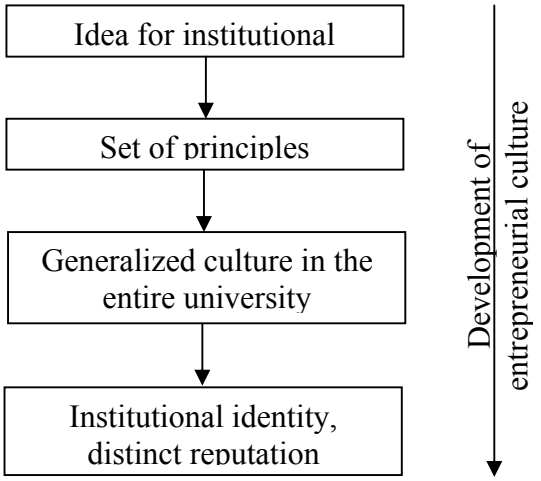

Fig. 1. Phases in entrepreneurial culture development

However, the university changes are not straightforward; several obstacles have to be confronted since it is a well known truth that the universities are conservatives concerning their structures. This is, partly, the effect of the fact that the institutions are lead by academic staff selected from inside and not by specialized manager staff. Other reasons may be [1]: the lack of real stimulation for cooperation, the lack of cooperation abilities at individual level, since we speak about individuals with a professional life governed by competition and specialization. These obstacles make the entrepreneurial centres to develop, in the first place, at the periphery of the traditional institutional structure. They start by being fragile, with an unsure financial situation, risking to remain without financing, which determines them to activate themselves, to adapt to the market in order to survive.

IV. The case of Transilvania University of Brasov

Given Given the new economic conditions and the fact that the engine of

industrial development is nowadays the knowledge-based industry, the importance of universities in regional economic development is more and more acknowledged in Romania. As enterprises need knowledge for immediate use in practice to meet the market needs and, not in the last place, to generate profit, they tend more and more to look for University resources to supplement and substitute the rather expensive in-house effort.

Many mutual benefits are identified to a close relationship between the university and an industrial company [7]. The company gains access to not only leading edge technologies, but also highly trained students, professors and university facilities. On the other hand, the company can gain prestige and acceptance in its stakeholder community through its association with a prestigious university.

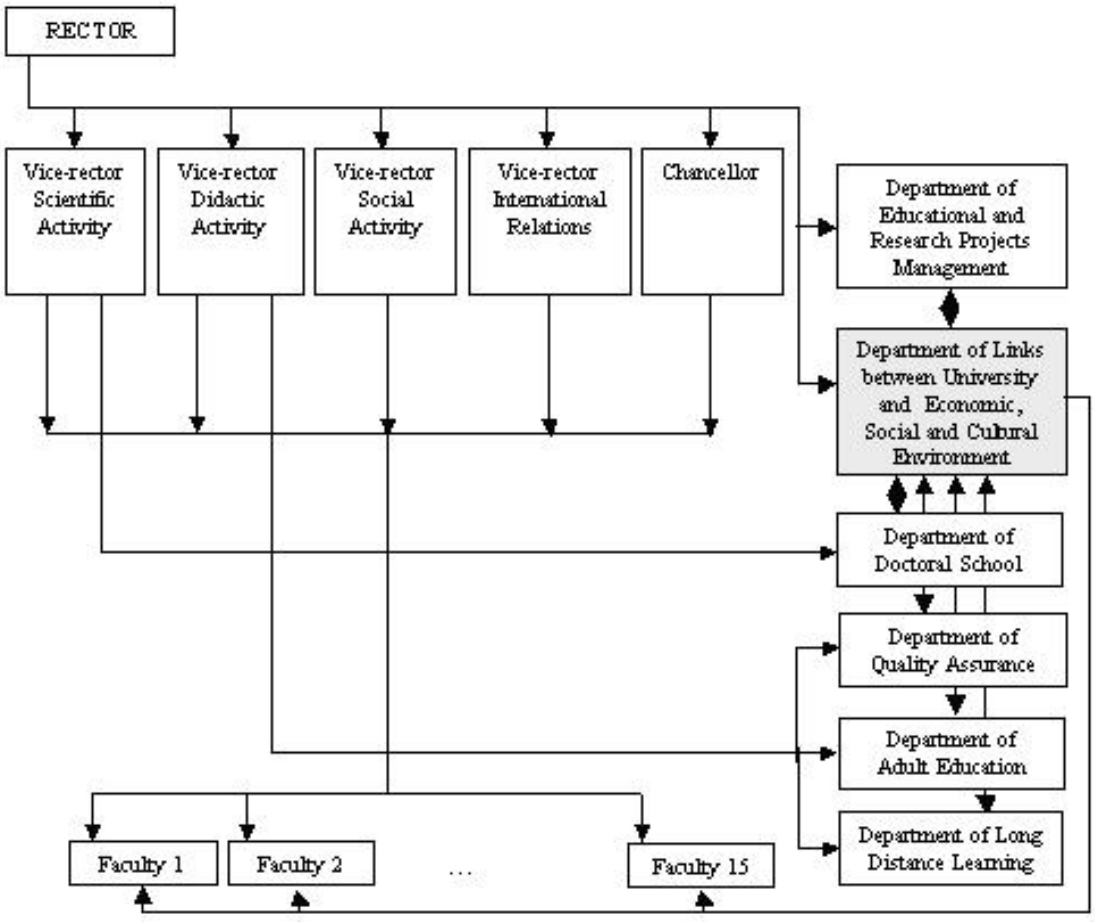

Fig. 2. The place of Department of Links between University and Economic, Social and Cultural Environment within the Transilvania University management (simplified scheme)

According to these realities, Transilvania University of Brasov has adopted the entrepreneurial concept and has developed the infrastructure to implement it (Fig. 2). It is quite recently (an year) since the Department of Links between the University and the Economic, Social and Cultural Environment has been developed, aiming to be the interface between university and the extra-academic environment, regarding the cooperation on three main directions:

– Students education and training: by developing cooperation in practical

placement, graduation / dissertation thesis with subjects proposed by the economic environment; identifying the needs of the economic environment and changing the academic curricula in terms of these needs;
- Research and development: scientific research and technological transfer;
- Training in alternative systems: life-long education, open distance learning, low frequency, by launching the university offer into the economic environment, on one hand, and by identification the needs of the extra-academic environment and their tuning to the university offer, on the other hand.

Fig. 2 presents the place of this department within the Transilvania University management structure, its relations of subordination and co-operation with other departments and faculties.

Working with the industry provides other pedagogical and academic value to the students and faculty [7]. Faculty and students can be involved in solving practical problems and gain access to knowledge developed outside the academic environment. This is important mainly in the fields where academic research and publications usually lags industry.

University – industry cooperation in the research field takes several forms. Four inter-related components may be identified in this respect [7], as depicted in Fig. 3: research support, cooperative research, knowledge transfer and technology transfer.

A. Research support

Research support involves contributions of both money and equipment to the university by industry. This type of contribution is valuable as it provides great flexibility to upgrade laboratory and develop programs in certain areas of interest.

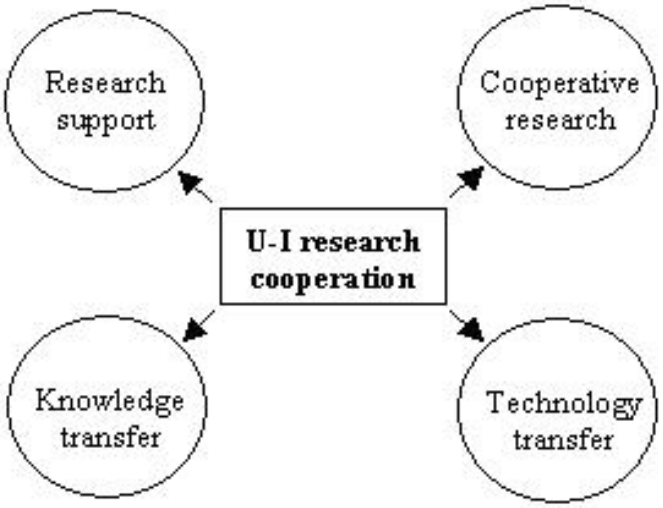

Fig. 3. Components of university – industry cooperation

The cooperation model under which Transilvania University of Brasov develops such cooperation consists in university providing spaces for companies to organize laboratories equipped with means and at standards according to their requirements. In return, the university provides following services: training the students in subjects of interest for the company, developing research project with subjects proposed by

the company, working with the company as partners in national and European projects, human resources recruitment. This model has been used in several cooperation schemes, as follows:

– UTBv – *Siemens PSE*: three laboratories developed, in the field of telecommunication, automation and informatics (the last is under development);
– UTBv – *Motorola*: one laboratory equipped for didactic activities in telecommunication;
– UTBv – *Ina Schaeffler*: research activity in the field of automotive industry, development of a training centre consisting of two laboratories for CAD/CAE/CAM;
– UTBv – *Viessmann*: research activity in the field of renewable energy, development of the Solar Thermal Laboratory;
– UTBv – *Autoliv*: one lecture room and one CAD/CAM laboratory for training graduates in Automotive Safety Systems Engineering, master programme.
– UTBv – *LMS International*: Automotive & Aerospace Engineering Centre – under development.

B. Cooperative research

It is a quite new achievement that the university has developed cooperative research consortiums with industry to pursue research and development in some common areas of interest. These centres provide formal structures to advance technology through various types of cooperation between university and industrial companies, among which research contracts represent an important mean.

In this respect several examples may be presented:

– direct cooperation with the industrial company – through research contract (financed by the company);
– cooperation with industrial companies in the framework of national research projects – *Excellence Research Programme* (financed by the government);
– cooperation with industrial companies in the framework of international research and education projects – *FP5, FP6, FP7, Leonardo da Vinci, Socrates/Erasmus.*

C. Knowledge transfer

Knowledge transfer involves many activities that include both formal and informal means of communication, interactions and personnel exchanges at student and faculty level. Involvement of the companies in the university curricula is one of the most important mechanisms for knowledge transfer. Often students work on corporate problems for their theses and dissertations, in companies such as: *Siemens PSE* – students from Faculty of Electrical Engineering and Computer Science and from Faculty of Mathematics – Informatics; *Dacia-Renault Group* – students from Faculty of Mechanical Engineering; *Continental* – students from Faculty of Electrical Engineering and Computer Science and from Faculty of Mechanical Engineering. Cooperative education programs, internship and job placement for students and recent graduates provide means for knowledge transfer.

On European level, the Leonardo da Vinci mobility students programme provides useful tools for knowledge transfer, as well. Until 2003 this programme was extensively provided by our European partners, among which the Student Affairs & LEONARDO Office Thüringen, Ilmenau University of Technology, Germany has

been very active. There are only some years since when Transilvania University has begun to develop, as coordinator, student mobility projects. The results have already appeared in training the students for promoting and implementing renewable energy sources, and they are under development in training the students for promoting and implementing energy efficiency in industry. This year another proposal has been submitted and the evaluation results are expected. It is related to training the students for working in it intensive technical engineering applications. Beginning with this proposal, which it is hoped to be transformed in a project, another cooperation model may be implemented as presented in Fig. 4:

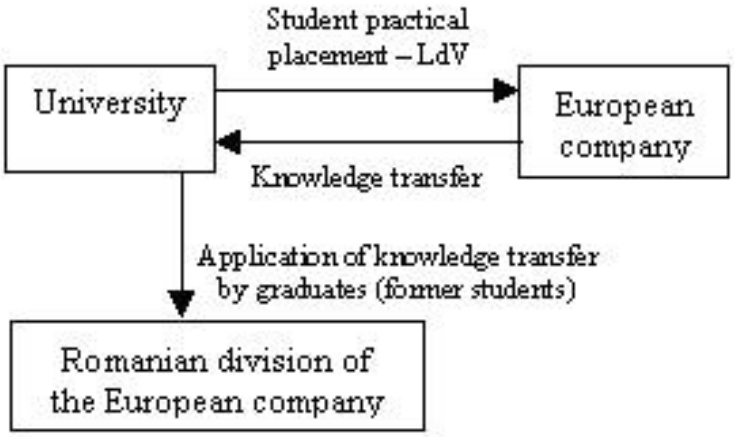

Fig. 4. Model for Leonardo da Vinci student mobility

One direction in students' education is achieved by the educational process within Transilvania University of Brasov, at undergraduate/ master and doctoral level. The weak points identified in relation with the practical oriented activity can be compensated by the transnational mobility, which will provide increased chances for students on the labour market, will develop the innovative spirit of young people and entrepreneurship skills. The added value the transnational mobility provides is related mainly to the following issues:

- updated knowledge according to the new approach of training on IT intensive technical engineering applications;
- more insight on product-oriented and custom-oriented design;
- skills on team working and networking (by dealing with work in a transnational company);
- market oriented activities.

The recently opened opportunity of having subsidiaries of European companies in Romania extends the benefits of Leonardo student mobility by the possibility of applying the knowledge gained during the practical stage within the future working place of the beneficiary, in Romania.

Another interesting model of knowledge transfer consists in organizing master courses oriented on the company needs. It is the case of the master course in *Automotive Safety Systems Engineering*, developed at Transilvania University, in cooperation with Autoliv. The target group consists of young graduates, employed by the company, which also pays for their study fees. The curriculum is set-up by a joint team of academics and company specialists, so it is done the evaluation process.

This seems to be a success model, there are already other companies interested to adopt it as the need for highly specialized graduates becomes a reality in the present days.

D. Technology transfer

Technology transfer is generally based on the collaborative research with the industry; different models have been developed along the years: business incubators, science parks, technology parks, etc. all being created to foster entrepreneurship and business development. Professor Rice from Babson College [8] emphasizes on the fact that assisting entrepreneurs in business incubators represents a complex process that depends on the strategic objectives of the entrepreneurs, on their capabilities of being managers for these incubators. At Brasov some attempts have been carried on this subject, however nothing consistent came out until now. The present regional development and the local community preoccupations set up the premises for a technology park development in the nearest future.

V. Conclusion

An overall analysis regarding the paper's subject would lead to the following conclusions:

- the concept of entrepreneurial university gains more and more supporters nowadays; more and more academics agree with a already well known prediction saying that in the XXI century the universities will be entrepreneurial or they won't be at all.
- Transilvania University of Brasov follows the principles of the entrepreneurial university; strong relations with the extra-academic environment (economic, social and cultural) are developed, supported by a structure especially created for this purpose.
- Leonardo programme provides a useful framework for university – industry cooperation; speaking from the student mobility point of view, the advantages are straightforward; however, this opportunity is not taken fully advantage of at Transilvania University, a limited number of projects have been developed until now.
- The present opportunities opened by the European companies coming to Romania gives a new prospective to the cooperation between university and industry, at all levels (students practical placement, training programmes and scientific research).

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Chapter 18 Best practice and case studies in university-enterprise networking for European student mobility – LEONARDO reflections on student placements in industry

Frank O. March

Abstract— *Student placements are suited to gain practical work experience in a professional environment. The European Union gives grants to these placements in a wide range of professional areas and the promoters (contractors for mobility projects) need different levels of networks and a lobby to run the projects effectively. The role and importance of regional, national and transnational networks and conditions are described by practical experience in Germany with a review of more then ten years experience in that field. The needs of partners and participants show the big challenges of networking and common ways to initiate a high quality of individual measures. To cover the needs and the role of the support of incoming students as part of service for local/regional industry is discussed. Finally some recommendations are given to optimise the efforts of strengthening the university-enterprise co-operation. A very practical review of participation in student mobility.*

I. Introduction

The development of student mobility is a long term target of the European Union. Many promoters have specialized for more then 20 years to motivate students to go abroad for a specific time within their studies. The number of participating countries increased rapidly and so does the number of contractors. It was a dedicated focus of European policy to bring the two sectors of education and so called practice or practical world together to learn from each other, to understand the needs of both sides and to bring two obviously different worlds together. It was aimed to realize the transfer of knowledge through brains or heads by individual mobility activities accompanied by financial means. From 1986 until 1995 the COMETT program (COMmunity action program in Education and Training in Technology) set the fundamentals for the present LEONARDO DA VINCI program with a big variety of strands and initiatives. Former strands fixed target groups right within the programs names but under LEONARDO DA VINCI the target groups are described within the action lines. It is the fundamental interest of students and companies to get closer to each other - but how to be done? A good stimulus is the European initiative to bring both parties together and bridge the gap between them by grants and promoters who provide placements as companies do not have neither the time nor the human capital to recruit placement students inside their company. The idea under COMETT was to establish permanent networks to gap the bridges between universities and enterprises. A parallel effect was to bring science and the so called daily practice in industry

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together to bring new impacts to their individual co-operation. In 1995 a new mobility program generation was implemented and some of the former expertise disappeared. All new and old promoters of student's and young graduate's mobility adopted to the new regulations and requirements. The former COMETT family as such disappeared nearly and new structures were built. But the needs to run the projects were the same as before – all projects need at least small local and transnational networks as part of the requirements inside the project drafts. The situation changed with the integration of new member states. Since 2000 participants from Central and Eastern Europe Countries could take part in the mobility actions and the story of this integration was a successful one. LEONARDO DA VINCI brought new ideas and challenges as it is a laboratory of ideas and methods. Synergies between mobility actions and pilot projects are on the focus of peers and a new initiative to take quality aspects into the project drafts and concepts came up. Special focus was made on the synergies and results of common activities between the different strands of the European education programs.

The chapter concentrates on the aspects of benefits of partners, networking as it is at present in Germany, the role of incoming students (incomings) for the success of the partnership and the different types of networks.

II. ASPECTS OF RUNNING MOBILITY PROJECTS

IN the following paragraph the main principles and benefits from student mobility are listed. The enumerations reflect different aspects and views of placements and benefits of the participating persons and institutions.

A. General goals of student placements

1. New learning and working methods and a transnational way of thinking are to be stimulated and developed.
2. A focus is to be made on the stimulation of competitiveness of small and medium sized enterprises SME's, a contribution to knowledge provision in the field of university education and to the employability for the beneficiaries (students and young graduates).
3. Technology transfer between participating partners should be stimulated and supported. Student placements are mainly realized in the sector of engineering. So these placements help to deepen/extend theoretical knowledge, to become acquainted with new technologies and to develop new skills in social and language competence of the prospective graduates. By this student placements give support to the technology transfer between the regions of Europe.
4. The transnational exchange of people helps to built-up a network, that make a high efficiency of co-operation within international projects possible.

B. Benefits for students to participate in mobility projects

Related to long term experience the following benefits of students can be identified within mobility projects:

- Curiosity to international experience
- Lower-cost stay abroad, as grants are provided

- Challenging working tasks within the vocational training period
- Extension of the individual cultural horizon
- Development/acquirement of a „career brick“/ references
- Pronounced interest for support, help in orientation, counselling and offering of a student placement and a financial contribution to the stay abroad
- Extension of language competence
- Search for a potential prospective employer
- Closing the gap between theoretical training and the „real“ professional life

C. Benefits of companies acting as hosts for the students

- To gain experience with international project work
- Acquirement of language competence for all people involved
- Technology transfer between universities and enterprises by application of latest scientific knowledge from teaching and research at universities and practice/labour world
- Solution of internal problems with calculable risk but without prejudice
- Increase of motivation of internal staff by new experience in co-operation with „international“ people
- Unique opportunities for public relations for the host enterprise in the home country of the placement student
- Placement students can be prospective employees in their home countries and thus contribute to the entrepreneurial success of a region
- Placements can be part of staff development strategy and contribute to the internationalisation of business
- Pre-selection of applicants by a counselling office with regional and European orientation (projects).

D. Benefits for universities

The sending universities benefit from the participation of student and graduate's mobility by:

- Attractiveness of a university increases by international co-operations
- The labour market chances of graduates increase considerably (employability), the motivation of graduates to be self employers as well
- New international co-operations are developed
- Transnational exchange of experience „through the heads“
- Influence on curricula and quality of education is possible and targeted at this area
- Additional financial means for mobility actions
- Participation in network activities – new partnerships and scientific co-operations are possible
- New ways of recognition of academic and labour market relevant study records (diploma supplement, Europass Mobility, certificates/references)
- Influence opportunities on European education and training policy
- Bridging function between regions and countries
- Technology transfer opportunities, new individual partnerships between universities and enterprises with the European dimension

E. Running projects – ways to settle student placements

The following procedure is typical for the development of a mobility project proposal within EU programs (abstracted):

1. Project idea development – following the calls for proposals
2. Establishment of a local and transnational partnership (fundamental criteria of the proposal evaluation) – sending and host institutions, applicants (students)
3. Creation of project conception, development of strategic aims and goals according to the needs and calls and program priorities
4. Stage of a successful proposal (convinced peers)
5. Recruitment of applicants – development of motivation with the potential participants
6. Recruitment of host companies – collection of job offers
7. Realization of student placements
8. Supervision of the partners and participants
9. Reports and evaluation
10. Dissemination of results
11. Development of new proposals

The above factors describe the different influences and variables for student mobility. The main difference to a study period abroad (mobility between universities) is that students really change the character of living, working and learning into a professional world and it can be stated that they get practice orientated tasks at a high level of responsibility and independence.

Of course there is a competitive situation between a) the applicants for the places/grants and b) the projects for the acceptance of National Agencies NAs (experts).

III. NETWORKS

Types of networks for mobility projects

To run the projects the contractors need different kinds of networks to realize the mobility activities. These are in detail as follows:

A local network at university level = financial aspects, integration of faculties, partners in local industry and administrative matters. A contractor has to be identified.

Can be realized by local initiatives = university as a contractor / career centre with limited working radius.

A regional network to integrate the enterprises, regional ministries for co-financing aspects and make influence on the own region and make lobbying. It is useful to develop partnerships in a region to run projects together with efficiency. Practical examples are university-enterprise- partnerships like type UETP/AUEF, career center, Chamber of Commerce and Industry, sectorial associations (for instance IT, material sciences etc.).

A national network to co-operate with other contractors of a country to optimize the project(s) and to develop synergies within a country. The contractors/promoters can share experiences and integrate national/regional or sectorial associations for new levels of lobbyism and interests. Example is the German network of contractors

By such co-operations the simplification and unification of rules and conditions can be progressed, obstacles can be removed and combinations between different strands and programs can be developed, e.g. synergies between student and young graduate mobility, staff exchange (target groups) and thematic networks / pilot projects. Close connection can be made to vocational education when universities train in this area as well (administration, craftsmen in workshops etc.). At the same time new concepts and professional profiles for new technological development and requirements can be developed.

European networks to share experience between the projects and to built the necessary platforms for partnerships (to get the letters of intent LOI) and to guarantee a high level of quality of the placements and conditions. These transnational networks can form a lobbyism. The efficiency of running the projects, the increased flexibility to take care for the applicants and participants bi-directional and development of mutual trust and understanding are essential factors for the successful realization of an European program.

IV. NEEDS OF THE PARTNERS

ALL partners in mobility projects have specific needs or expectations to optimise the project conditions and the success factors:

a) contractors
- high degree of flexibility to place the students in the target areas - companies
- additional money when the needs exceeds the budget of the project
- open minded partners and high degree of acceptance of the applications from the sending region/country
- real needs analyses of a region – can not be done within a mobility project alone; help and assistance of associations like Chambers of Commerce and Industry is needed
- open minded host companies to give supervision to students and young graduates, to hand out references and to contribute by means of additional money or money in kind
- additional grants from local authorities like ministries (public contributions)
- platforms to exchange experience like international conferences or workshops
- understanding for the necessary administrative conditions (delivery of LOI, reports of participants, references from the hosts etc.)
- supervision for the own students done by promoters in the target country (as a part of a general network)
- long term stability for running projects

b) students / participants
- simple application procedures
- high level of funding for subsistence and travel costs

- references for the labour market
- to gain skills for the professional life
- little requests with reports and evaluation sheets
- support at problems and finding accommodation
- academic recognition at home university

c) sending universities within a network
- participation in European programmes
- high reputation by internationality
- easy combination between ERASMUS and LEONARDO – study and work abroad
- establishment of bridges between R&D and production at international level

d) host enterprises as receiving partners
- permanent contact points to co-operate with
- flexibility with time and requirements
- short term decision opportunity
- easy procedure to participate in European programs
- students as ambassadors from other countries and later employees or contact persons abroad – networking strategy

V. THE GERMAN WAY OF RUNNING THE PROJECTS

THE German experience is based on the long term experience of running so called UETPs – University-Enterprise-Training-Partnerships. These structures were saved from the early times of running student mobility projects with a given network of partners all over Europe (without the new member states). The situation here is characterized by a still living network of contractors which act as regional partnerships. New models of contact points were developed, career services integrated the mobility activities into their offer.

The coordinating points (UETPs/LEONARDO-Offices) are still alive and have a permanent platform to communicate with each other under active co-operation with the NA – Deutscher Akademischer Austauschdienst DAAD. Practical instruments are an electronic platform – e-mail forum established and by DAAD, annual meetings, meetings of contractors, publication of strength and weaknesses of the project proposals (evaluation sheets), establishment of a board of contractors to communicate problems and conditions to optimize the project realization. Strategic discussions to develop the criteria and conditions of project management are permanent part of the work of the board of contractors in strong co-operation with all contractors. The discussion led to a solution that incoming students could be involved in the running projects. This point will be describe in the following chapter.

VI. ROLE AND MEANING OF INCOMINGS

THE general program regulations do not implement a model to support/grant incoming students, but many students do not have a contractor nearby in their

home country. They need help to realize their intention to do a student placement abroad. Especially in the new member states the networks are not developed enough to provide placements according to the needs or the needs are not quite spread out as the opportunity is not well published. The latter fact is not a problem of the new member state only but a fact to publish the EU programs in general. The projects are orientated to realize a certain degree of reciprocity but in general the grants can not be given to incoming students. The German contractors developed a model to allow the projects to provide grants up to 20% of the total budget for incomings to serve this need. It is an experience that local industry asks for students from certain countries and applicants can apply for placements and grants very easily via the German projects. It is a service of project partners to get human recourses. This measure led to many new and interesting contacts to the member states and widens the networks. All partners as sending universities fully agree to that initiative because by this bilateral co-operations with partner universities can be stimulated and sister city partnerships as well. Only a few countries share that idea up till now but within LEO-NET (www.leo-net.org) this idea is discussed. Another aspect for contractors is the increasing flexibility to react on applications from partner regions/countries to welcome these students without long delays when no project is available in the appropriate region.

The German network communicates the flows of students and where grants and placements are (still) available. By this no placement offers and grants get lost and all regions in Germany are covered as the network helps even when no projects are there at present. Coordinator meetings take place at a very open atmosphere and practical experiences are exchanged.

VII. THESIS AND SYNERGIES

- Specific networks are very helpful for the realization of mobility projects.
- Networks can be distinguished according to the field of efficiency between regional, national and international and with regard to the content by sectorial and regional ones.
- Networks in mobility projects increase quality of individual measures and of the project in total. They extend and take care for partnerships, shorten information distances and improve the opportunities for disseminations of results.
- Networks increase the flexibility of promoters in preparation, realization and attendance of project measures (forum DAAD, LEO-NET).
- Networks offer opportunities for effective installation/application of project data management (Databases => dissemination of information, application procedures, finance management, report requirements, statistics)
- Tools of networks are: data processing facilities, workshops and conferences, information material, PR under one common label = identification!.
- National Agencies (DAAD – internal platform in internet, inWEnt – GLOBAL-Campus) support the establishment, running and extension of networks by means of conferences, meetings of promoters and events to publish best practice.
- Networks are dynamic institutions that integrate other contractors and forward experience.

- Networks provide synergies for participation in other types of projects – i.e. staff exchange, pilot projects, network/thematic projects, ...=> here partners come together by common esteem for competence in mobility projects.
- Networks are able to form their own lobby.
- Networks cover the needs in mobility projects considerably, gaps can be closed by co-operations – redistribution of grants, placement offers and placement enquiry.
- There are no network structures yet in the new member states and this leads to enormous efforts in these areas and does not cover the (real) needs there. For instance: 2000 – 2002 in CZ about 235 projects with 2.450 participants; 2000 – 2002 in HU about 330 projects, 2003 - 132 projects with 340 participants. In 2003 in Germany there were 25 projects in the co-operation university-enterprises with a budget of 4,6 million Euro and 1.800 participants (about 150 per project)
- The university-enterprise-network offers newcomers active support and exchange of experience to support the implementation and integration of new countries and regions.

VIII. RECOMMENDATIONS FOR FUTURE PROGRAMMES

- The improvement of student mobility must be based on long term experience and evaluation of projects. The expertise is there and should be kept for the next program structure from 2007 on.
- Mobility projects including their partners need long term stability to develop trust and mutual understanding. This can be given by a strategic orientation within the coming **I**ntegrated **P**rogramme of **L**ifelong **L**earning IPLLL and the sector of university-enterprise co-operation needs a separate place. International offices are not in the position to take care for these co-operations as they do not have the connections to industry. Career services are suitable structures to cover that field.
- Mobility projects need networks to act with high efficiency to cover the needs in preparation, realization, supervision and evaluation including preparation of new concepts.
- The quality of projects and individual mobility measures has to follow agreed and fixed – the Quality charter integrated 2004 is the first step in that direction but only a framework. Detailed activities have to be carried out by all partners in the process chain.
- Additional grants and sources of funding are necessary to cover the needs of individual mobility. Sources can be additional contributions from the companies, governmental money from local/regional ministries and bodies.
- Future concepts need the flexibility to take care for incoming students as an instrument for the promoters and participating partners.
- Regional networks with associations of universities and enterprises improve the efficiency of mobility projects as the efforts to run them are reduced.
- Transnational networks are lobbying instruments to improve the work of contractors. They can use electronic platforms for placement settings and databases for job and application purses. They can offer training offers for promoters and newcomers.

- Promoters need platforms to communicate and to exchange experience, results and visions. The platforms should provide podia for discussions and to meet each other.
- The co-operation with National Agencies leads to trustful work in a country by respecting the different role the players play. This can cover the needs for use of all grants given and earned by a country when all partners help each other. It is in the real sense of the European Idea/Dimension.

Abbreviations and terms

COMETT – COMmunity action in Education and Training in Technology
DAAD – Deutscher Akademischer Austauschdienst (German Academic Exchange Service)
inWEnt – internationale Weiterbildung und Entwicklung gGmbH - German NA for the vocational sector
IT – information technology
LOI - letter of intent
NA – National Agency
R&D – research and development
UETP – University Enterprise Training Partnership (AUEF in French)
incomings – European slang for incoming students – coming from an outside country into a host country

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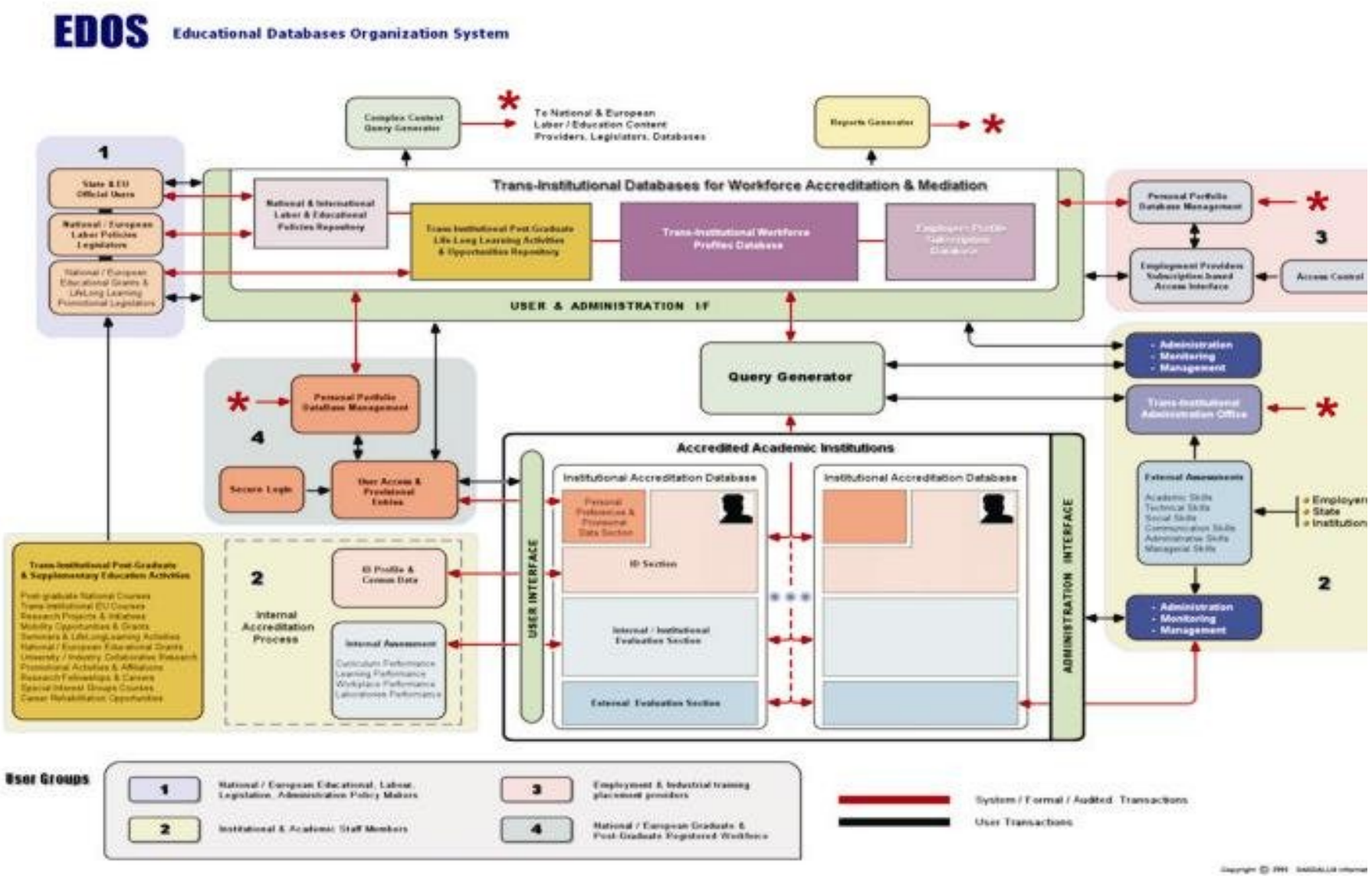
EDOS
Educational Databases Organization System
Complex Context Query Generator
To National & European Labor / Education Content Providers, Legislators, Databases
Reports Generator
1
State & EU Official Users
National / European Labor Policies Legislators
National / European Educational Grants & LifeLong Learning Promotional Legislators
National & International Labor & Educational Policies Repository
Trans-Institutional Post Graduate Life Long Learning Activities & Opportunities Repository
Trans-Institutional Workforce Profiles Database
Trans-Institutional Databases for Workforce Accreditation & Mediation
USER & ADMINISTRATION I/F
Personal Portfolio Database Management
3
Employment Providers Subscription based Access Interface
Access Control
Query Generator
- Administration
- Monitoring
- Management
Trans-Institutional Administration Office
4
Personal Portfolio Database Management
Secure Login
User Access & Provisional Entries
Accredited Academic Institutions
Institutional Accreditation Database
Personal Professional & Provisional Data Section
ID Section
Internal / Institutional Evaluation Section
External Evaluation Section
Institutional Accreditation Database
USER INTERFACE
ADMINISTRATION INTERFACE
External Assessments
Academic Skills
Technical Skills
Social Skills
Communication Skills
Administrative Skills
Managerial Skills
- Employer
- State
- Institution
2
- Administration
- Monitoring
- Management
Trans-Institutional Post-Graduate & Supplementary Education Activities
Post-graduate National Courses
Trans-Institutional EU Courses
Research Projects & Initiatives
Mobility Opportunities & Grants
Seminars & LifeLong Learning Activities
National / European Educational Grants
University / Industry Collaborative Research
Promotional Activities & Affiliations
Research Fellowships & Careers
Special Interest Groups Courses
Career Rehabilitation Opportunities
2
Internal Accreditation Process
ID Profile & Census Data
Internal Assessment
Curriculum Performance
Learning Performance
Workplace Performance
Laboratories Performance
User Groups
1
National / European Educational, Labour, Legislative, Administrative Policy Makers
2
Institutional & Academic Staff Members
3
Employment & Industrial training placement providers
4
National / European Graduate & Post-Graduate Registered Workforce
System / Formal / Audited Transactions
User Transactions

Chapter 19 Technical and Methodological support of Training Programme for International Project Management

S. Sidorenko, V. Gerasymchuk, S. Shukayev and O. Zakhovayko

Abstract— *In this chapter the ways of development of international activity management in higher education establishments of Ukraine are illustrated.*
By the example of the National Technical University of Ukraine "Kyiv Polytechnic Institute" the main problems of Ukrainian universities in terms of integration and globalisation increase in the world, in educational and scientific field in particular, have been illustrated. The main directions of international activity of NTUU "KPI" and the results achieved over the last few years in this field have been illustrated.
This information about the realization of the project, which is carried out in NTUU "KPI" with the support of the UNESCO «Technical and Methodological support of Training Programme for International Project Management».

I. Introduction

TODAY Ukraine is a country with transitive unstable economy. The production pattern presents great difficulties in the economy transformation, resulting from the fact that Ukrainian economy used to be a part of the USSR industrial complex. Thus, Ukraine inherited power-consuming production and high-tonnage mechanical engineering with incomplete stages of production process. On the other hand, Ukraine has great potential: it is rich in natural resources and skilled personnel, and owns a well-developed higher education system that creates the necessary prerequisites for rapid economic increase and integration of Ukraine as a full member into the European and universal economic area.

Globalisation and integration processes, taking place throughout the world, induce Ukraine to join international organizations that expect their members to harmonize their legislative base according to the world standards and, hence, build transparent economy. Meeting this kind of requirements guarantees that countries having transitive economy, like Ukraine, will be enrolled in investment attraction and various international projects aimed at economy raising, which demands qualified personnel for organization and implementation of such projects.

The National Technical University of Ukraine "Kyiv Polytechnic Institute" (NTUU 'KPI') is one of the largest European technical universities and has more than century-old traditions in training qualified engineers for different industry sectors. Its graduates traditionally occupy key posts in government, Academy of Science and higher education establishments, run powerful enterprises and industrial complexes both in Ukraine and countries of the former USSR, as well as in others throughout the world.

The authors are with the National Technical University of the Ukraine (NTUU).

II. TRAINING OF MANAGERS OF INTERNATIONAL PROJECTS – REQUIREMENT OF NOWADAYS

TODAY NTUU "KPI" places high emphasis on economic training of engineers. Several faculties and chairs have been established, bringing together specialists in the fields of economics, management and marketing.

Considering the lack of specialists in international project management in Ukraine, especially in industry sectors (mechanical engineering, power engineering, computer technologies and biotechnologies, microelectronics etc.), training of such specialists is very relevant. This is especially important considering the fact that Ukraine incurs losses caused by poor project management, becoming apparent in unstipulated investment of economically unsound projects and, sometimes, in lack of knowledge about projects supporting business setting up and development.

Intentions to start training of specialists in international project management for industry and high education system of Ukraine on the base of NTUU «KPI» were supported by the UNESCO. In the framework of the programme «Participation Programme in the activities of Member States » for 2004-2005 the project «Technical and Methodological support of Training Programme for International Project Management», suggested by NTUU «KPI», has been financed by the UNESCO.

The project purpose and idea lie in establishing training of highly skilled specialists for industry, able to assess the importance, future prospects and efficiency of international projects, on the base of the UNESCO Chair in Higher Technical Education, Applied System Analysis and Informatics at the National Technical University of Ukraine "Kyiv Polytechnic Institute".

Another important activity sphere for international project managers is educational sphere.

Integration and globalisation processes could not bypass the sphere of higher education. The brightest example of the development of these projects in Europe is creation of the European zone of higher education as the main goal of the Bologna process. At the same time the process of creation of the common European scientific area takes place. In the framework of these processes scientific and educational exchanges between European universities have become more and more intensive, the mobility of teachers, students and post-graduates has been increased.

Almost the same tendencies are being observed in other directions of the international cooperation, in Asian, American etc in particular.

During its more than a century-old history the National Technical University of Ukraine "Kyiv Polytechnic Institute" has accumulated a great collaboration experience in scientific, technical and educational spheres, and the rate of this collaboration is being increased from year to year.

Over the last few years the number of international projects in the framework of international organizations and funds, which is being carried out by scientists of the NTUU "KPI" has been increased greatly.

NTUU "KPI" actively develops cooperation with influential international organizations: UNESCO, WIPO, UNIDO, UNDP, NATO, EC, EDNES, CODATA, British Council, IIASA, SALZBURG SEMINAR, VISBY program with the aim of our higher technical school integration into the world education – European scientific and information area in particular.

Thus, during the last few years cooperation has been developed in new strategic, important for Ukraine and for the university directions, by which the collaboration of these organizations with the scientific and educational sphere of Ukraine has not been developed yet. They are:

- TEMPUS-TACIS – under European Commission program – on network electronic libraries development in Ukraine;
- NATO Scientific Committee – on creation of the telecommunication network URAN, on integration of Ukraine into European information area, connecting the European network GEANT;
- EDNES (International Association "Earth Data Network for Education and Scientific Exchanges", Strasbourg, France) – on technologies of information society for CIS countries;
- VISBY program – development of cooperation with Baltic countries universities;
- UNESCO – on distance education in CIS countries;
- WIPO (World Intellectual Property Organization and its World Academy, Geneva, Switzerland) – on education in this field with distance learning technologies;
- UNIDO (United Nation Organization of Industrial Development) – on Technology Foresight for Ukraine;
- CODATA (Committee on Data for Science and Technologies at the International Council for Science) – on problems of databases access in all spheres of science and technology;
- United Nations Development Program in Ukraine – on problems of gender education.

Another direction of international activity in the NTUU "KPI" is training of specialists for different countries of the world.

During its more than a century-old history NTUU "KPI" has trained more than 6000 specialists for 112 countries all over the world. Today 1500 citizens from 43 countries study in the National Technical University of Ukraine "Kyiv Polytechnic Institute".

As it has been already mentioned, one of the most important tasks of the university's international activity is activation of teachers, students and port-graduates exchanges. They are being carried out mainly in the area of international programs demanding significant efforts for accumulation, analysis and distribution of information within the university and its subdivisions.

It should be mentioned that the NTUU "KPI" actively collaborates with leading international programs and funds. Ukrainian representative office of the DAAD is situated at the NTUU "KPI". Representative offices in Kyiv of the British Council and the Goethe Institute began their activity in this institute.

Today common structures with educational and scientific establishments of other countries are being actively established and developed. They are:

- Joint Ukrainian-German Faculty of Engineering (the National Technical University of Ukraine "Kyiv Polytechnic Institute" and Otto-von-Guericke Institute of Magdeburg);
- Ukrainian-Japanese centre of NTUU "KPI", created to promote development of cooperation in different spheres between Ukraine and Japan (the project of the Japanese Information Collaboration Agency (JICA) «Ukrainian-Japanese centre»);

- Ukrainian-Chinese centre of High Technologies and (the National Technical University of Ukraine "Kyiv Polytechnic Institute" and Zhejiang University)

Taking into account constant expansion of international collaboration and the university scale – near 42 000 of students and more than 2000 teachers, research officers and post-graduates – a problem of effective organization of international activity has emerged. The most productive from our point of view way of solving this problem is involving of all parts of administration of the university, first of all on the level of faculties and institutes, to direct participation in the organization of international activity.

In 2005 the Academic Council of the university accepted a strategy of decentralization of many directions of activity including those in international sphere. It resulted in creation of international offices at some faculties, and this process continues developing.

One of the main obstacles on this way is the lack of skilled specialists in the international sphere of the university. Today the university departments need professionals in international project management (by the way, such a situation is typical to the majority of leading universities of Ukraine).

III. TRAINING PROGRAMME FOR INTERNATIONAL PROJECT MANAGEMENT.

FOR the purpose of solving the problems mentioned above the Faculty of Management and Marketing has organized the Training Programme for International Project Management on the base of the UNESCO Chair. The general mission of the Programme is to produce a positive business image of the higher education establishment academicians in the sphere of international cooperation.

Programme strategy:

- to raise the level of the academicians' skills in the sphere of international activities of higher education establishments;
- creation and further improvement of the methodical base for the international activity management in higher education establishments;
- distribution and popularisation of the knowledge of international activity management of higher educational establishments.

A training plan of subjects aimed to achieve the set goals was created.

The period of study – 2 terms without separation from working process.

The first term involves studying of the next disciplines.

1. European integration is an introductory discipline which will cover theoretical concepts of integration processes, the stages of their development, the practice of European Union creation and operation.
2. International Economic Law. The objective of the course is to introduce students to scientific concepts and practical problems of legal control of the international economic relations.
3. International Economics The course is aimed at forming of a knowledge system in the International Economics, conditions, forms, methods and the main techniques of International Economic activity.
4. International Accounts and Currency Transactions – the course which belongs to the series of fundamental subjects. It aims at teaching students the principles of international accounts organization, account techniques with the use of letters of

credit, collections, bank transfers, using bills and cheques in the accounts, the understanding of the foreign currency transactions mechanisms, using financial techniques in hedging the currency risk, the strategies of currency risk control.

5. Applied Systems Analysis The present course objective is to give the knowledge of the development of the complicated processes realization strategy, making decisions at every stage and taking the potential risks and possible compromises into consideration and prediction of the future outcome of the made decisions.
6. Internet-Technologies in Management. The course is aimed at training students for the application of present-day techniques of information processing for accomplishing economic tasks of modern companies, forming of theoretical knowledge and practical skills system in the information systems and technologies development and operation.
7. The Language of International Business Papers. This course is based on the study of the requirements of holding general documentation and foreign-economic activity documenting, getting familiar with document processing techniques, acquisition of decision-making skills in some practical issues of the office work by students.

The second term.

1. International Innovation Investment Activity. Giving theoretical knowledge about the investment process functioning mechanism.
2. International Marketing. The course aims at the formation of an up-to-date outlook of international activity in the sphere of marketing, the substance, the aims, the methods of business activities in the foreign market.
3. International Project Management – providing students with knowledge of modern methods, techniques and tools of the international project management.
4. Accounting, Analysis and Audit of the Foreign-Economic Activity. The subject covers methods of efficient organization and running of business accounting at enterprises by means of using progressive forms and national standards, acquisition of processing and accounting usage skills in management.

You can get information about the training programme operation at our website: www.tpipm.ntu-kpi.kiev.ua.

Up to date the training programme is attended by the specialists from the following faculties, institutes and departments: Faculty of Informatics and Computer Engineering, Faculty of Linguistics, Faculty of Chemical Engineering, Faculty of Electronics, Faculty of Physical Engineering, Institute of Telecommunication Systems, Faculty of Chemical Technology, Faculty of Physics and Mathematics, Faculty of Applied Mathematics, Faculty of Biotechnology, Faculty of Heat Power Engineering, International Projects Department.

The first results of the training programme activity have been already received by now. Thus some of the students are already applying the acquired knowledge when preparing project propositions for participation in the international contests, such as the 6th Framework Programme, TEMPUS-TACIS etc. A part of the students is involved in the organization and holding of the international conference under the aegis of ICDE “International conference on capacity building in Europe for distance and ICT based education”, that is going to be held at the NTUU “KPI” in September 2007.

IV. CONCLUSION

THE international component of the modern university's activity is becoming decisive in terms of growing integration processes and globalisation. And the prospects of successful functioning of any higher education establishment directly depend on its ability to compete in the foreign market of educational and scientific services. And this is impossible without qualified administrative staff, which is able to efficiently operate in the international sphere and meet the fast-shifting demands of today's world.

ACKNOWLEDGEMENT

ORGANIZATION and functioning of the training programme for international project managers have been supported by UNESCO.

Chapter 20 Binary stars*- trends and features of university-industry cooperation in Italy

Sveva Avveduto and Daniela Luzi

Abstract— *This chapter presents an overview of a typology of recent industry-university collaboration in Italy. The cooperation activities have expanded and diversified significantly over the last decade and many universities have set up specific services to implement closer links with enterprises. The prevailing typology is the education and training cooperation scheme. University activities of knowledge transfer are carried out through the implementation of services and structures that support patenting activities, spin off and incubators.*

I. INTRODUCTION

THE cooperation between university and industry in carrying out research activities and in exploiting results has followed across the years a wavering track that moves backwards and forwards between opposite poles: the ivory tower and the service station icons. Since the '70 when the well known metaphor has been introduced [1] there has been a change in behaviour and a new approach in knowledge exchange has taken place.

Universities are increasingly engaged in commercialising their principal product, i.e. knowledge, and firms are interested in using this resource in order to raise their economic returns. The two aims are not conflicting, and both university and industry can benefit from mutual co-operation to improve their capacity to influence the social, cultural and economic development.

The public private partnership has been recognized as one of the powerful tools to boost innovation [2]. This policy instrument has been recognized as one of the best ones to fill the knowledge gap in innovation systems as it is a rather flexible one and can take specific forms to adapt to local, sectorial, and field requirements. A relevant number of policy issues have been identified that can be addressed by promoting cooperation between public and private sectors, specifically university and industry partnerships, that can benefit both partners and science and technology system at large. Among them Oecd has identified:

- ✓ Developing the infrastructure for knowledge and technology diffusion.
- ✓ Funding of early stage technology.
- ✓ Upgrading companies' technological competences.
- ✓ Receiving/offering expert advice.
- ✓ Enhancing innovation capacity of regions.
- ✓ Developing high technology geographical clusters.
- ✓ Enabling innovation in goods and services purchased by public sector bodies.

* A binary star system consists of two stars both orbiting around their barycenter. For each star, the other is its "companion star". http://en.wikipedia.org/wiki/Binary_star

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- ✓ Promoting the development of technologies, products and services relevant to the public sector and social needs at large.

II. OBJECTIVES AND OUTCOMES OF COLLABORATION

In In the late '80s Nelkin and Nelson believed that theories about a wide gap between academic and industrial culture were too excessive [3]. The Authors call, after Prygogine, the renewed forms of collaboration the 'New alliances', since the beginning of the Nineteenth Century the balance and perspectives of cooperation have changed considerably and nowadays the long history of university industry cooperation has lead to an ever rising number of activities expanding both in quality and quantity level, as for funds expended and for the large variety of processes they follow.

Even if moving from different starting points, as working methods and ethos may differ considerably, a common ground can be found in view of a shared interest in knowledge production, diffusion and appropriation.

The number of objective that cooperation between universities and industry can contribute to reach is rather wide and goes from the 'behavioural' to economic outcomes. The following scheme summarizes some of them as they have been chosen by recent research works:

Among the economic outcomes we can group:

Input and output additionality: in sharing costs and in getting industry leadership within University-Industry cooperation, the weight of public support on business R&D and innovation increases.

Better R&D attainment. On the public side involving industry in research activities means getting access to private financial resources and competencies that can be oriented on public interest (e.g. in areas such as health and environment).

Commercialisation of public research results. Typically through the creation new technology-based firms as spin-offs from public research.

Among the more cultural and behavioural outcomes:

Promote synergy. The cooperation activities, being often included or promoted by national or regional schemes, contribute to develop innovation clusters and to reach the critical mass either wise not available to carry out research.

New ethos. University-Industry cooperation changes the respective behaviour of public and private researchers in sharing the same work project, and contributes to build a different approach to reciprocal work attitudes and ethos and to enhance trust and personal networks necessary to implement present and future cooperation.

New links. Particularly for SME's it has been difficult either to express their innovation needs or to find the right solutions for their technological problems: bridging the gap between university and industry in promoting new direct links is a measure to be taken.

Training and mobility of human resources. The cooperation activities are almost all designed to allow the exchange of students/researchers and the between the public and private sectors.

III. COOPERATION BETWEEN INDUSTRY AND UNIVERSITIES IN ITALY

IN Italy the experiences of cooperation between universities and firms date back to the first half of last Century. At the beginning of the cooperation process the initiatives were taken mainly by individual professors and/or entrepreneurs and only afterwards there was a commitment of their organizations. A coordinated action in a common science policy framework though is defined much later and still needs further improvements.

Increasing correlation between scientific research, higher education and economic development pushes towards stronger expectations of direct returns of investments in knowledge. These partnerships are expanding since the late '80s and governments are investing more on these kind of cooperation as it improves the the weight and influence of public support to business R&D through cost and risk sharing. It may also assure a high level contribution of the private sector to R&D activities carried out in the public sector and universities particularly in the mission oriented ones and allow the commercialisation of results from public research. The Italian experience of the Mission Oriented Projects (Progetti Finalizzati) implemented by the National Research Council during the late '80s and the '90s is a clear example of the mutual benefit that universities, public research bodies and firms did take in sharing knowledge in R&D and risk in undertaking new initiatives. [4]

According to the latest data available [5] R&D expenditures in Italy have reached 1,1% of GDP in 2003. R&D expenditures are by 49,1% in the public sector, (made by the sum of 32,6% universities, 14,2% public research bodies and 4,2% other institutions), and by the remaining 50,9% in the business sector. The evolution of industrial investments in R&D in the time span 1999-2003 shows a positive trend. Expenditures of the business sector have increased by 4,3% in 2003 as compared to 2002 while the public sector has experienced strong cuts in budgets.

Research activities performed by the business sector are concentrated in firms with a relevant number of employees: 82,8% of all private expenditures are made in firms with more than 250 employees while SME's (less than 50 employees) sum ut to 5,6% and medium sized firms (50-249 employees) the remaining 12%. Besides the R&D activities are concentrated in some specific sectors: telecommunications, chemical products and pharmaceuticals, transport, particularly car industries, mechanical machinery and services for R&D. The growing overall trend is to be attributed to the specific growth in services rather than in manufacturing R&D activities (+11,8% in 2003).

In 2001 15% of firms performed their R&D activities within their own laboratories, while over half of R&D activities are organized in cooperation by different internal structures typically production and design. In the same year 39% of Italian firms with R&D activities had cooperation activities with external structures, 93% of those choose an Italian partner, among these 71,4% were other enterprises and 45% universities (multiple answers were possible).

As for R&D personnel, in 2001 in the public sector worked 13,006 researchers and 16,759 technicians, in universities 27,146 researchers and 31,713 technicians and in the business sector 26,550 researchers and 38,721 technicians (all in full time equivalent).

At present cooperation schemes between university and industry are supported in Italy by a network of formal agreements that link directly the different partners or

create a common framework programme managed by various actors. The main one are managed by the Italian Industrials association (Confindustria) and the Conference of Italian Rectors (Crui) that are currently the main institutional bodies acting as facilitators and promoters of cooperation.

The organization of the cooperation activities has changed over the years following different paths. On the one hand firms have been interested in having a privileged window on university forefront research and through investing a limited capital to have access to possible new products or processes. The cooperation activities are in this case limited in size and investments and do not generally require a large structural apparatus. On the other hand they have invested consistent human and financial resources to develop new product and processes also in cooperation with firms. Both modalities have their rationale and both still are present though the second one is the one that involves more directly and consistently university and firms and is much more expected to be governed by rules and agreements.

As for the motivations that push university and industry to cooperate a first element on the university side can be envisaged in the usefulness of new industrial funds to support research. The opportunities for professors and researchers to enhance their competencies and experiences levels in interacting with firms ahs also been frequently mentioned.

IV. COLLABORATION ACTIVITIES

THERE are a number of overall general attributes of a national science /education/production system that contribute to positively influencing the university industry cooperation. These attributes pertain to: climate, process, timescale and sustainability [6]. The general national climate should provide a favourable environment for innovation and risk taking as well as proper infrastructures that provide both services and facilities such as ITC, libraries, transport easily accessible, banks etc.

As for the national innovation process to be created it should be directed to drive relevant industries and stakeholders into research processes and on the same time to assure a considerable time span, reasonably 10 years, of support to assure a steady contribution to economy and society. Of course intermediate evaluation and milestones to be met should be set, but giving the way to a long term commitment is an essential feature to assure a relevant reciprocal contribute from either universities and firms. The continuity of cooperation seems to be a relevant point as it assures to follow the different phases of invention/innovation more closely and also to create the commonality in sharing behaviour and ethos more effectively.

The experiences in fostering university-industry relationships by the means of cooperative agreements generally follows three main directions to reach specific goals:

- Develop education for innovation, by either joint or separate but shared activities, all directed to create a specific education background and skills for graduates to allow them entering entrepreneurial activities.
- Develop research procedures that engage industry and push university towards the application of results.
- Integrate the education/knowledge/research elements in key structures either physically or virtually set together.

V. KNOWLEDGE TRANSFER THROUGH EDUCATION

ALTHOUGH university-industry cooperation activities have expanded in content and multiplied in number significantly, a recent report [7] still states that in the UK 80% of the companies have no formal interactions with universities. The Report assumes that the main reason for this lack are linked to the lack of awareness by firms of what university may offer them and which might be solved with university help. On the other side he points out the lack of receptiveness of universities to the needs and demands coming from the business sector felt as too aside from university interests. A main problem of lack of information and communication seems still to be the strong reason hindering cooperation activities. Actually it sounds paradoxical that still even in the UK this can be envisaged as one of the main problems in our present times overloaded by a surplus of information. One solution suggested to bridge the reciprocal information gap may be the education activities starting from introducing the students into firms and "educating and empowering agents of innovation and knowledge exchange when they are students". This solution is perceived as the one that can solve from the very beginning the information and communication questions [8].

The development of students skills is generally the first and more common ground of university industry collaboration as this level meets easily, or at least more easily than others, the interests and of both partners. On the university side the teaching activities are of course a prevailing part of its mission and there is a strong interest in keeping the students updated and linked to the evolving interests and goals of the labour market. On the industrial side cooperating with universities in organizing and running joint courses ends up in getting a new labour force more creative and more proficient on specific issues.

In Italy this type of collaboration is increasingly taking place through the institution of new universities courses and degrees with the aim of creating professional profiles needed in a specific local environment or in a specialised field. An other important form of collaboration is represented by organisation of training in industries during universities courses, theses carried out in enterprises, seminars carried out both by entrepreneurs and university teachers, etc.

The agreements, which make these initiatives possible, are closely linked with the new roles of universities in offering students services, which can facilitate their entrance in the labour market. This trend is confirmed by the analysis of data taken from the Confindustria report [9] (fig. 1). From 47 universities, which represent 61% of Italian public universities, 31 have organised services, that aim to integrate theoretical with the practical education, facilitating training and apprenticeship in enterprises. These services have different names (generally Stage and Job placement) and offer a variety of facilities. Sometimes they give information on the procedures necessary to organise training activities both for students and interested industries, in other cases they provide students with lists of available opportunities. These services are often carrying out activities aiming to facilitate students' university choices, visits to enterprises, etc.

Another important way of connecting students with labour market is to develop databases on curricula of students who have obtained the degree. Since 1994, the statistic observatory of Bologna University has promoted the so-called AlmaLaurea service [10], which is managed by a university consortium and supported by the Ministry of Education, University and Research. 23 universities participated to this

initiative in 2003 and the number is increasing each year. Data on students' curricula are officially given from universities, they pertain the name of the university, faculty and type of degree, bachelor credits, title of the theses. Students, who can directly update the database, give other data on skills and experiences. Some data are used in an anonymous form as they are elaborated for statistical purposes.

A smaller number of universities (8 universities on the 47 reported in the Confindustria report) has developed its own database. Some of them connect it to apprenticeship or job offers, or give special access to enterprises, which are allowed to retrieve information from these databases or can update their industry profile. An example of such initiatives is the development of a portal of the Basilicata university (http://itinera.uniba.it), which gathers information on didactic, apprenticeship offers, job opportunities in Italy and abroad.

We have also reported the initiative concerning the institution of annual prizes for students or graduates, who have had the best entrepreneurial idea with high technological content, (such as StarCup prizes given by the university of Bologna and Padova with the financial support of local banks).

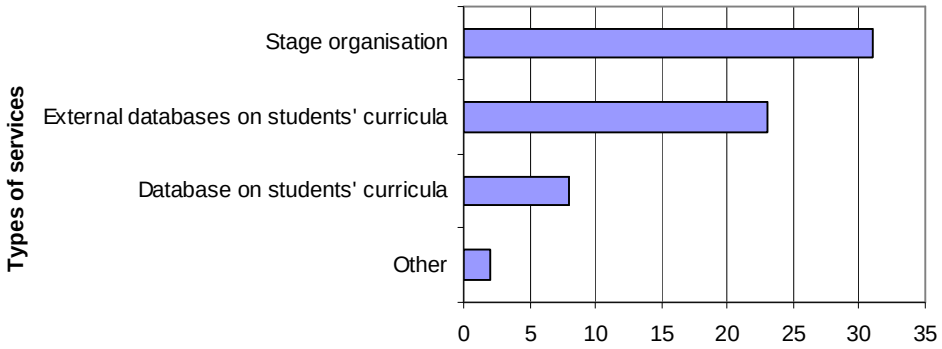

Fig 1 - University Knowledge transfer activities

VI. KNOWLEDGE TRANSFER ACTIVITIES THROUGH UNIVERSITY SERVICES

In the last decades universities tend to increase and place more value on the results of their research activities. Together with the "traditional" way of supporting R&D through the education of human resources and the diffusion of scientific publications, universities are introducing changes in their organisation, which reveal a more concrete approach toward the exploitation of their research results and the collaboration with external partnership to promote technological transfer.

In order to present a framework of such cultural and organisational changes, we have analysed the information from the Confindustria report, which describes the initiatives of Italian university reported on web sites, specifically devoted to the university-industry collaboration. The information is updated to 2003 and indicates a more effective interaction with the socio-economic environment in which universities operate. From the textual description reported in the Confindustria report, we have classified the initiatives carried out by universities, focusing in particular to information which indicates the institution of specific organisational

university infrastructures devoted the exploitation of research results and the activation of collaborative partnership with enterprises.

Figure 2 shows that 14 universities on the 46 described in the report have organised their own offices to foster technological transfer. They are called in different ways, Industrial liaison offices, Knowledge transfer offices (KTOs), university-enterprise services. Their mission and tasks are various, as we will see below, from the diffusion of research results to the support of patent and property rights protections.

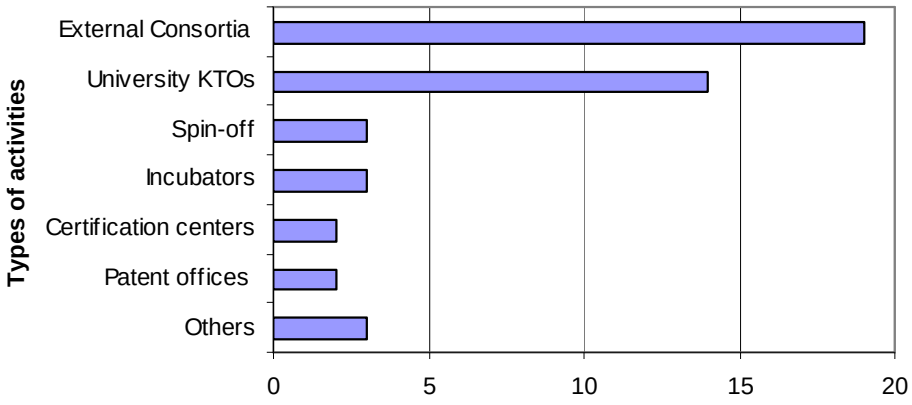

Fig. 2 - Knowledge Transfer Offices

A larger number of universities (19 on 46) participate to consortia and innovation relay centres which carry out common research projects. Two universities (Milan Polytechnics and the University of Rome "La Sapienza") have specific services/offices devoted to patents, outside the KTOs or industrial liaison offices. 3 universities contribute or directly manage incubators and promote the creation of spin-off. Only 2 universities (Turin and Milan Polytechnics) report the availability of services for certification.

In the class "Others" we have summarised some initiatives that universities are undertaken to promote a closer connection to the local environment to foster innovation and technological transfer. For instance the university of Pisa, in collaboration with the Tuscany region and the Scuola Superiore di S. Anna, has activated an observatory on regional high-tech enterprises gathering information on their consistency, characteristics and needs, in order to promote an effective collaboration [11]. The university of Pavia has carried out a project aiming to map demand and offer of technology within the Pavia province. The project is funded by the Cariplo Foundation and it is carried out together with the Commerce chamber and the Pavia industrial union. The project result will be the development of a directory and a web side, containing information on local technology needs and offers. The Pavia university also publishes and distributes to enterprises a volume reporting the description of its research and the skills and competences available at the university. The university of Siena has also developed an online information system which describes its departments and research facilities, the applicability of the research carried out, competences and collaborations with private and public partners [12].

Another information source that gives relevant data on these kind of services is the "Third survey on exploitation of university research" [13] edited by NetVal, a

network of 47 Italian Universities that since 2002 supports the promotion and exploitation of R&D activities performed in university. Its main activities are carried out by creating a network of Knowledge Transfer Offices (KTOs) already existing in universities and promoting training for KTOs officers. The survey has been made in cooperation with the European network ProTon Europe (Innovation from Public research) and has been supported by the Italian Conference of rectors. The previous two surveys took particularly into consideration the licensing activities and the spin off companies, the 2004 one, which we are referring to, is devoted specifically to the KTOs organization, functions and functioning. KTOs have been introduced in Italian universities in 2000 and some first consideration on their activity can be done. The survey presents an interesting picture of industry-university cooperation activities in the 47 universities that answered the questionnaire. Table 1 shows the comparison between the 3 different surveys and it is possible to note that out of the 29 universities that answered the first survey 14 were part of a technological park or had a technological park within their premises, and 10 were engaged in an incubator activity.

	N. of University		
	2002 (n=29)	2003 (n=26)	2004 (n=47)
	SI	SI	SI
University holds participants to a Science Parks	14	17	28
University holds participants to a Incubator	10	8	23

Table 1 - Numbers of Science Parks and Incubators linked to a University
Source: NetVal 2005

These values increase each year and in 2004 reached the number of 28 for the technological parks and 23 for the incubators.

The main institutional objective of the exploitation activities of KTOs is, according to the respondents to the questionnaire (table 2), to create new additional resources for university and university departments, other motivations, such as spill over on national or regional economy or creation of direct additional revenues for people involved are considered less important.

	2002 (n=25)	2004 (n=26)
Provide additional resources for University	1,20	1,27
Provide spill-over on regional/local economy	2,44	2,31
Provide resouces for academic personnel	2,42	2,85
Provide spill-over on national economy	2,52	3,12

Table 2 - N Relevance of institutional goals (1=very important; 4= less important)
Source: NetVal 2005

The authors of the survey note that these evaluations are not in line with the common goals that literature and empiric surveys carried out in other countries point out as relevant for a KTO, mainly the spill over effects at local or national level and rarely the direct fund raising. We assume that a reason that may explain this difference may be found in the problems of budget constraints for Italian universities and the choice of getting as much external funds as possible from profitable sources.

The NetVal survey focuses on the organization and functions of the KTOs, which are relatively new university structure, as the figure 3 shows.

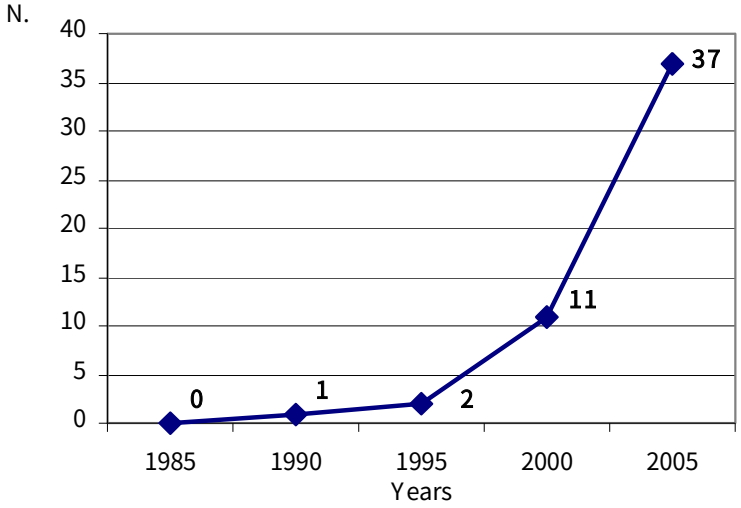

Fig. 3 - Year of creation of Technology Transfer Office in Italian University
Source: NetVal 2005

Universities have started to create their own innovation offices in the 90s and their number increases starting from 2000.

The functions of the majority of KTOs are the support of spin-off and the management of intellectual property rights (figure 4), while a minority of them also manages technical services or scientific parks.

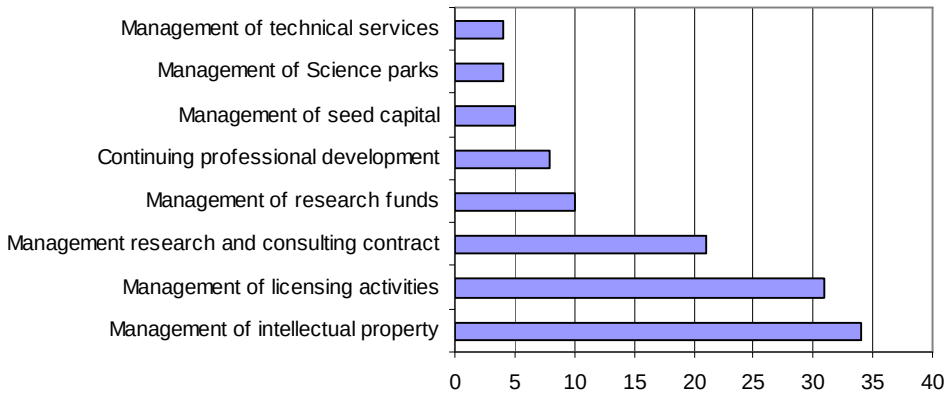

Fig. 4 - Functions of KTOs
Source: NetVal 2005

VII. CONCLUSIONS

A number of critical factors have to be met to manage the university industry cooperation in order to minimize the unavoidable questions of different if not conflicting working cultures. Among those factors Oecd [2] has identified four major ones:

- "Long-term commitment from both government and industry, based on a shared vision.
- Achieve critical mass but also deep reach within the National Innovation System. Avoiding to create high-tech islands but be imbedded in local and regional innovative clusters, and benefit innovative SME's as well as large firms.
- Build on existing networks but do not neglect areas where potential actors are still dispersed (e.g. multidisciplinary research) and/or inexperienced in accessing government support.
- Implement efficient steering mechanisms that ensure a sustainable balance between public and private interests".

Can University-industry cooperation in Italy, as elsewhere, be envisaged as similar to a binary star system? Both partners are part of a unique system but run separately even if each one influences and is influenced by the other. The evolution of these relationships and cooperation activities might take from the 'companion star' model the indications of a dynamic balance to be constantly pursued.

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Chapter 21 An integral 3-layer technological model for Education and Labour interleave and intensification

Evangelos M. Mylonas

Abstract— *This chapter introduces an integral 3-layer roadmap for implementing an effective and pragmatic delivery, of a technological model able to interleave and render an individual's employment and academic profile, as inter-nested to his/her life-through education. The introduced technological and operational infrastructure for its implementation, may foster a complete framework for hosting State-supported initiatives towards LLL.*

I. INTRODUCTION

APART from radical leaps in exploitation of technology, education should pursue transition to a stage –a **system of methods** as a more candidate term- **able to manage and espouse change itself**. This very notion has not been exhaustively addressed in European education and, the infusion of technology has not reached further than the realm of **e-Learning**. The e-Learning initiative proposed by the Commission in order to attain the goals set by the Lisbon European Council, is designed to mobilize the education and training communities, along with the economic, social and cultural players concerned, in order to enable Europe to catch up and accelerate the introduction of the knowledge-based society. The e-Learning initiative is based on four main lines of action: multimedia equipment and networking, training at all levels for each teacher and trainer, the development of good quality multimedia services and contents, the development and networking of centres for acquiring knowledge. Although the e-Learning initiative may have defined the main modalities for allowing technological accession in education, there are **several milestones of operational and technological nature** that will **need to be developed** as to enable this, as well as to actually **connect it to a roadmap leading to a commensurate labour reformation**.

This preliminary study, introduces an **integral 3-layer roadmap** for implementing an effective and pragmatic delivery, of a technological model able to interleave and render an individual's employment and academic profile, as inter-nested to his/her life-through education. It can be readily applied as a complementary activity to standing policies and institutional structures. Effectively, this model is realized as a set of next-generation distributed applications designated as:

a) **Audited database classification** and maintenance of an individual's integral and dynamic profile of dexterities and qualifications acquired along his/her carrier path, as an intermediate link between industry and academy, as well as provision of automated employment profile correlation and matching.

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This layer establishes a "perpetual" relation between an established academic certification authority and the individual, which may apply even through the early years of his education. Several benefits are served via this approach, including a cohesive, lifelong link between academy, individual and employment. In this respect, the academic institution provides a lifelong service to the individual by optimally serving as both, a career monitoring and sustained advisory service, as well as a mediator for candidate industrial placement. The aim is to signify and establish a distinct roadmap for an ascending educational "ladder" potential for the individual, where the thread of his progress is adaptable to his occasional capacity. These educational, certification /accreditation services being offered by the academic institution, are also complemented by commensurate mediation services in employment opportunities. In this respect, the traditionally rigid relation between supply and demand in conventional labour models, is converted to a highly adaptive process customized as to suit the individual's potential. Key principle is the adjacent placement or services and communal procedural management between career rehabilitation, skill accreditation and lifelong education. The envisaged curriculum database environment to implement this service should allow an open structure, configurable environment where formal (accredited) data would be committed by the institution, in addition to free career-related curriculum data that could be maintained by the user. A structural "container" service is also required in such an environment, as to host and classify regularly incoming census, statistical and other career-related data at the user's portfolio. The database should also allow a registered service to employment offering national, international, private or public vendors, in addition to an embedded notification service to the user. A forward looking future service, would generate employment seeking search agents, able to match the user's competence profile to employment providers' databases.

b) Distributed Information Repository Servers as a mediation and engagement environment for project collaboration and management between industry and graduate or post-graduate academic candidates. A key point in bridging the temerarious gap between an individual's graduate and industrial competence, is the establishment of a multi-purpose mechanism for mediated task rendering, monitoring and accreditation by both collaborating adjudicators, i.e. industry and academy. Several pertaining issues are also apparent, as is the necessity for an objective and pragmatic evaluation of the individual's composite skills and competencies, as well as other important social and personal merits. A viable common denominator for meeting all above criteria as well as offering an intensive and sustainable link of collaboration between academy and industry, may be realized as being a dynamic project management framework, whereat the reference ground for all attending parties would become a tangible asset of achievement in the form of a project. The "token" value required as to render this process accountable, auditable and redeemable, is realized in the form of the "document", in turn being a composite assembly of information (token) delivered from the trainees to the monitoring academic and industrial tutoring parties, in order to accomplish the given project at a certain time. The monitoring authorities may also serve a different role of accreditation, delivering a joint evaluation. The envisaged software tool for this layer of implementation, would be

described as a composite content (document) management repository, extended with the necessary functionality for offering dynamic and distributed project management monitoring features to the participating parties, where the tutoring and accreditation parties are also the project administrators. Forward looking anticipated services for such a candidate repository environment, is the potential of embedding legislative registration procedures on repository actions, thereby converting the repository environment to a depository equivalent.

c) **Thematic Knowledge Depositories** as an accompanying asset to an individual's academic and employment capacity. Primary infrastructure for delivering an aggregative model of distributed knowledge and distributed services, as a fore step for implementing the virtual enterprise of knowledge workers. The dawn of the knowledge era will require a major shift in the modalities and methods via which education and labour are implemented into society. They will both be subjected to perpetual change and they will interleave to a mutually supporting and beneficial, motive-driven relation. Technological challenges will focus on delivering great amounts of knowledge context to the individual, at the most dense cognitive rate. The acceleration of the educational rate will become a major social issue of the 21st century, in turn posing a high stake to multimedia rendering technologies. This anticipated boost to the individual's learning capacity, may only be achieved by targeting his/her "natural frequency" of achievement-driven motive, which in turn emerges through option provision for a core learning subject selection –an apparently different choice for each individual. This proposition, highly deviates from the currently adopted communal and group-centric public education models. It also introduces a radically new approach in education, as it implies an asynchronous pace of learning, suited to the individual's capacity rather than to a group's average capacity. This feat may prove the crucial importance of technology in future education, as it may only be substantiated and realized as a pioneering vault in information technologies.

   The endeavoured software environment to host this layer of implementation, should ideally act as an extension to the individual's arsenal of competences as well as a supporting infrastructure to his personal know how. A key innovation principle to be introduced here, is the requirement from such an advanced personal "knowledge depository" environment to host not only assimilated knowledge structures, but expertise clusters as well, being possibly defined as ontologies of procedural steps for unattended execution of specific tasks on demand. The variable degree of consistency and compliance of such expertise clusters towards definite task(s), could render their candidature as either local (personal) or distributable (group or network) tools. Forward looking anticipated services for such a "knowledge acolyte" environment, would be advanced networking and federation features as to enable collaborative distributed knowledge environments to be dynamically created, laying a true roadmap towards the information society. A new realm in our social and political manifestation may become eventually possible, if the enterprise of the 21st century, becomes the very individual itself.

II. AUDITED DATABASES FOR WORKFORCE REGISTRATION & PROMOTION

THE European labour market cannot function effectively and smoothly without a European framework to stand as a common reference for the recognition of qualifications. It is a matter which has also significant implications for every member of society and society itself: equal opportunities on the European labour market and the development of European citizenship also depend on the extent to which the people of Europe will really be able to have their diplomas and certificates recognized everywhere in the European Union.

A framework of this kind in Europe must naturally be based on the national frameworks which themselves must be coherent and cover the various levels of initial and continuing training. The necessary mutual trust can only stem from quality assurance instruments which are appropriately compatible and credible so that they can be mutually validated. In this connection, the "common framework" for the development of quality vocational training (as part of the follow-up to the Copenhagen Declaration) and the creation of a platform for quality assurance or accreditation in higher education (in conjunction with the Bologna process), should be top priorities for Europe. The Commission appears determined to make all necessary efforts to achieve this by 2005 and expects the Member States to do likewise.

This proposed layer establishes a “perpetual” **relation between an accredited academic certification authority and the individual**, which may apply even through the early years of his academic education. Several benefits are served via this approach, including a cohesive, lifelong link between academy, individual and employment. In this respect, the academic institution provides a lifelong service to the individual by optimally serving as both, a career monitoring and sustained advisory service, as well as a mediator for candidate industrial placement. The aim is to signify and establish a distinct roadmap for an ascending educational “ladder” potential benefit for the individual, where the thread of his/her progress is adaptable to his occasional capacity. These educational, certification/accreditation jurisdictional services offered by the academic institution(s), are also complemented by commensurate mediation services in employment opportunities. In this respect, the traditionally rigid relation between supply and demand in conventional labour models, is converted into a highly adaptive process customized as to suit the individual’s competency potential. Key principle is the adjacent placement of services and communal procedural management between career rehabilitation, skill accreditation and lifelong education.

The envisaged curriculum database environment to implement this service should allow an open structure, configurable environment where formal (accredited) data would be committed by the institution, in addition to externally submitted career assessment evaluations, as well as free career-related curriculum and open personal data that could be maintained by the user. A structural “container” service is also required in such an environment, as to host and classify regularly incoming census, statistical and other career-related data at the user’s portfolio. The database should also allow a registered service to host employment offers by either national, international, private or public vendors, followed by an embedded notification service to the users. A forward looking future service, would generate employment seeking search agents, able to match the user’s competence profile to employment providers’ databases.

Effectively, such an environment could be divided into **two synergistic entities**, a "vertical" action comprising the assembly of inter-networked databases of the accreditation institutions, and, a "horizontal" action comprising the integration activities of the respective vertical databases –among other parameters, into a unifying superset database scheme, offering a publicly accessible facility. The apparent operations include subscription-based services for all operational actors, including graduates (employment seeking), industrial partners (employment provision) and State Servants. Collaborating incentives and interfacing provision is also provided for active content (i.e. legislation) providers, and, either private or public jurisdictional authorities, that could regularly update particular sections of monitored public sectors. This parallel service is systematized and contextually formatted, prior to availability and circulation to all registered parties of the horizontal activity, on a variety of notification options or rich context formats. In the case of the graduate subscribers, as they are also members in one of the vertical databases, the circulated content could automatically update their personal portfolio section, which is an important feature offered to them as part of their database membership. In all, an open environment for **life-through promotion of an individual's full accredited curriculum** is proposed, designed for implementation as a full on-line, browser accessed service, implemented under the JAVA language. The candidate database engine used for this highly distributed application, could now be a publicly available open source environment, such as MySQL. The selection for an inherently open and operating system independent environment, further fortifies the scope and span of the applications, making it also an ideal environment for direct internal support by academic institutions. Further to being a fully feasible application, the proposed endeavour may readily combine with existing institutional structure and legislation.

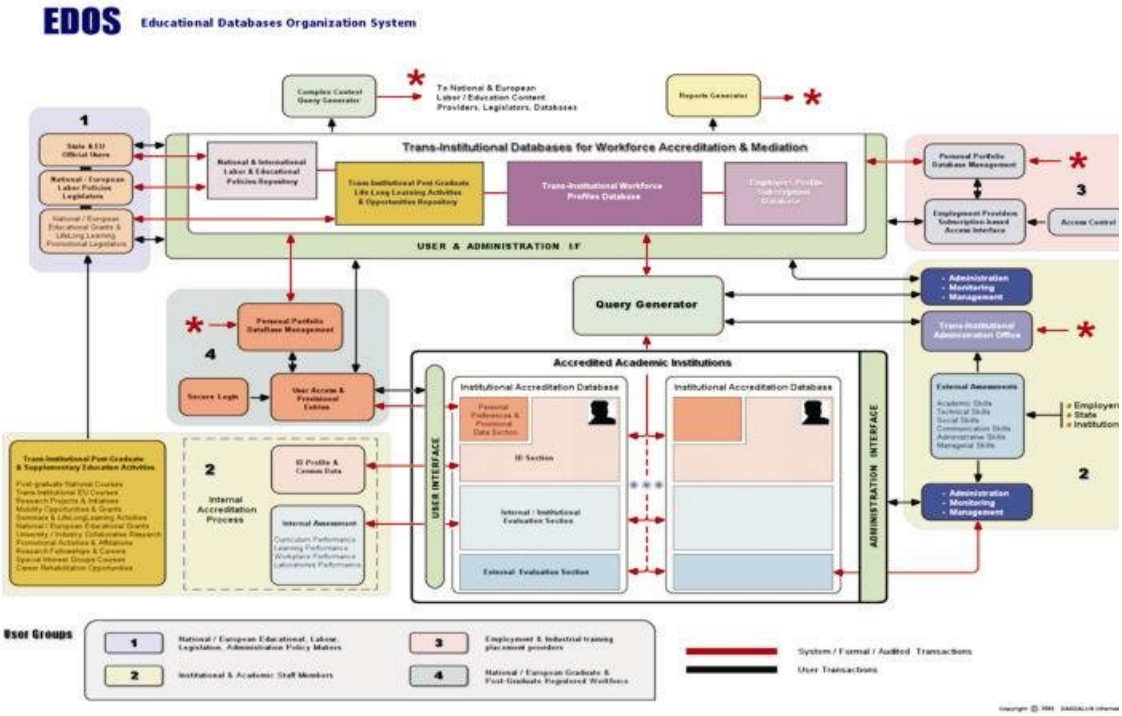

Fig. 1 Operational diagram of the relation between "vertical" and "horizontal" activities in formal institutional accreditation and curriculum registration databases, for promotion of synergy between employment actors in academy and industry (*see page 153 for an enlarged version*)

Fig. 1, above, demonstrates the described relations between vertical and horizontal activities and databases. It should be also noted that the environment is fully adept for accepting external accreditation for any particular user profile as well, thereafter recorded and appended to his/her respective curriculum in a vertical database. This facility provides a complete accreditation cycle registration mechanism, where life through acquired professional dexterities, experience and supplementary academic education, may be officially moderated, rated and promoted to ameliorate employment and career opportunity. Among many side merits, this mechanism also acts as an incentive to the individual, where a tangible motive for developing his profile becomes apparent –implicitly under his private discretion and consent in what is concerning the horizontal activities. This last observation should be emphasized, as a notion of paramount importance for individual rights. In this respect, the offered services are not compulsory to the individual, further than maintaining his minimal institutional record. The choice for the individual to derive obvious benefits from a scalable range of services, is entirely entrusted to the individual's discretion. Nevertheless, the apparent corollary should also apply on fact that, acceptance of a series of formally offered public services to the individual, should also imply his/her acceptance of a minimum agenda of accreditation for the information –either of private nature or otherwise- that would become available to designated third parties.

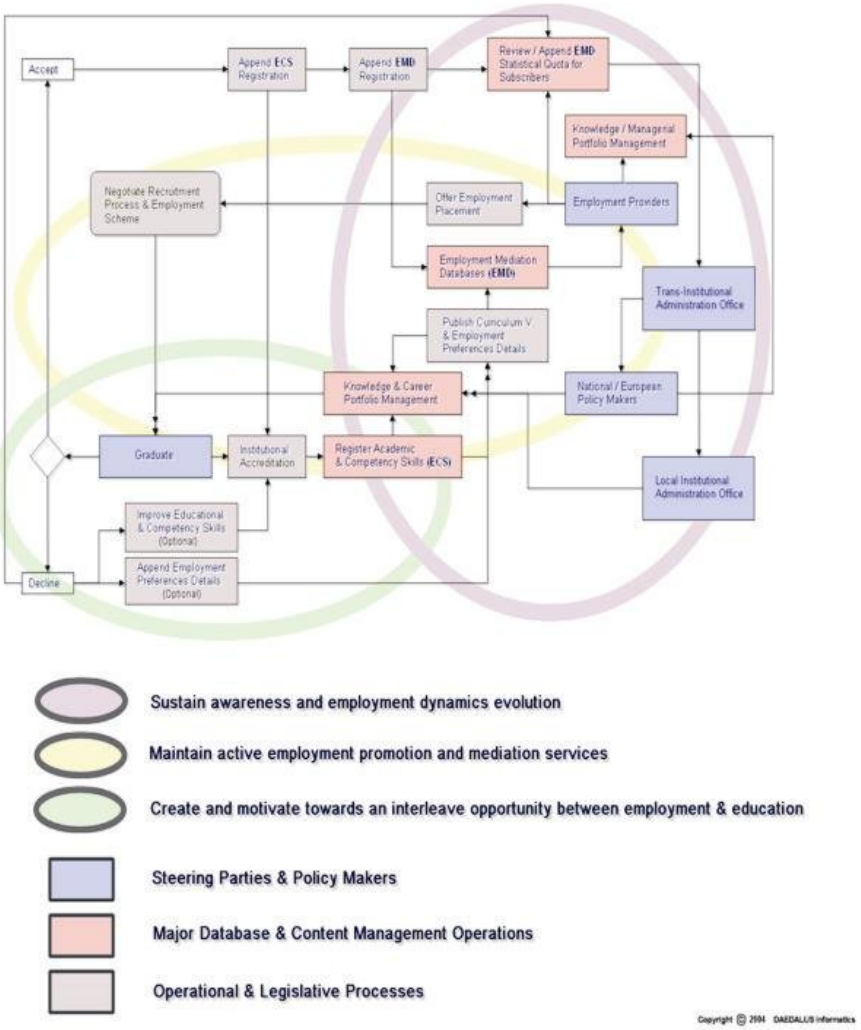

Fig. 2 Flow diagram of the relation between vertical and horizontal activities in formal institutional accreditation and curriculum registration databases, along with major policy cycles served

Fig. 2 further demonstrates the basic flow diagram of this synergistic relation between vertical and horizontal activities, between institutional accreditation and curriculum registration databases, as well as the major trend policies that are eventually served by the long term operation of this model. Indeed, fostering of –at least- 3 major socio-educational motives should progressively evolve, namely: sustain awareness and employment dynamics evolution, maintain active employment promotion and mediation services, create and motivate towards an interleave opportunity between employment and education.

Designing an integral system for employment rehabilitation, will inevitably have to satisfy both, long standing policy requirements along with technical challenges. However, the immense latent potential lays with the social perspective. An issue that should receive an exclusive consideration by itself, is the overall evaluation and consent cycle required to establish such a public accreditation system. This postulation is based in the mere observation that absence of a technology framework able to deliver such an ambitious service, has not been the true hindering factor for its implementation. The core prohibits remain in non-exact factors and obstinately retained localized policies of Institutions and political constrains. However, the international status per se, can no longer postpone the devolvement to a system of certifiable values and actions, towards the new model of **life-through education and scalar employment opportunity**. Whatsoever, no deviation from statutory individual rights is suggested, as this would induce an operational constrain in the proposed system. Provision for exclusion from publishing an individual's curriculum, is subjected to his consent for profile promotion to the horizontal activities, on subsequent –apparently- disadvantage of non-benefit returned from employment mediation services. In addition, the local evaluation and accreditations criteria suggested by an institution may be maintained whilst registering/appending an individual's profile. However, promotion of registrations to the horizontal database will have to abide to standardization criteria, common to all authorized institutions. Effectively, the motive force for delivering standardized accreditation will become the individual himself, requiring maximum promotional benefits of his achievements. The deduction is, maximum benefit can not be possibly asserted by a system, if not reverting to a normalized and publicly audited system of values and a straightforward method for assessment registration is not adopted.

Several subsidiary benefits as a result of using this environment should obviously appear, yet are quite beyond assessment of this paper. The governing concept should be that living and working in an increasingly knowledge-driven economy, puts human resources - as the principal 'knowledge carriers' - at the forefront of policy debate. In order for a country to maintain its competitive base and provide quality of life to its citizens, as well as create employment opportunities and employable workers, the skills of its workforce require continuous upgrading and, the cumulative force of these skills will prove as quintessential to the country's economic performance.

Policy-makers are therefore interested in information that will help them to make policy decisions aimed at better exploiting their country's employment potential, of which the upgrading of skills is an important aspect. A variety of indicators has been developed in recent years and a wide variety of data have been collected for that purpose. Indicators measuring the number of researchers in relation to the total workforce, their disciplines, their qualifications, their research and publication

output, their research efforts and related expenditures as well as their impact on new or improved products, processes and services, are of interest to policy-makers. First of all, because these indicators allow them to get factual information on the basis of which they can make better informed decisions. And secondly, because these data will allow them to compare their country's innovation performance in that particular area, with that of other countries. The trans-institutional database activity proposed, may prove as an invaluable tool for monitoring and laying out policies towards these directions.

It has long being widely recognized by international development and financial agencies (e.g. World Bank, Mansell & Wehm, 1998), that knowledge is a critical resource and commodity of development, regardless to the geopolitical expedience and social adversity, that may purposely resource from the very lack of a binding framework for its recording and evaluation. Nevertheless, a fair exploitation of this resource, requires urgent and extensive national and European actions in delivering an "integral" curriculum certification system, aligned to the academic and employment profile on the citizen. Although technological constrains may not present a significant challenge to this realization, social and political constrains may well do. Although the historical source of concerns is realized, the force of progress has proven that this action has been already disturbingly delayed. From now on, large and decisive steps will have to be performed as to bridge an expanding gap. After all, it is impossible to cross a chasm with a thousand tiny steps.

III. Distributed Information Repositories – Project Management

A key point in bridging the temerarious **gap between an individual's graduate and industrial competence**, is the establishment of a multi-purpose mechanism for mediated task rendering, monitoring and accreditation by both major collaborating adjudicators, i.e. industry and academy. Several pertaining issues are also apparent, as is the necessity for an objective and pragmatic evaluation of the individual's composite skills and competencies, as well as other important social and personal merits. A viable common denominator for meeting all above criteria as well as offering an intensive and sustainable link of collaboration between academy and industry, may be realized as being a **dynamic project management framework**, whereat the reference ground for all attending parties would become a tangible asset of achievement, in the form of a project. The "token" value required as to render this process accountable, auditable and redeemable, is realized in the form of the "document", in turn being a composite assembly of information (token) delivered from the trainees to the monitoring academic and industrial tutoring parties, as to accomplish the given project within a certain time. The monitoring authorities may also serve a different role of accreditation, delivering a joint evaluation.

Fig. 3 presents the basic functionality and role of participants in such an environment, where a cycle starting from declaration of the academic institution resources, fields of expertise and competence, as well as the active academic force (tutors and graduates), are engaged into the full process layout required for analysis, design, monitoring and progressive implementation, of a knowledge intensive project to the mandate of industrial partner(s). The potential role for the principal legal and operational entities in such an envisaged cycle, namely Industry, University, Students and State, is also depicted. Apparently, other categories of formal actors

may also participate under the same environment, by merely designating their role in project management, administration and delivery process.

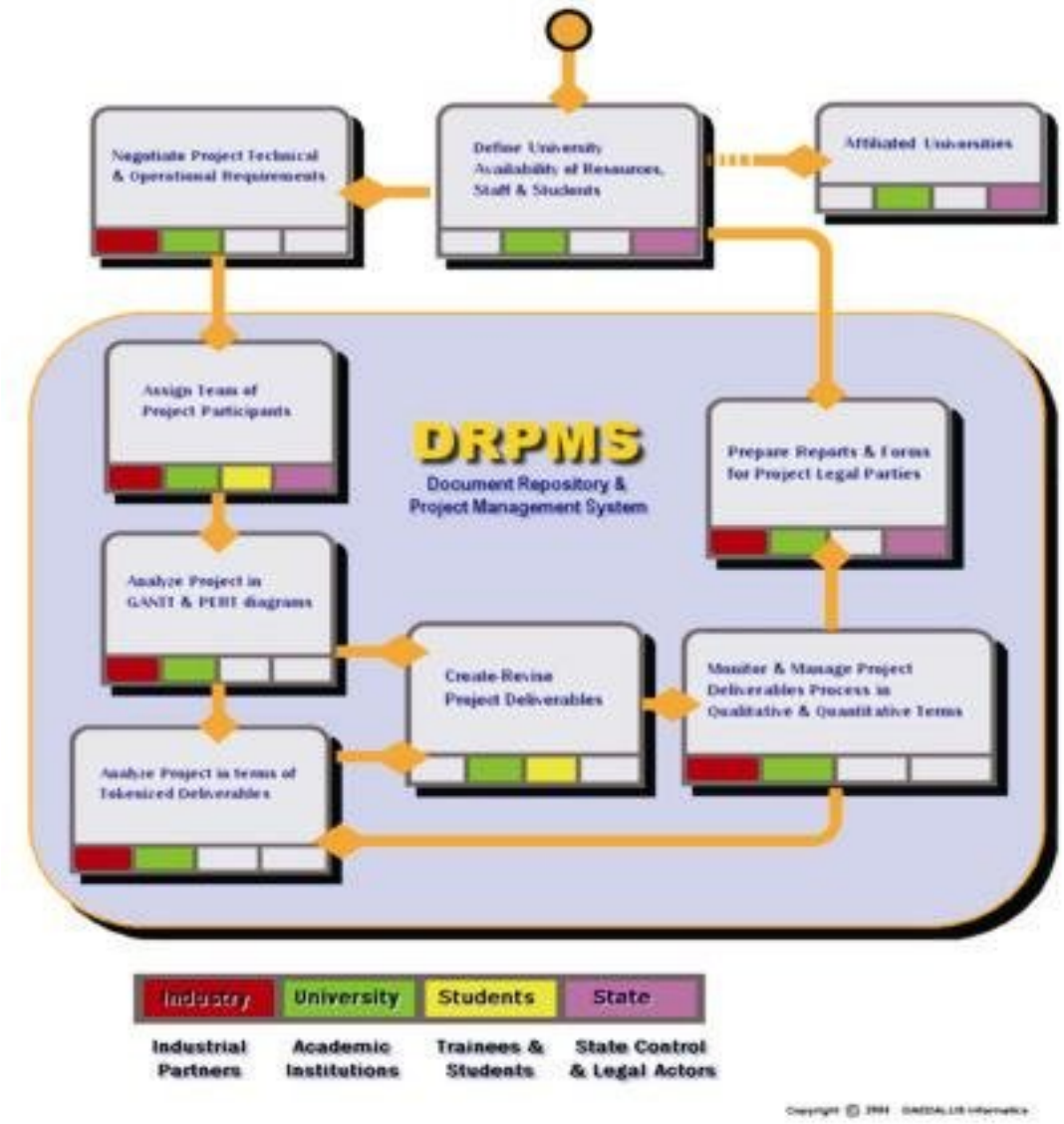

Fig. 3

Layout and principal functional modules and role of participating actors of a Document Administration and Repository Server, as the on-line infra-structure for a Project based collaboration between University & Industry

IV. Building a simple & seamless repository environment as the basis for multi-vendor collaborative computing

The envisaged on-line software service for this layer of implementation, would be described as a composite **content** (document) **management repository**, extended with the necessary functionality for offering dynamic and distributed project management & monitoring features to the participating parties, where the tutoring and accreditation parties are also the project administrators. Forward looking anticipated services for such a candidate repository environment, is the potential of **embedding legislative registration procedures on repository actions**, thereby

converting the repository environment to a **depository equivalent**. This service, among many possible ancillary options, should provide a minimal set of functions comprising universal time stamp options for registering operations, fully audited transactions, link to a certifying independent public authority, and a high level of local access security, possibly including on-demand encryption. A new dimension of inter-cooperation may be available via **GRID networking** between repositories, sharing data and processes.

Several peripheral modules could extend the functionality of such a Repository Service. Although non compulsory to the anticipated core service, there is an obvious multiple benefit integration of a broader environment offering services such as:

- Synchronized Calendar Scheduling
- User initiated Thematic Forums
- A Document Revision and Versioning System including supplementary binding of extensive Comments Options
- A trans-repository Document and Comments Context Retrieval Options (GRID oriented operations)
- Collaborative Users' Desk for Audio, Video and Shared Chat & Image Area
- Networking Functionality with related (GRID, Federated) Repositories

The basic concept and layout of such an environment is portrayed in Fig. 4.

Fig. 4. Basic Layout and principal functional modules of an on-line Document Administrations and Repository Server, as a basis for a Dynamic Project Management & Collaborative Environment

The vision behind the general rational for implementing such a **Repository Service**, stands on the realization that management only cannot promote a culture of change, but leadership can. In particular, leadership focused on applying the university's vast intellectual capital to reinventing itself, is the hidden force that has to reach its true forte. The gap between the supply and demand of skilled IT professionals appears to be global, as indicated by reports from Canada, UK, etc, and outsourcing to countries such as India or Israel with their large IT labour force, or hiring new technology immigrants, are among their major strategies. To further retrograde this trend, the growing inability of graduates to become competitive enough immediately after leaving university -as to claim a candidate employment, progressively grows to be an alarming issue. An urgent need for university leadership should attend to a three-fold strategy:

a. Preserve, manage, circulate and systematize the created Intellectual Capital
b. Commercially promote this Knowledge as an enabling commodity in the from of combined Know-How and academic high intensity services, for addressing tangible, project-oriented industrial and state requirements
c. Render these Services under an advanced, project-centric collaborative environment, offering a fully monitored and result focused process. This is the process that engages the students as the implementing research force, whilst also providing the route to gaining their competency without sacrificing financial compensation

The assembly of these rigid requirements described can be optimally met under the proposed **DRPMS** (Document Repository & Project Management Server) environment. The full endeavour may be implemented as a fully on-line service, whilst the developing framework can again, be based on JAVA and MySQL as generally obeying to a philosophy of relying and profiting from open source environments.

European Universities, progressively lacking the critical mass required to compete with leading universities in the United States, could optimally deploy such a collaborative project management environment, as an endorsement of their own efforts to put technology transfer on an equal footing with research and teaching. Equally important, a motivation for leveraging and sharing resources between privileged and less privileged European Institutions is also favoured in a directly applicable mode, offering a more viable incentive for promotion of a virtual trans-European Institution.

V. Conclusion

The dawn of the knowledge era will require a major shift in the modalities and methods via which **education and labour** are implemented into society. They will both be **subjected to perpetual change** and they will interleave to a mutually supporting and beneficial, **motive-driven relation**. The exigency for providing a technological framework for rendering this relation at a European trans-institutional level has been clearly manifested since long, but implementation of a robust scheme is far lacking. This exigency is due to become more intense in the expanded EU-25.

This chapter has demonstrated that such a framework is fully feasible now and may be assessed via a relatively modest, technological infrastructure, under an open architecture. A combination of statutory and institutional control, may apply via such a scheme, as to facilitate and promote it to a full accreditation-enabling process as well. The engagement process demonstrated, via the Dynamic Project Management Repository Environment between industry and academy as well as between institutions, is the leverage mechanism to effectively steer long-standing problems in redefining a labour model and assessing LLL.

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