Drivers and Barriers in Implementing the Knowledge Triangle

Sjoer, Ellen; Nørgaard, Bente; Goossens, Marc

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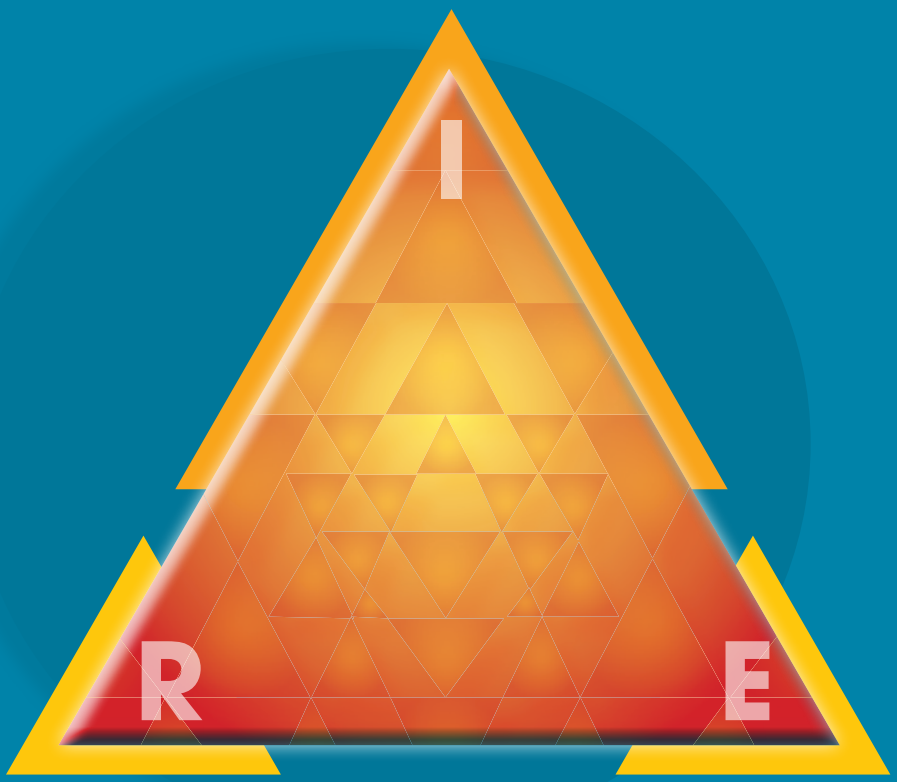

The Knowledge Triangle

Re-Inventing the Future

European Society for Engineering Education SEFI
Aalto University
Universitat Politècnica de València

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– Re-Inventing the Future

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Editors
Pia Lappalainen, Aalto University
Markku Markkula, Aalto University

Graphic design
Juha Pitkänen, Taivaankaari Ltd, Finland

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Contents

ACSI	Aalto Camp for Societal Innovations; A new-generation innovation agenda bringing forth a concept, operating mode and network for a global innovation platform fostering the integration of research, learning and innovation in real-life cases.
CE	Continuing Education.
CEE	Continuing engineering education.
DAETE	Development of Accreditation in Engineering Training and Education. The IACEE project strove to establish a self-assessment matrix for continuing education organizations to analyze and develop the enablers and the results of CE activities.
Ecosystem	A community of organisms that interact as a system and thereby create synergy.
EHEA	European Higher Education Area. Targets a more comparable, compatible and coherent higher education system in Europe.
EIT	European Institute of Innovation and Technology.
EUCEN	European University Continuing Education Network.
EUGENE	European and Global Engineering Education. 3-year thematic, academic network project operating within the EU Lifelong Learning Programme. Aims to improve the impact of EEE on competitiveness, innovation and socio-economic growth in a global context.
Formal learning	Structured learning that typically leads to certification, offered by a learning or training institution.
FWBL	Facilitated work-based learning; Partnering of a company, learners and the university to secure the systematic and targeted development of learner expertise on the job.
HE	Higher Education.
IACEE	The International Association for Continuing Engineering Education.
ICT	Information and Communication Technology.
Informal learning	Non-structured and often non-intentional learning resulting from daily life activities.
Innovation	The creation of commercially feasible products, processes, solutions, technology or services that bring new value or meet customer or market needs in new ways.
KT	The Knowledge Triangle; increasing synergy between research, education and innovation.
LLL	Lifelong learning; all learning taking place over an individual's entire lifespan.
LLP	Lifelong learning programme.
NBRIC	Nano, Bio, Robotics, Information and Communication technologies and cognitive science.
Non-formal learning	Learning that occurs in a formal learning environment but is not formally recognized (e.g. workshops and seminars).
Open innovation	An open process of innovation and sharing of results with the surrounding society or other external operators.
PBL	Problem-based learning.
Quadruple Helix	Quadriple Helix: An extension of the Triple Helix innovation model, comprising four strands: university, industry, government and individuals as users adding the fourth dimension 'society' to the original model.
RDI	Research, Development and Innovation.
SIRUS	A Project Shaping Inclusive and Responsive University Strategies.
SME	Small- and medium-sized enterprise.
TBE	Technology(/ICT)-based education.
TE	Traditional education.
Triple Helix	Collaboration model for universities, enterprises and public administration.
WBE	Web-based education.

Dear Reader

According to the Europe 2020 strategy and the plans of Horizon 2020, one of the key success factors for Europe is to achieve more innovation out of research. The authors of this book have met several times in the recent years within international networking through SEFI European Society for Engineering Education (in particular in the context of the thematic network EUGENE) and IACEE International Association for Continuing Engineering Education. In a series of projects, workshops and conferences, all focusing on the triple play of research, education and innovation, we were able to share our common understandings and to develop and create advanced new concepts. This book brings together our lessons learnt in an interesting compilation of articles, reflecting our consolidated knowledge together with some brand new insights.

Our common view is that the future success of innovation ecosystems is based on continuous learning, or call it lifelong learning, measured increasingly in innovation actors' abilities to connect and manage their talent, competences, partnerships, and practical innovation processes – in integrating the local and global knowledge base and grids. As this publication focuses, in particular, on putting theories into practice, we want to invite our readers to also get themselves acquainted with one of the founding readings in the field: "The New Age of Innovation" by professors C. K. Prahalad and M. S. Krishnan. They describe the ongoing fundamental transformation of business, and the message is clear. Many new innovative businesses are based on two main pillars:

- Value is based on unique, personalized experiences of consumers; the focus is on centrality of the individual (N=1).
- The focus is on access to resources, not ownership of resources; all companies will access resources from a global ecosystem, from multiple vendors and often from around the world (R=G).

What does this value creation model mean for universities? We need more research on the value networking – especially on complex service solutions and offerings creating value for both customers and providers. The driver of change is the entrepreneurial discovery mindset among researchers integrating their interests to learning and innovation. In this the essence of international collaboration and partnerships is crucial – up to the level of strategic alliances.

The EU has already for several years stressed the importance of university reform – one cornerstone being the creation of more synergy between research, education and innovation. In professional and academic life only a few have committed themselves as the forerunners in implementing this in their daily practice, and unfortunately even fewer serve as change agents making this principle a reality throughout European universities. Governments have also played an important role in this trend

of university reform by promoting programmes for a better implementation of the Knowledge Triangle. The Campus of Excellence in France, the Initiative of Excellence in Germany and the International Campus of Excellence in Spain are manifestations of university-government collaboration: we extend our gratitude for opening new innovative thought avenues to the VLC/CAMPUS, the International Campus of Excellence promoted by Universitat Politècnica de València, Universitat de València and the Spanish National Research Council.

Further, networks such as SEFI and IACEE have set up task forces, developed projects, prepared networking opportunities and organized conferences all over the globe in order to bring together not only researchers, educators and innovators, but also learners, business people and other societal stakeholders. These efforts have resulted in a totally new knowledge base of globally networked expertise, brought to you in this book, as a first step towards a more fundamental and embedded implementation of the Knowledge Triangle throughout high-quality academic practice.

With the articles in this book, we want to challenge the academic communities to recognize the enormous opportunities and the huge challenges ahead of us. Moreover, we aim to trigger a more general debate, at European and global levels. We especially challenge the EU to further enable, empower and encourage higher education institutes, the corporate world and all societal stakeholders in implementing the Knowledge Triangle to full extent. This could be achieved by providing the necessary accompanying measures to stimulate ground-breaking research, modernize high-quality education and trigger real-life innovation into one global ecosystem. Only then will the objectives of Europe 2020 and Horizon 2020 become an appealing reality for all its citizens.

This book is not just a combination of selected articles. As initiators of this book, we fully cherish the input from all the contributors. We took the liberty to structure and organize their writings in such a way that the readers can review the articles separately, or read through them consecutively. We hope to give you pointers for drawing, step by step, your own interpretation of the Knowledge Triangle, but even more, we hope to spark a further global discussion and invite all our readers to actively contribute in future innovative ecosystems.

We want to thank all the authors for their tremendous efforts. We have gained great learning experiences with all of them in analyzing the Knowledge Triangle, especially in examining ways in which the Knowledge Triangle could be implemented and harnessed to bolster the European future. With these contributions, we challenge our readers to join us in building a better future, a better world. Finally, we thank Dr. Pia Lappalainen, who is the editor of this book: through her commitment and relentless enthusiasm in helping and pushing all the authors, we have been able to make this publication a reality.

Wim Van Petegem
SEFI President
KU Leuven

Markku Markkula
EU CoR Rapporteur
on Horizon 2020
Aalto University

Carlos Ripoll Soler
Director VLC/CAMPUS
Universitat Politècnica
de València

From the Editor

Innovation is one of the most prominent buzzwords of our era. It echoes divine ability, flabbergasting insight, inarticulate foresight and unlimited potential. Its connotations are positive, implying potential for assets and profits, prosperity and well-being, advantage and achievement. Subsequently, innovation has become the ultimate driver of success in today's society, so much so that the passion for creating something new for creativity's sake has at times taken precedence over pragmatism and realism. And yet most pinnacles in postmodern times can be traced to spunky and unconventional thinking, boldness and creativity, crediting their innovators with merits in societal development and build-up.

Targets on economic growth and productivity gains commonly prevail as criteria dictating many industrial and societal operating policies and principles. However, such softer aims as citizen engagement have begun to challenge the self-justified position of economic goals as determinants of success, inviting industries, education institutions and the government to direct their attention to physical and mental well-being, fulfillment and overall life satisfaction. The synergies and complementaries between diverse societal operators become imperative in striving to yield the aforementioned benefits on both individual and societal levels.

This book celebrates the creation of the new, while honing recognition for education and research. And for that sake, it examines how innovation could be fostered, promoted and enhanced more intensely through and in education and research. Instead of viewing the three as separate activities of society, this publication calls for intertwining, interweaving and orchestrating – by tying the three more solidly together, innovation turns into a natural outcome and no more, no less than an equal component in a continuum that we here view as the Knowledge Triangle.

With smooth orchestration our Triangle will let out music unheard before, but for that to happen, players from all sectors of life and society need to join the orchestra. For that, this book – and the Knowledge Triangle – is a call of duty; it invites dreamers and doers alike to contribute to a better future. As Alan Kay once stated, "The best way to predict the future is to invent it." Take a look inside – this is where inventing, creating and innovating starts, on the platform of education and research.

Espoo, 28.3.2013
Pia Lappapainen
Editor

Markkula, Markku
Advisor to Aalto Presidents, Aalto University
markku.markkula@aalto.fi

I. The Knowledge Triangle Renewing the University Culture

Abstract

Several policy statements stress that higher education institutions have a central role in building a Europe where the impact of knowledge building can be measured in terms of economic, social and ecological progress. The Knowledge Triangle (KT) highlights the importance of jointly fostering research, education and innovation, and of paying due attention to the linkages between them. University actors in the KT are at the core of the innovation web, where enhanced capacities, high degree of integration and leadership are prerequisites for scaling up Europe's innovation performance. KT concepts are crucial instruments for Europe to achieve this.

However, there is a lack of good examples of what the KT means in university practice and of ways in which the principles of the KT are applied in real-life. Moreover, universities have not defined the priorities of the key success factors, such as the need for necessary new concepts for better use of existing and new research-based knowledge, and the new entrepreneurial mindset for knowledge co-creation and innovation. This article discusses potential answers to these problems by introducing the opportunities that KT conceptualization and implementations offer for universities as they develop their operations in order to play their important role in answering the acute challenges of society and in proactively influencing their changing operational environment. This article also highlights the opportunities that the KT opens for university administration and leadership development. An essential new dimension in university management is orchestration related to the build-up of a new culture of collaboration and knowledge co-creation based on the regional innovation ecosystem in which the university is the driver of innovativeness and transformation.

Keywords: knowledge triangle, university management, orchestration, societal impact, regional innovation ecosystem

1. The Strategic Role of Universities – Aalto University Pioneering the European University Reform

The name of the EU's new funding programme for research and innovation – Horizon 2020 – reflects the ambition to deliver ideas, growth and jobs for the future. When setting the target for Europe to become a global leader in tackling the grand societal challenges, as stated in Horizon 2020, the research, development and innovation activities need to have a strong regional dimension based on a deep understanding of innovation ecosystems. The best political alignments or upper-level programmes yield no results unless the working life takes concrete action to apply new knowledge in practice and unless local decision-makers in cities and regions make strategic choices to invest in renewing the structures and processes towards innovativeness and efficiency. All levels of decision making should profoundly reflect the statement made by the EU Committee of the Regions (EU CoR 2012):

> *"The laboratories for innovation are no longer traditional university facilities, but regional innovation ecosystems operating as test-beds for rapid prototyping of many types of user-driven innovations: new products, services, processes, structures and systems, which need to be of transformative and scalable nature."*

The three-pillar structure of Horizon 2020 creates opportunities to achieve the Europe 2020 Strategy targets. In terms of evaluation and funding criteria, the emphasis is on global excellence; all activities draw from scientific expertise. The role of universities is crucial. However, positive answers need to be sought for the key questions: Are European universities ready and able for the needed transformation? Are the political decision-makers at EU, national, as well as regional and local levels committed to necessary investments in intellectual capital and in new concepts of knowledge co-creation?

This article, in creating new openings to tackle these challenges, is based on analyzing the recent European Union university policy developments and the experiences of the societal impact perspective of the Aalto University[1] transformation process, as well as applying some of the recent business and management developments in defining the change requirements and options for universities. The mission of Aalto defines the unique target level of the strategic role of the University as follows (Aalto 2012a):

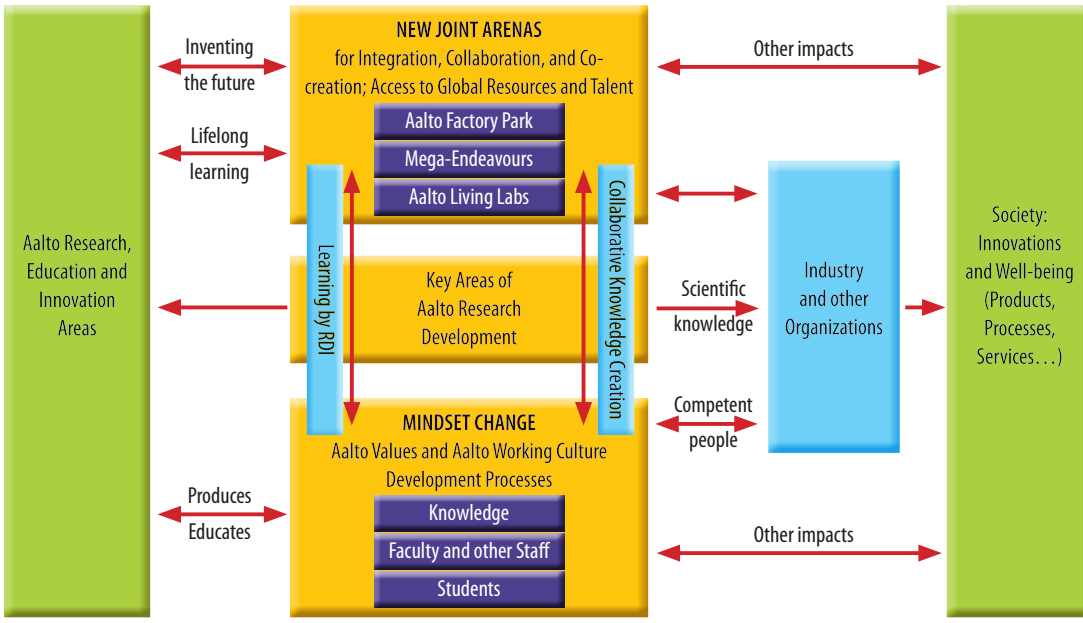
> *"Aalto University works towards a better world through top-quality research, interdisciplinary collaboration, pioneering education, surpassing traditional boundaries, and enabling renewal. The national mission of the University is to support Finland's success and contribute to Finnish society, its internationalization and competitiveness, and to promote the welfare of its people through research and by educating responsible, broad-minded experts to act as society's visionaries and change agents."*

[1] Aalto University was formed as a merger of Helsinki University of Technology, Helsinki School of Economics and University of Arts and Design Helsinki.

Building the new Aalto University is a pioneer endeavor materializing the European university reform. The new University is created on a foundation of strategic basic research, with a unique voice in formulating a policy on global innovation. At the centre of the Aalto strategy, there are four tasks by which the university strives to realize its mission and attain the goal: top-level research, pioneering teaching work, trend-setting art, and cooperation to regenerate society. Top-level research emerges only through the actions of visionary and intuitive people. Aalto research highlights long-term goals, high quality and a cross-disciplinary approach that produces groundbreaking results of a global scale and with a social impact (Aalto 2012b).

The development activities are based on the Research Assessment Exercise (RAE) conducted at Aalto University in 2009 and the Teaching and Education Evaluation (TEE) conducted in 2011. According to the RAE outcomes (Aalto 2009) the main and most distinctive strength of Aalto University's research is the societal impact of research in general and the interaction and cooperation with industry in particular. Several recommendations are highlighted, with special focus on the role of long-term and high-risk basic research. The main challenges include also academic leadership. When setting objectives for impacts, the Aalto University Board emphasized in-depth and sustainable societal, cultural and financial impacts as well as integration of the various functions within Aalto, to fully benefit from the synergy created. In addition, these alignments accentuate the focus and risk taking in potential breakthrough endeavors.

Figure 1 outlines the interaction between university and society. Attaining the high-level goals necessitates a systemic approach in creating the prerequisites for the different activities and ways of working and collaboration.



Markkula, M., Pirttivaara, M. & Miikki, L., 2009.
Developed by using ideas of Lester & Sotarauta, Tekes report 2007 "Innovation, Universities, and the Competitiveness of Regions"

Figure 1: Dynamic Interaction between University and Society.

The principles underlying the illustration and the university activities need to be examined in more detail. The core comprises three inter-related elements:

- research directed at focus areas can be found in the middle,
- the constantly evolving mindset at the bottom, materializing in knowledge content, the activities of the staff and academia, and studying, among other student activities,
- new ways of working at the top: new arenas and platforms for multidisciplinary collaboration, such as Factories, Living Labs and Mega-endeavours formed by many synergic projects on one thematic entity.

Scientific breakthroughs and innovations are ever more frequently results of multi-disciplinary research cooperation, with one field of science studying and feeding the borders of another one. Merging the operations of three leading universities opens up opportunities for internationally unique activities by drawing on multidisciplinarity and the strengths of each university. Based on the results of the Research Assessment Exercise and building on the current capacities and interdisciplinary opportunities, the University has identified four broad themes as strategic focus areas spanning across the entire University:

1. digitization
2. the service economy
3. energy and sustainable use of natural resources
4. human-centric living environment

When defining the new university policy, one needs to understand the shift in the focus of education from the traditional teacher-centric model to a learner-centric model, where a new networking and collaboration culture is the key for success. Education as such will not entail the desired positive outcomes. Teaching and learning will yield the targeted added value, when integrated with research and innovation in accordance with the KT principle more intensively than before. The growing importance of scientific knowledge, as part of the innovation process, needs to be emphasized. When setting targets for the development activities from the student perspective (undergraduate, graduate, and postgraduate), eliciting a strong motivation towards scientific knowledge and use of research-based knowledge needs to be high on university priority list. This means that:

- part of the university studies needs to be dedicated to the in-depth studying of the theories underlying science;
- another part should focus on real-life processes and challenges posed in solving the wicked societal problems.

To implement the Knowledge Triangle and to make the mindset change in education to happen the Aalto Teaching and Education Evaluation TEE brought the following elements on the implementation agenda (Aalto 2011):

- motivating university students to effective and target oriented studies by developing teaching methods and support systems, such as student's

personal study plan, multidisciplinary study teams and virtual learning environments;
- targeting more development activities on curriculum and learning environment initiatives, especially for the first-year studies which are essential to learning-to-learn;
- increasing ICT-assisted teaching and learning by developing new forms and methods of pedagogical education for all university teachers to equip them with skills and competencies as facilitators of learning;
- taking advantage of situations in which studies are focused in solving real life cases and many study teams include also professionals to apply lessons from the classroom to their work environment. They also include projects that require students to work across traditional boundaries;

For increasing its societal impact Aalto University has defined the following key areas of development (Aalto 2012a):

1. building strategic partnerships
2. developing open innovation platforms based on cooperation
3. promoting the role of the creative economy in developing society
4. promoting entrepreneurship
5. enabling lifelong learning through professional and executive education services
6. involving the alumni in Aalto's activities
7. contributing to the positive development of society at large

Let us take an example of the long-term commitments with well-targeted goals to make a desired change in the university culture. One of the major aims of the Aalto Factory Park Concept is to create the needed infrastructures and the working culture to encourage collaboration between research and education carried out by the departments and the Aalto Factories, the Aalto Learning Labs and other Aalto activities, in cooperation with Aalto stakeholders. From the perspective of education this means enormous opportunities to build multidisciplinary learning services and to integrate research, basic and continuing education, development projects as well as experts from different disciplines. The key to success is to implement unique services, to have the courage to focus, and to avoid conventional solutions. Factories as well as other joint platforms serve as instruments for lifelong learning.

2. Creating a New University Culture – Transformation as a Process

Universities must be determined in developing their academic culture, as well as operational processes and structures, if they are to meet the challenges related to their societal role. They must be able to let go of the traditional methods based on sectorization and silos. Instead, they ought to create a culture of networks and co-creation that crosses through the entire university. Reaching the target level requires

that several critical success factors and necessary measures are recognized and a goal-oriented holistic action plan is created. If the university aims at success in its field and wishes to be a unique forerunner, it must benefit from the opportunities available for a university operating in the global environment and change its ways of operation with the help of the best leadership theories and practices.

A typical, strategic transformation is basically all about determined interconnecting of vision and operational change management factors: the two key leadership principles to be applied are orchestration and shared ownership. The university community must define the vision, develop the processes required to implement it and develop the skills and structures required to support the implementation. Community culture, network economy mindset and collaboration processes and instruments emerge as critical success factors in the globalizing world characterized by rapid changes in the operational environment.

According to Wallin orchestration can be defined as (Wallin 2006):

> *"Orchestration is the capability to mobilize and integrate resources for the purpose of providing an offering to a customer and simultaneously create value for the customer, the orchestrator, and the network members involved. The orchestrator considers the constraints, based on which conversations are nurtured, to define and execute the purposeful resource allocation to create, produce, and provide the customer with the offering."*

In this, offerings include elements and activities, which create added value without monetary transactions for the collaboration network. Open innovation is an increasing phenomenon in university-industry co-operation, and for this to be successful orchestration adding new dimensions to traditional project management is an essential foundation. Through orchestration the network actors jointly reinforce the value constellation by strengthening their resource allocation, as well as by engaging and cultivating the network capabilities in a best possible way. The diverse projects and tasks are not implemented separately from their individual starting points and needs to serve sub-optimization, but instead, all activities are planned and managed by optimizing the benefits of the whole.

Every university must be developed from its characteristic starting points that take into consideration the local, regional, national and global dimensions. The intertwined sectors that affect all of these dimensions are the university community itself, operational environment, culture and innovation system, stakeholders and customers, as well as practices of funding. If the university wishes to be in the leading edge of development, incentives need to be focused on open co-creation and targeted foresight knowledge. These must be emphasized in all operations.

A particular challenge for universities stems from political decision-making that requires significant results in the near term, instead of in 10–20 years' time. Universities in their current operational structures and culture are not yet ready for this. Huge development work is imperative for universities to be able to change their own operational processes. The key stepping stone is the disassembly of silo structures and accomplishment of an in-depth collaborative working culture. This can be simplified by means of two principles: modernizing the Triple Helix PPP-collaboration model

(public-private partnerships, i.e. cooperation between universities, enterprises and public administration) that has been in the spotlight for decades and now needs to be made functional with strong focus on the fourth P, that is, people. And second, the Knowledge Triangle collaboration model (research-education-innovation), that accentuates the synergy between different university functions, needs to gain ground. Together these form the avenue towards regional innovation ecosystems where universities drive societal change.

The process nature of the intended university transformation is being emphasized, and enormous requirements are placed on the orchestration of the operations in order to accomplish gigantic changes in:

1. creating an innovation ecosystem with strong regional and global foci
2. the quality and joy of research, learning and working, when the university activities are based on the real life & real case approach
3. increasing the effectiveness and efficiency of the university community when its operations are based on the implementation of the KT principles and practices

In all this, digitalization plays a crucial role. We have already seen that the new network and service infrastructures have gradually replaced the internet and web the way we used them before. The challenges that both education and working life are facing are mental rather than technological. Our way of working and learning draws from existing opportunities only to a marginal extent. The optimal level of using the latest digital technology and services is far higher than currently used. As international competition between Europe and especially Asia becomes increasingly fierce, innovative and even radical, measures need to be taken to move forward.

3. The Knowledge Triangle Influencing the Entire University

The societal role of universities and other higher education institutions is crucial in building a Europe where the impact of intellectual capital can be measured in terms of social and economic progress. European Council stated on 26 November 2009 the following regarding the development of the role of education in a fully-functioning Knowledge Triangle in its conclusions (EC 2009):

> *"If the European Union is to be equipped to meet the long-term challenges of a competitive global economy, climate change and an aging population, the three components of the knowledge triangle must all function properly and interact fully with each other"*

The conclusion urged EU and the Member States to establish the following seven priorities for action:

1. Developing more coherence between policies in the field of education, research and education
2. Accelerating pedagogic reform

3. Partnership between universities and business and other relevant stakeholders
4. Measures to develop an innovation culture in universities
5. Creating incentives for universities to develop transferable knowledge
6. New approaches to quality assessment
7. Developing the EIT as a model for the future

The report for the study on the **Education in the Knowledge Triangle,** for DG Education and Culture, evaluated renewal needs and opportunities in education (DG EAC 2012). It assessed already completed renewals and best practices all over Europe in universities which all, one way or the other, represent pioneers in university modernization. For this, twelve case studies (universities)[2] were selected from across the European Higher Education Area with the aim of highlighting different types of approaches, different geographical, regional and local priorities and different types of institutions.

The analysis of the case studies was based on the priorities set in the Council Conclusions on developing the role of education in a fully functioning Knowledge Triangle. In the Council Conclusions, each priority is accompanied by suggestions describing specific areas for engagement for universities. These have been drawn out and examined in more detail in the case studies.

This rich collection of information from 12 very different universities brings together a number of potential ideas and lessons for universities and policy makers on how better to integrate the Knowledge Triangle with education activities. In brief, these are summarized as follows:

1. Embedding the entrepreneurial culture throughout the higher education institution
2. Involving students as co-creators of knowledge and as part of the innovation system
3. Creating rich learning environments for talent development
4. Quality assurance and recognition of new skills development
5. Taking an interdisciplinary approach
6. Developing academic talent
7. Internationalization as a way of improving institutional practice
8. Implementation of flexible manageent models
9. Transforming working environments – widening access
10. Embedding evaluation and monitoring of the impact of activities related to the Knowledge Triangle in the university strategy
11. Smart specialization as a focus for knowledge triangle activities
12. Taking the longer-term vision for change at the institutional level

[2] The universities analyzed are: Aalto University, Finland; Aarhus University, Denmark; Chalmers University of Technology (Chalmers), Sweden; École Polytechnique Fédérale de Lausanne (EPFL), Switzerland; Université Joseph Fourier, Grenoble (UJF), France; Karlsruhe Institute of Technology (KIT), Germany; Mondragon University (MU), Spain; Umea University (Umea), Sweden; University of the Arts London (UAL), UK; University of Trento (Trento), Italy; University College London (UCL), UK; Zürcher Hochschule der Künste (ZHdK), Switzerland.

13. Incentives and funding structures
14. Engaging with the national policy environment across the areas of research, education, enterprise and innovation

As these findings demonstrate, the application of KT principles in practice involves university operations on a large scale. The most challenging and difficult target for change is the university management culture. Its key questions comprise: How to sustain the autonomous freedom and independence that over the centuries have made an essential part of the society-renewing university role while obtaining solutions from the university system to the economic crisis that has stirred Europe for quite some time now? How to highlight the importance of persistent basic research while encouraging the academic to yield solutions to grand societal challenges? How to steer the academia towards unique scientific excellence while accentuating speedy and more productive design of research-based innovations? With these questions in mind, this article and the sections that follow focus on ways in which Knowledge Triangle principles can be applied to develop the university-level operating culture and administration.

4. The KT as a Strategic Leadership Instrument within the Transformation

According to the key statements of the Swedish EU Presidency Conference "Knowledge Triangle Shaping the Future Europe" (31 August–2 September 2009), European higher education institutions should play a central role in KT interactions by creating and disseminating knowledge valuable for society and businesses as well as by linking education, research and innovation through collaboration with the wider community. The Knowledge Triangle concept relates to the need for improving the impact of investments in the three activities – education, research and innovation – by systemic and continuous interaction.

Universities themselves have a responsibility to adapt their research strategies and management, improve their financial sustainability and make the Knowledge Triangle a reality. Through the project SMART (Stimulating the Modernisation Agenda for Research and Technology), CESAER[3] has investigated these aspects from the particular perspective of universities of technology drawing on experiences from the full CESAER network.

In her forewords of this study (CESAER 2011), the CESAER President Karin Markides, the President of Chalmers University in Gothenburg, highlighted the key recommendations with the title "The Need for Modernisation of Universities". The first one focused on the development of internal management systems of universities: "the systems need to be inclusive to ensure that researchers fully endorse the institutional strategies and their implementation without losing their ability to compete for grants and excellent research achievements." This is not an easy challenge to meet, but

[3] CESAER is a not-for-profit international association of leading European universities of technology and engineering schools/faculties at comprehensive universities and university collages.

some essential principles can be identified from among the recent experiences from university reforms.

During the Aalto transformation in 2008–2009, in preparing for the Aalto merger, Societal Impact was one of the areas of responsibility of the new operations. Implementation of Knowledge Triangle principles was incorporated into these preparatory activities.

The following three figures and descriptions illustrate that the KT is an essential principle also in terms of university leadership culture. It creates the prerequisites for a shared vision and operational culture of the entire university community and its most important stakeholders. This culture involves systemic creation of synergies between research, education and innovation activities.

The main elements of organizational structure – in universities just as in any other organization – comprise leadership, management and operational activities. In network economy, in the collaboration within the organization as well as with external actors, the role of processes and capabilities becomes emphasized. Especially with respect to transformation, such as the systematic transition to the KT culture, defining the processes collaboratively in a wide enough scale is a prerequisite for reaching the high target level. The new Knowledge Triangle culture places much more weight than before on strategic partnerships and alliances. The basic prerequisite for success is that each actor needs to be able to share enough of something valued by the others. This requires high-level mastery of the competences needed for the effective implementation of one or many of the process parts within the university community.

Figure 2 depicts these basic interconnections and illustrates the main responsibilities in the university transformation from the perspective of Knowledge Triangle. The management is responsible for defining the role and tasks of the university as well as its resourcing in relation to its societal dimensions. The management thus has the main responsibility for defining the innovation activity and the competences these require. The operational level which is managed by departments and other university units is in charge of implementing and developing the core operations of the university: research, research-based education and societal impact.

Throughout history, universities have been self-organizing communities. As digitalization has brought about awareness and also utilization of common support services and the advantages emerging from the culture of knowledge co-creation, it is time to create prerequisites for new leadership practices and improved results.

Figure 2 signals the importance of persistent development of processes and capabilities. This requires systems thinking where emphasis is put on processes and the interdependence of different actors and actions, as well as on simplifying complex entities into understandable concepts. The network economy is natural especially for universities but the ability to achieve good results also requires creating a culture of inspiring collaboration, as well as developing and implementing common methods, processes and models. This also refers to the development of new types of innovation platforms and knowledge management toolkits for the entire network. These factors are illustrated in Figure 3 which describes the above-mentioned demands.

The transformation from the Figure 2 situation to Figure 3 signifies the development and deployment of new types of instruments. This need was articulated already

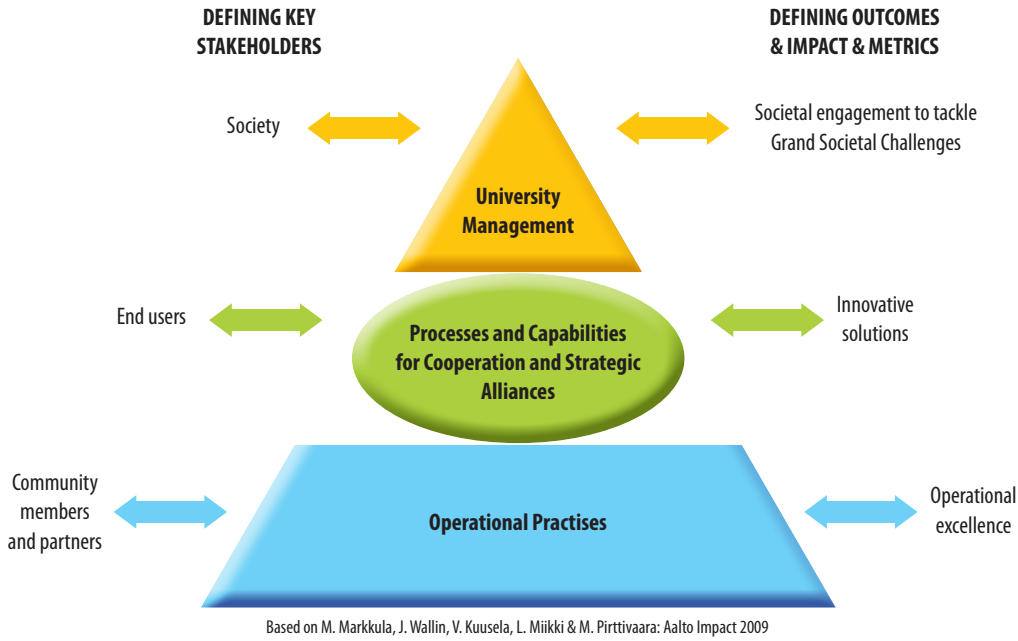


Figure 2. Frame for the Transformation Process towards a High-Level University Ecosystem.

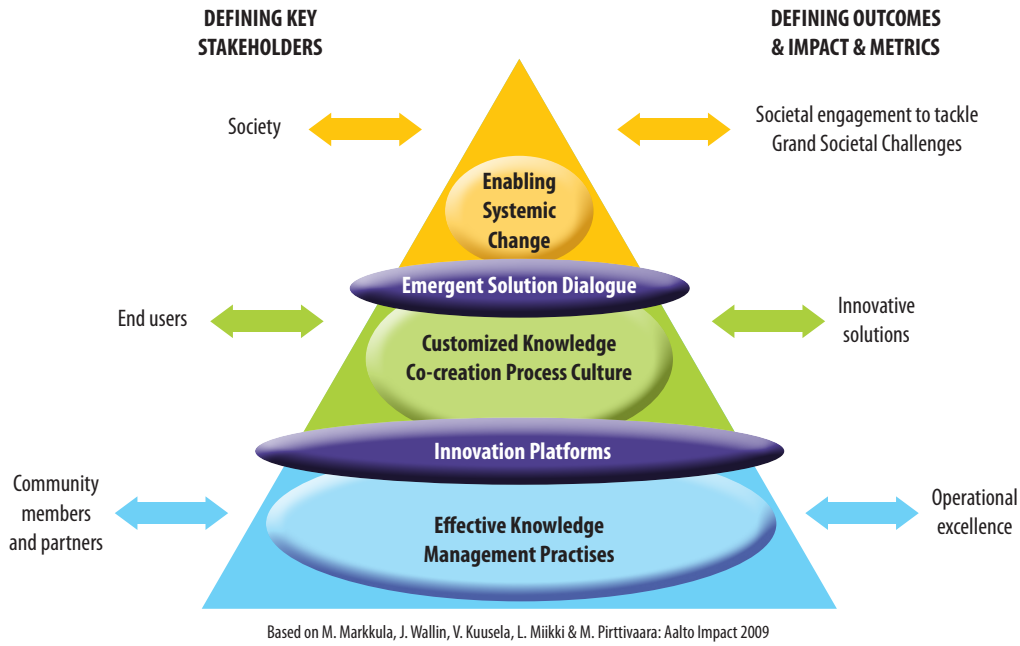


Figure 3. Development Needs to Enable the High Level Innovation Ecosystem Architecture and the Knowledge Triangle Culture.

in Figure 1, which introduced new forms and methods of increasing university impact. These instruments can generally be labeled as "Innovation Platforms", as described in Figure 3. They are characterized by a new type of a culture that encourages communality and collaborative ways of working, and highlight process development. Consideration is given to individuals' different goals and needs as they operate as knowledge producers and utilizers. Effective global operating based on knowledge sharing and knowledge co-creation is a basic characteristic of this culture – up to the level of the new entrepreneurial discovery mindset. It is particularly crucial for university management to create the prerequisites for this change and to serve as an example in actively seeking also new solutions to demanding challenges. This task is defined as "Emergent Solution Dialogue" in Figure 3.

Figure 4 illustrates the core elements of the transformation process: placing the strategic focus of the university on the chosen grand societal challenges and developing the operational activities of the units in accordance with the Knowledge Triangle concept. The prerequisites for reaching the high-level targets have been created together with the development measures defined in the previous Figure 3.

All-permeating development activities, and especially leadership and management training should be targeted in the following critical success factors of the transformation process:

- network-centric working culture focusing especially on the desired attitude and mindset change,
- targeted orchestration of major transformation operations,
- creating new collaborative value-creation methods, processes and models,
- planning and implementing the activities to create a regional innovation ecosystem architecture and
- making strategic choices to start potential breakthrough mega-level initiatives focusing on joint-research topics to create new solutions.

Around in Europe, there are a number on ongoing activities focusing on modernizing the Triple Helix concept. These will produce new developments and also entirely new openings with respect to the above mentioned success factors, as well as to the different ways to implement KT in practice. These issues will be tackled in more detail and the entire concept will be further devised also through the Energizing Urban Ecosystem EUE program, which is a four-year research program with a total budget of about 20 million euros. The program was kicked off in spring 2012. The program has a strong international flavor, thus creating new solutions to the challenges defined by the EU 2020 Strategy and the flagships (Markkula & Kune 2012).

5. From the KT Principles to Implementation

The global network economy requires numerous activities also from universities. These activities center on processes and structures of the network operations, as well as on developing competencies needed in creating and maintaining them. When the transformation measures are planned and implemented systematically through

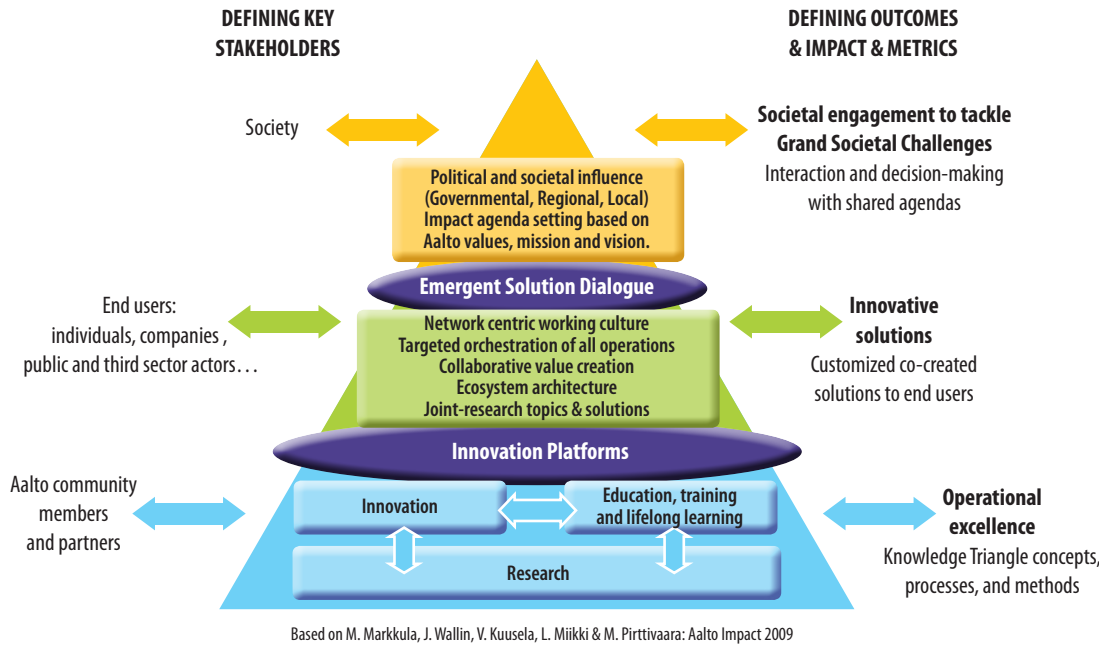


Figure 4. Ecosystems Architecture Design at the Aalto University Focusing on Impacts.

Knowledge Triangle implementation to benefit the entire university, all this becomes easier and the profitability and impact of the operations increases significantly.

Results are not, however, yielded in the short run. Renewing the university culture often takes years, even decades. The knowledge society paradigm shift hastens the need for change and downright demands this transformation. At the same time, it is important that the Knowledge Triangle itself is a research target. What are the practical starting-points for the intended development? Institute for Prospective Technological Studies IPST (part of the EU Joint Research Centre JRC) has analyzed the activities to strengthen the EU Knowledge Economy, and the need to conceptualize the Knowledge Triangle as a part of this. Their report "Connecting the Dots" emphasizes the need to implement the required measures in such a way that the impact of each measure unit is simultaneously evaluated from the viewpoints of research, education and innovation. This requires a well-managed orchestration of the measures in order to motivate a large group of university staff and stakeholders to create the new Knowledge Triangle concept and to implement it immediately through piloting. The IPST report includes e.g. the following viewpoints (Hervás Soriano & Mulatero 2009):

> *"The Knowledge Triangle concept goes one step beyond merely acknowledging the relevance of R&D, education and innovation: not only are these policy areas important, but there are important positive externalities between them. Thus, the need for improving the societal relevance of investment in these three areas calls for a systemic and continuous interaction.*
>
> *The contribution of research to innovation is already widely acknowledged: some scientific discoveries have applications that can be turned into commercial innovations. The Knowledge Triangle, however, underlines the importance of con-*

sidering also the reverse relation: commercial innovations can leverage research efforts by increasing their efficiency.

The Knowledge Triangle stresses the need for not treating education simply as an input within the context of human resources policies for R&D and innovation. Similarly, innovation should not be confined to the final stages of the knowledge creation process, being considered a mere output of education and R&D activities."

Based on the experiences of the Aalto University transformation process, and especially the Aalto Factory Park Concept with the university's long and wide-spread experiences from university-industry collaboration in Professional Development, Lifelong Learning and Living Labs, some pertinent concepts and instruments are to be created. Their detailed implementation will, in any case, take several years and require the synergic collaboration of various development projects as follows:

1. concepts and tools for increasing the university's societal impact with the help of the Knowledge Triangle
2. concepts and tools for improving university's own innovativeness in implementing the Knowledge Triangle
3. concepts and tools for improving the university's own productivity by using the Knowledge Triangle

Figure 5 outlines the Knowledge Triangle concept framework, including illustrations of some crucial contents. These are also critical success factors of the Knowledge Triangle operation. With respect to research, foresight, in particular, stands among them, as in a high-quality university also teaching and innovation activities are strongly future-oriented. In education, the success factors involve teaching and learning methods that encourage passionate lifelong learning. In innovation, these are typically competencies and methods for deep understanding of innovation ecosystems and innovation as a complex process. In this students play a crucial role. The efficient instruments and operational practices needed are illustrated in Figure 5 as platforms and processes stressing different perspectives and approaches. In addition, orchestration plays a pivotal role. The figure portrays this as an activity that integrates the different elements and dimensions.

The key message of the figure can be summarized as follows:

- To ensure a successful implementation and to create more synergy between research, education and innovation, the related activities need to be viewed and defined from different perspectives.
- To increase synergy, each of the three basic missions (research, education and innovation) has different key content areas to focus on. For example, research aims, in particular, to produce more foresight knowledge to be applied in education and in innovation. Resultatively, teaching and learning, among other benefits, gain better understanding of competence needs.
- Based on these three different perspectives, there is a need to define and establish three different concepts for platforms and processes to promote the implementation of Knowledge Triangle concepts.

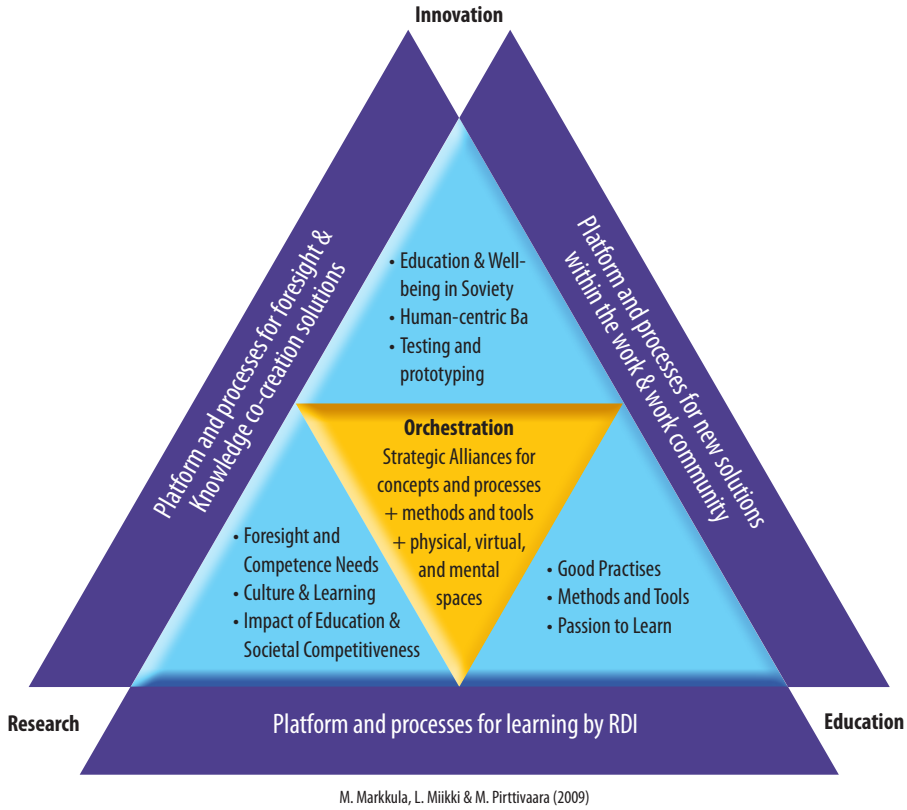


Figure 5. The frame for planning and running the Knowledge Triangle throughout university practices.

- As an example of increasing the interaction between research and innovation, the processes and the content of the activities need to be strongly based on foresight. Subsequently, with the help of foresight knowledge, the Knowledge Triangle brings considerable added value, especially by intensifying the multidisciplinary real-life and real-case approach as a university strength.
- To secure successful implementation and targeted outcomes, the Knowledge Triangle requires the support of effective university management and leadership practices. Orchestration plays a crucial role in making the Knowledge Triangle a reality.

Practicing what has been preached in these commonly acknowledged principles has advanced unfortunately slowly. It is not possible to alter university operations with top-down instructions. In order to accelerate the development in a way beneficial for universities.

CESAER and EUGENE[4] organized in 2012 several workshops to review the experiences of applying the KT principles into practice. The key findings include lack of financial resources and/or commitment for the making the KT a reality in most universities, the importance of KT in modernizing European universities, and practical benefits for all main actor groups: students, teaching staff, researchers and working life professionals. CESAER makes the following recommendation (CESAER 2011):

"The knowledge triangle should primarily be seen as a large-scale societal innovation through which Europe can strengthen its research potential, increase its capacity to educate talents and to promote and create demand-driven open innovation platforms for wide societal use. This means that national, regional and local governments together with the Commission should finance this reform as the long-term success factor for European competitiveness, and also as a crucial crisis exit strategy."

The results from "The CESAER SMART Initiative"[5] were published as the policy paper "Stimulating the Modernisation Agenda for Research and Technology". According to the paper, the KT means especially new developments and more impact on the following:

1. Value creation based on better use of intangible assets
2. New processes and methods for university-industry collaboration
3. Systemic change: focus especially on societal innovations

Under these headings, altogether 12 principles and practices are defined in more detail. The most relevant with respect to this article are summarized in the following.

There is a need for dialogue and sharing of expertise and through that also for the modernisation of the Triple Helix model. The new learning environment is based on a culture, which is characterized by learning and working together, and by research, development and innovation. Students need to be motivated to think outside of the box and take initiative and responsibility for collaborative learning. Bringing together theory and practice is essential in implementing the Knowledge Triangle.

Supportive structures and funding are basic enablers of innovations in university–industry collaboration. Bring together students and companies and create an interdisciplinary culture where dialogue and new thinking can take place. Provide places and opportunities for co-learning and create facilitator roles. The entrepreneurial mindset should be promoted throughout all learning environments, teaching methods and practices at the university and it must be integrated with all activities – for students, staff and faculty.

The major issue in promoting an entrepreneurial mindset is attitude. An entrepreneur is an innovator, creating something new and making things happen. This requires high ambition, motivation, positivity and risk-taking. This also requires renewal of operational culture and procedures, especially in what comes to enhancing synergies between research, education and innovation activities and significantly strengthening collaboration with other actors of the society. Innovation activities embrace not only corporate and organizational processes products and service innovations but also societal innovations. In societal innovations there is always a structural or systemic dimension, influencing societal operations on a large scale.

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[4] EUGENE is a thematic network aiming at improving the impact of European Engineering Education (EE) on competitiveness, innovation and socio-economic growth in a global context.

[5] The principal author of the part "Making the knowledge triangle a reality" in the SMART initiative was Markku Markkula, Aalto University.

Orchestration of knowledge, skills, competencies and activities is needed to co-ordinate complex projects and create new innovation capabilities. Advanced leadership and managerial competences are needed in orchestrating interdisciplinary, inter-sectoral and intercultural communities. This clearly opens a new challenging role for universities taking a key position in orchestrating such interactive processes involving all actors of the Triple Helix in a balanced way. Bottom-up (instead of top-down) and user-centred thinking boosts innovations and enables the dissemination and implementation of innovations.

The KT principle not only refers to the synergic integration of its three dimensions in university education and research activities but it should have a more profound impact on all university operations.

6. Orchestration

The demand for heightened quality of societal activities, the increasing complexity of processes needed to constructively solve societal challenges, and the globalization and digitalization that have changed industrial earnings logics, all accentuate the need for systemic innovations. This desired change cannot be guaranteed by private-sector actors only. The only way is to establish strategic partnerships and change programmes serving common interests. To pave the way, high-level pioneers are needed with their global networks and capability in acquiring and deploying the most pertinent scientific and applied knowledge.

Creative people and many crossing flows of ideas form the core for innovation hubs. Traditional management, regardless of how effective it is, cannot achieve high international-level targets. Orchestration allows to unleash the resources of those within the innovation ecosystem and to direct them to each individual's core interests while increasing the interaction for knowledge co-creation. The application of KT principles in larger endeavors involves the integration of goals and ways of working that may partly contradict. The end of chapter 4 described in brief one such mega-endeavor, the EUE research programme.

The orchestration of collaborative platforms and operation within many interfaces has proved to be one of the most critical success factors in the collaboration of university-industry-public administration. Traditional management does not ensure enough co-creation to tackle the complex ecosystem-type interaction. Instead of operating through a traditional Triple Helix model, we need a concept characterized by many interactive elements and processes, which are typical to successful global business ecosystems. The regional innovation ecosystem model (RIE) is based on a network culture with a large number of collaborative actors operating with different roles and responsibilities.

This means that the Triple Helix model is complemented with market aspects, demand factors, sub-contractors, and also increased participation of citizens as users and developers of innovation. In addition, the ecosystem operations include orchestration practices bringing together key stakeholder interests and challenges related to the value constellation in global contexts.

Orchestration means systemic but at the same time flexible channeling and managing of the ecosystem-level resource flows to support shared activities and collaborative processes. The public-sector actors should focus on taking care of the policy foundation and the regulatory framework to meet the funding requirements and providing the researchers with a broadest possible freedom without administrative burden to focus on their scientific interests. However, one should keep in mind that societal needs promote active innovation and cross-sectorial collaboration. In parallel with the long-term scientific and discovery interest, the private-sector actors target their focus also on the innovation processes for delivering the maximum commercial benefits. As all the parties involved cannot accomplish their respective missions without the others, they are drawn to establish strategic alliances and other forms of productive and mutually beneficial partnerships.

The duties of orchestration include improving the collaboration scheme (such as common terminology, facilitating work methods, coordinating the intermediate processes, sharing interests with third parties) that need to be aligned to achieve truly fruitful outcomes.

Orchestration centres on the well-planned management of any large endeavor. The integration of research, education and innovation activities serves as an essential impacting factor during all of this lifetime. The management approach with a strong orchestration flavor calls for an explicit shift of focus into managing the cross-sectorial processes, and a smart approach to addressing the associated hand-over of responsibilities, support and authority across domains.

This process can be depicted as in Figure 6, based on the EUE experiences, through the individual projects and the orchestrated processes of their actor networks. In orchestration these processes are interwoven into routine administration, the activities of work groups formed flexibly for diverse needs, and deployment of facilities and procedures strengthening the collaborative work culture.

Orchestration is a key process for maintaining effective innovation ecosystems. Once actors are able to find each other, communicate effectively, and understand each other's questions, interests, and needs, trust and mutual respect can grow. Collaborative learning becomes possible, and the investment of time, effort and attention participants need to make in order for collaboration to be successful can begin to pay off. Support infrastructure – methodologies, technologies, tools, activities, and shared spaces – both physical and virtual meeting and co-working spaces – are important to facilitate communication and to build shared understanding.

Changing mindsets is often an important and difficult aspect of the innovation process, but it is essential both on an individual and a collective level. Thinking in outcomes and impact, not outputs, is the basic principle in regional innovation ecosystems. Moving from proprietary ownership to open innovation, from personal to partnership, from following to initiating, from risk-aversion to experimentation – these are building blocks of the culture of innovation Europe is looking for, and which the Horizon 2020 program hopes to achieve. They mark shifts in deep understanding, which are necessary in order to create value in society.

Beyond this, the right attitude is required, and diverse skill-sets are needed for pioneering and discovery. Discovery skills form part of the creative intelligence of inno-

vative entrepreneurs. These skills work together to create what the authors call "the innovator's DNA" (Dyer, Gregersen & Christensen 2011). This idea was used for designing the original Aalto Camp for Societal Innovation (ACSI) concept, and has been taken over in developing ACSI-style interventions for the EUE program. Two additional aspects were added to the original five, creating the concept of an innovation dynamo to guide the mentality of EUE participants to focus and strive for the regional impact.

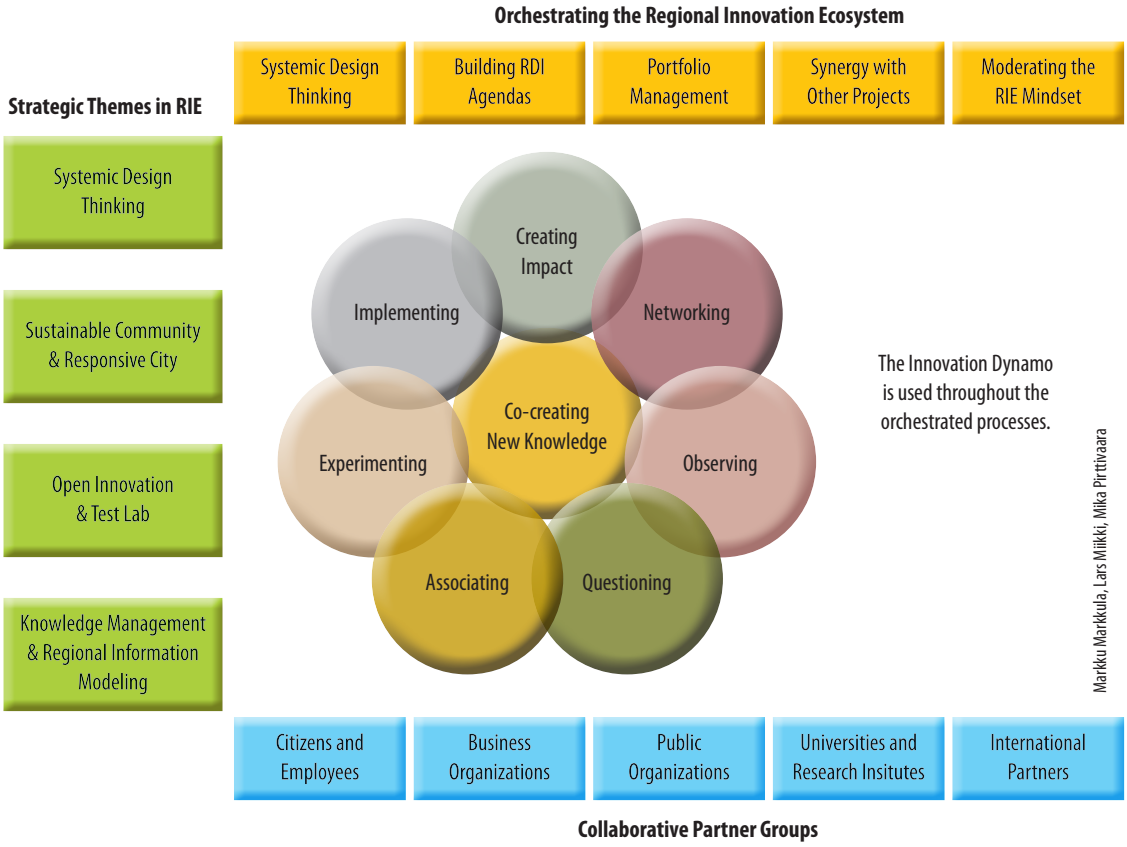

Figure 6. The RIE Concept. The content sub-areas, actor groups and ways of working of the orchestrated activities within the regional innovation ecosystem.

The Innovation Dynamo (see the core in Figure 6) harnesses the five discovery skills to two aspects of the innovation process essential to realizing innovation in practice: Implementing and Creating Impact (Markkula & Kune 2013):

- **Associating** is the ability to make connections, linking seemingly unrelated issues and ideas in new fruitful combinations.
- **Questioning** leverages the power of provocative questions to create new perspectives and modes of thinking.
- **Observing** is the key to understanding how things in the world work, and why people behave as they do.
- **Experimenting** means going with best guesses and not being afraid of failing your way forward. It is an essential skill of innovators.

- **Networking** allows us to tap into the collective and distributed intelligence for insight, explanation, expertise, and inspiration, as well as critical thinking.
- **Implementing** is the litmus test for innovators – realizing a good idea in practice.
- **Creating Impact – and Celebrating it.** This is the proof of the pudding: does a new product, service or realized idea actually create value for its users – and for the ecosystem. If it does, then we should celebrate it, making it clear to all those involved that this innovation works.

This is how the Innovation Dynamo generates innovation power and the energy required to maintain the ecosystem. Working with these skills, pioneering innovation regions are able to leverage their potential to create societal impact.

7. Conclusions

The target of conceptualizing Regional Innovation Ecosystems (RIE) is a way of understanding and strengthening the region's ability to nurture new innovation and strengthen competitiveness. Universities most often play the drivers' role in the RIEs. Companies that commercialize innovations are the main actor group, but not the only one. The various RIE actor groups can best be described as diverse researcher networks, developer networks, user networks and producer networks, which are all needed in order to quickly produce and spread new competitive products, services and other innovations into markets.

This article described a multitude of views impacting RIE activities and success. The ecosystem that is formed of individual parts and entities comprised of several of these parts poses immense challenges to all those involved. The notion of mega-endeavor, highlighted in the text, constitutes an entity of several projects. Some of these are interlinked as activities operating within shared administration and others are lightly connected projects with common interests and synergies. Such entities can more effectively be led through orchestration than through traditional management. The mega-endeavors provide universities with an opportunity to renew their operating culture and to significantly enhance their societal, economic and cultural impact. Orchestration is effective in constantly connecting new projects to the mega-endeavors and their domains, as well as activities within the region and in international networks that are beneficial and even essential for attaining RIE goals.

We need a systemic research and innovation policy to respond to the complexities of ever-changing needs and behavioral patterns of urban development. We need to create new mechanisms to increase the renewal capital of our society and especially the key work communities – universities have to renew their own operational culture to be able to fulfill their mission to provide power to renew societies. All this can be called "the Entrepreneurial Discovery Mindset".

Applying the KT principles in practice has shown that especially the following guidelines are essential in creating regional innovation ecosystems: shared vision, favorable atmosphere for discovery and entrepreneurship, collaborative learning

and knowledge co-creation, joint concepts and mental models, systemic culture of change management and orchestration, motivating users as innovators, commitment on long-term change, accepting even radical innovation, piloting and rapid prototyping, and optimized full-use of digitalization as an all-permeating resource.

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About the author

Markku Markkula, MSc, works within Aalto University as the Advisor to Aalto Presidents, focusing on European Union strategy affairs. His previous university assignments comprised membership of Aalto University Transformation Team (2008–2009) and the Director of the Centre for Continuing Education (1985–1991) and the Lifelong Learning Institute Dipoli (1992–1995, 2003–2008) of the Helsinki University of Technology (TKK). Markkula is a member of the EU Committee of the Regions, CoR. He is the Chair of the EPP/CoR Task Force on Europe 2020. His CoR role includes being the rapporteur on the Role of Local and Regional Authorities in Achieving the Objectives of the Europe 2020 Strategy, as well as the rapporteur on the Horizon 2020. Markkula is a former member of the Finnish Parliament (1995–2003) with membership roles in the Committee for Education, Science and Culture and the Committee for the Future. As an MP his international role included the Presidency of EPTA Council, European Parliamentary Technology Assessment Network. He has served the global engineering community as the part-time Secretary General of the International Association for Continuing Engineering Education IACEE 1989–2001. He has been awarded the European Society for Engineering Education SEFI Fellow 1995. As a tribute to his achievements he was in 2008 elected to the International Adult and Continuing Education Hall of Fame. In Finland his role has included memberships in the boards of several companies and organizations, among others Tekes, the Finnish Funding Agency for Innovation and Technology. He has also served Finnish society as the Chairman of the Espoo City Council (1990–1992, 2010) and the Espoo City Planning Board (2004–2012), as well as the Chairman of the boards of the Finnish Association of Graduate Engineers TEK (1993–2005) and the Finnish Information Society Development Centre TIEKE (2000–2011).

Henna Tomperi
Head of Leadership & Competence Development, Aalto University
henna.tomperi@aalto.fi

II. Developing Academic Leadership at the Heart of the Knowledge Triangle

Abstract

A key component in orchestrating the Knowledge Triangle is organizational leadership, which is also a key enabler in the implementation of the entire Aalto University Strategy. Inside the academic community, the interest in leadership has grown considerably during the past 10–15 years. As an organizational phenomenon, leadership is instrumental for universities in aligning their ranks behind shared strategies and in meeting the augmenting demands for economic efficiency and accountability in academic work. (Kekäle 2003) Leadership has also been identified as one of the vehicles universities – as well as other profit and non-profit organizations – use to enhance their innovation and creativity (Mumford et al. 2011). In addition to the organizational approach, the increased focus on academic leadership can also be viewed from the individual perspective. Whereas earlier the level of leadership was almost fully dependent on individual leaders, and their abilities and interests, these same leaders are presently made accountable for the level and quality of leadership they provide. Although leadership is typically not their main task, it is seen as an important role for which time and attention need to be dedicated – academic employees are entitled to a leader who is interested in their work and personal development.

The search for good academic leadership is challenging, as there are no ready-made models. This article discusses innovation and leadership as well as leadership development in Aalto University in a practice-oriented way by examining the different elements of academic leadership, as they have been described by academic people from across Aalto University. Further, the article focuses on the philosophy underlying academic leadership development and

the practical development activities, and discusses reasons behind the selection of these specific activities. Finally, the article concludes with the future steps in the development of academic leadership in Aalto University.

Keywords: academic community, organizational leadership, university transformation, leadership development

1. Introduction

The world around Aalto University is changing and the University strives to ensure it is a change for the better, both globally and nationally. But it is not enough to be part of the global changes; increasing competition and pace in research and education, as well as new generations of faculty and students with their new expectations for work put the University under great pressure to ensure the organizations internal ways of operating keep up with these changes.

In today's world, there are new demands for innovativeness and creativity in universities. These are seen more and more as organizational characteristics, not just results of individual geniuses working on their own. It used to be believed that it is best for leaders not to try to lead creative people – just to get out of their way and let them be innovative. However, as Mumford et al. (2011) show in their review of research on innovation and leadership, this assumption is simply not true. Leadership and innovativeness are clearly linked; the "right" type of leadership efforts seem to result in an increase of innovation and creativity. But how can we then pinpoint the "right" leadership efforts? Research has proposed different viewpoints for exploring the performance of leaders who lead creative work. Mumford et al. have roughly grouped the results into the following categories: the cognitive traits of the leader, the motivation of the individual employees, the right level of control in creative work, a participatory organizational climate, and the quality of interactions between the leader and the individual team members inside the team, as well as in the wider organizational system.

So leadership at individual, team and organizational levels is important in enhancing the innovativeness and creativity in an organization. But what is good leadership for creative people? What kind of leadership practices actually promote innovation? And how do we develop and promote these practices in an academic community where leadership is still often seen as something questionable; if not as an obstacle to everyday work, then at least something of a nuisance.

To address these questions and to initiate a profound change in Aalto University leadership, the university instigated systematic dialogue on academic leadership among its academic leaders. Based on the discussions, most academic people agree with Välimaa's (2012) argument that universities are not like companies, and thus the management and leadership models cannot be directly copied from the corporate world. There are several historical layers on which the new understanding of academic leadership needs to be constructed. On the other hand, the old fragmented approach to leadership does not work either; there are too many academic employees who feel neglected due to the lack of any kind of leadership. This places Aalto in

the middle of a transformation; we know we need to let go of the old paradigm, but we still need to construct the new one together.

The leadership development activities in Aalto University reflect this transformation. The aim is to work on the organizational and individual levels simultaneously, i.e., by supporting individuals in developing their leadership skills while simultaneously facilitating a continuous dialogue on what academic leadership in Aalto University really should look like. We see that these two processes feed into one another; the more familiar the individual leaders become with their personal leadership style, the easier it is for them to take part in the discussions on the desired leadership culture. This approach is also well in line with the academic findings that state that the most effective development activities combine the individual or leader development with organizational or leadership development (Day 2011).

2. What is Academic Leadership?

The term leadership seems to evade a shared definition among academics. Further, when we combine the term 'leadership' with the academic environment, we can without doubt state that academic leadership is complicated. Academic leadership in Finland has its roots deep down in the history of the university institutions of medieval Europe (Välimaa, 2012). Leadership and decision making at university level have traditionally been collegial, characterized by variation and individuality in the leadership cultures of individual departments. As these were built around single professorships, their leadership often reflected the individual qualities of the professor and the discipline (Kekäle, 1995). During the past decade or two, there has been a continuously growing demand for structured management – not leadership – related to the universities' public role. This has often led more and more to a situation where the shared understanding of the role of an academic leader is that of an administrator and manager – not a leader.

When we examine research on leadership of creative work, the truth could not be further away. Mumford et al. (2011) emphasise the challenging nature and complexity of leading creative and innovative people. Whereas there are similarities with attributes linked with good leadership in general, there are also elements that are specifically important in leading for innovation. First, the leader's cognitive capabilities play an important role in the success of creative work: the leader needs to be smart and an expert in an area relevant to the work. Second, the leader needs to be able to facilitate the creation of a climate that supports innovation. And third, the leader plays a key role in linking his or her team's creative work with the other on-going activities in the organization. So, creative leadership seems to emphasize specific elements of both individual and organizational leadership.

As there are no ready-made, cookbook models for academic leadership, it is important to develop some level of shared understanding of what is meant by academic leadership, and thus help individual leaders in framing everyday leadership situations. In Aalto University, this is pursued by sustaining a continuous dialogue on the academic leadership culture with academic leaders from department heads and deans

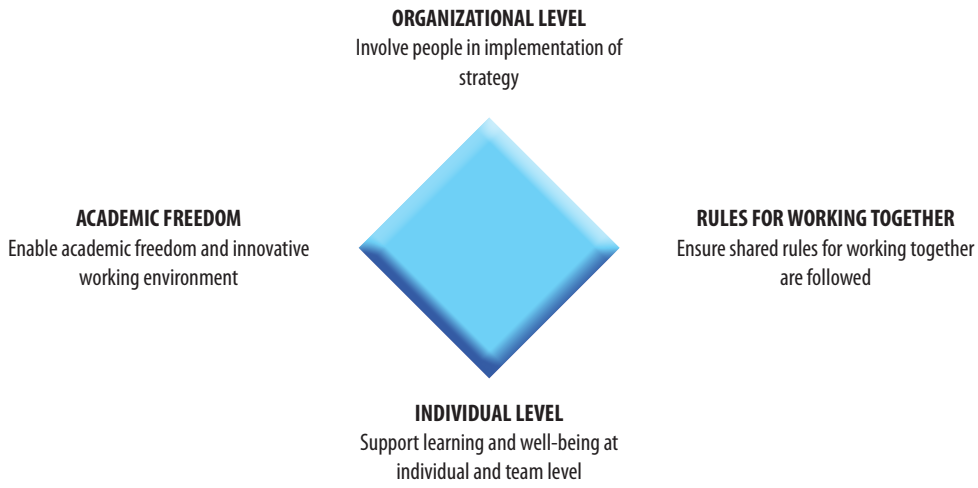

Figure 1. Aalto University Leadership Principles.

to the academic vice-presidents and the president. This group of leaders is far from uniform: their individual situations, backgrounds and levels of leadership experience vary substantially. However, they all describe the key elements of academic leadership in roughly the same terms. These descriptions have been documented as the Aalto University's Leadership Principles (Figure 1) which are a result of several workshops organized for more than 100 Aalto leaders during the first year after Aalto University started its operations.

The Leadership Principles describe academic leadership which aims to offer experts the best possible individual and organizational starting point for creative work in science, arts and education; the aim of the leader is to enable the success of other people. At the individual level, the leader should ensure employees receive sufficient guidance and feedback in order to be able to know what is expected from them and to succeed in reaching their targets, as well as to keep on learning and feeling good about their work. The level of attention needed varies between employees and situations, so a good academic leader shows interest in the employees and is ready to listen to them in order to better understand their individual circumstances and needs. On the other hand, academic leadership is also about empowering people when they are ready for it – creative and innovative work requires independence and ability to affect one's own work. Mumford et al. (2011) highlight this right balance between structure and freedom as one of the key success factors in leading creative work.

At the team level, the Leadership Principles emphasise another balancing activity: the creation of a climate which combines the academic freedom and creativity with respect for other employees and their work. The leaders need to ensure that individuals act within the framework of Aalto values, even though they are offered extensive flexibility in defining the exact content of their academic work. Diversity which is built on a shared value base and respect for one another is a real strength in an academic team.

At the organizational level, the Leadership Principles emphasise the need for joint search for the strategic targets of the organization. In order for people to feel committed to the shared targets, experts need to feel involved in the definition of the organizational strategy. The leader's role is to facilitate the process and ensure everyone involved is aware of the wider context of their research; that way it is possible to align the research strategies of an individual research team with the overall aims of the university. This naturally requires that the leaders have active networks inside and outside their own organization.

In light of the Leadership Principles and the ideal picture they paint of an academic leader, and combining that with an understanding of the complexity of the everyday leadership situations, we can only agree with Mumford et al. (2011) on the complexity of leading creative work. So it is no wonder many academic leaders feel stressed and even overwhelmed by the responsibilities of leadership – and especially by the challenge of combining their leadership role with their academic work (Gmelch & Burns, 1993). This is highlighted by the fact that most academic leaders have not aimed for a career in leadership; most people who remain in the academic world do so because they are passionate about research and education, not in order to lead other academics. When balancing their leadership and academic work, leaders are actually working with one of the core elements of academic leadership; as Mumford et al. (2011) mention, one of the key success factors in leading creative work is the expertise of the leader – and this expertise needs to be kept up-to-date for the leader to be a credible academic.

3. Developing Academic Leadership

One of the challenges in academic leadership is that, apart from the academic expertise discussed in the previous paragraph, the characteristics of a good researcher are not necessarily those of a good leader. We are all familiar with the stereotypes of an introverted researcher deep in thought in his or her study, and that of an extroverted leader inspiring hundreds of people in front of a large gathering. Luckily for us, those are just stereotypes! But in real life, leading people is different from doing research.

So, one of the starting points in developing academic leadership at the individual level is to help the leader create the identity of an academic leader – something that is different from the identity of a researcher, but one that is still based on the same personality. In Aalto University, we are in a unique position, as we are building that identity at both individual and organizational levels at the same time. As a new university with new strategic targets, we also need to create a new, shared leadership culture. The starting point is challenging: as there is no tradition of in-depth leadership training for people assuming academic leadership roles, there is considerable variation in people's understanding of what good academic leadership looks like.

In this situation, we need to ensure our leadership development activities focus on both individual and organizational levels. Based on research, the most effective development practices integrate both individual leader development and organizational leadership development (Day 2011). Figure 2 shows ways in which the two lay-

ers are combined into a process of continuous learning. At the organizational level, the aim is to encourage and enable networking among academic leaders. In practice this means that all the development activities focus on the right people mix e.g. when participants in leadership development programmes are divided into groups for exercises or when selecting mentoring pairs. Some development activities are organized to facilitate networking. This active mixing of people from different parts and different levels of the organization enables a continuous dialogue and sharing of experiences. Furthermore, the related dialogue facilitates the emergence of a shared understanding of what is meant by academic leadership at the organizational level and it also helps individual leaders learn from the experiences and best practices of one another.

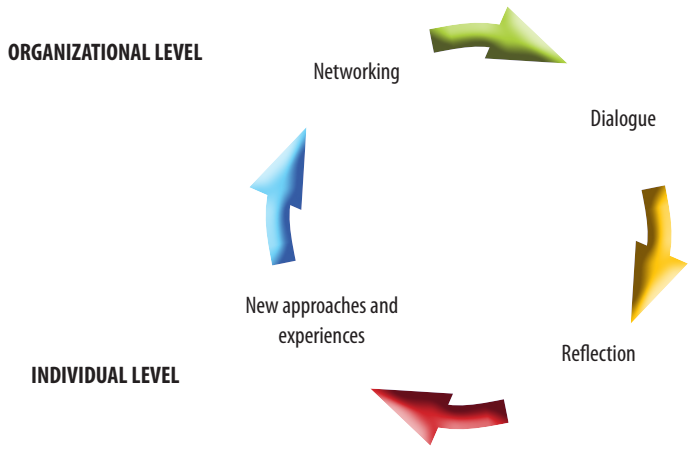

Figure 2. Developing academic leadership at individual and organizational levels.

The organizational level thus feeds into the individual level and vice versa. In addition to the organizational dialogue, there is naturally a host of other ways of supporting individual leader development, and all of the input concerning individual leadership starts to make sense to an individual leader through personal reflection. This process of reflection and build-up of self-awareness is a key element in learning at the individual level. If and when this reflection turns into changes or new approaches in leadership behavior, then the results of the leadership development activities start to have a real impact on the organization – when the leader behaves differently, then also the followers may react in new ways. The continuous sharing of these experiences with other leaders from across the organization is the link back to the organizational level; bit by bit all the levels learn and create new best practices for academic leadership that define and re-define a shared understanding of academic leadership.

4. Leadership Development in Practice

Many academic leaders openly express that they would like to have help in learning to lead in a new way. For some academic leaders, leadership development is

a continuous process of raising one's self-awareness and more consciously driven leadership behavior. For others, leadership is something that happens on the side – one does not have to think about it too much. In between these two ends of the spectrum, there is substantial variation between individual academic leaders in their motivation and interest in developing academic leadership. In order to meet these different needs – as well as to help leaders in finding suitable support for their individual leadership challenges when they need it – Aalto University has built a portfolio of leadership development solutions that is available to all the University leaders.

As discussed in the previous chapter, one of the basic principles in building the portfolio has been to combine individual and organizational levels of leadership development, and to support learning together and from one another as much as possible. This principle is important not just in the selection of the different learning solutions, but also in the way each of them is designed. Another important principle has been to emphasize the role of learning on the job. Leadership development only reaches its targets when people learn something new from the formal development solutions or from their peers, and then adapt their decision making or leadership behavior in real life as a result (Day 2011). This is again taken into account in the kind of

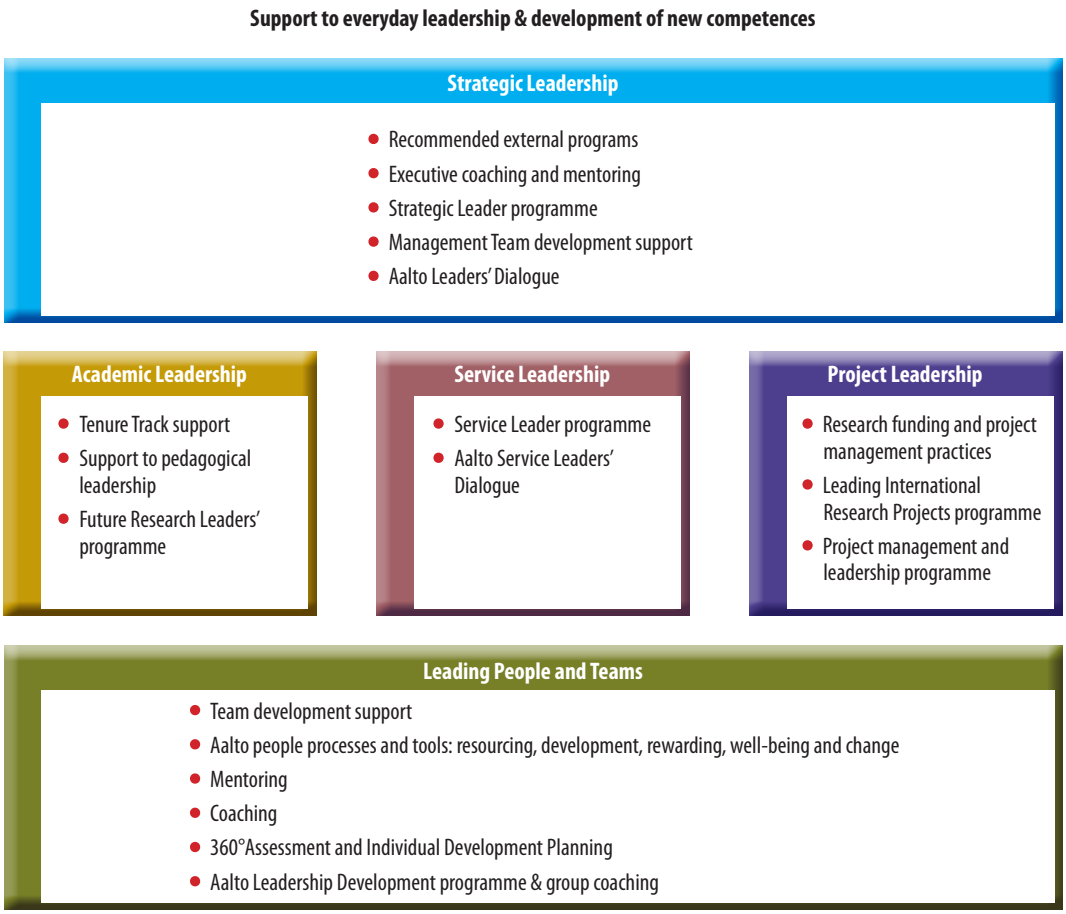

Figure 3: Leadership development framework in Aalto University.

learning solutions that are offered, as well as in the ways in which individual learning solutions are designed. Coaching – in groups and individually – is a good example of a learning solution that focuses on the leaders' individual everyday challenges in leadership. A third principle in building the leadership development framework has been to use Aalto Leadership Principles as the starting point for the design of the development solutions. Even though the University is not offering detailed, ready-made guidelines for academic leadership, the Leadership Principles help to define a wide framework for good academic leadership in Aalto University.

The leadership development framework consists of three layers (see Figure 3). At the bottom, the basis of "Leading people and teams" is meant for all leaders across the organization and at all organizational levels. The layer in the middle consists of three separate boxes: "Academic leadership", "Service leadership" and "Project leadership". The development solutions in these boxes have been tailored to the specific target groups. The top layer in the illustration, "Strategic leadership", brings together all leaders with responsibility for strategic leadership, i.e., the development solutions in this box are again meant for people from all schools and for both academic and service leaders.

Under the heading "Leading people and teams", Aalto offers a leadership development programme and group coaching to new leaders. The programme is also open to more experienced leaders who want to refresh and reflect on their leadership skills. The 360° assessment uses questions based on the Leadership Principles in collecting feedback on individual leader's leadership behavior from the subordinates, peers, manager and the individual him- or herself. The results are discussed confidentially with a trained feedback coach. More in-depth coaching processes are offered either individually or in groups consisting of peers in similar professional situations. All coaches are professionally trained and in most cases from outside Aalto University. Mentoring is another individual development solution. In the last year, Aalto has had approximately 50 mentoring pairs with participants representing different schools and even organizations from outside Aalto University. The majority of day-to-day support with Aalto people processes is offered by HR coordinators in departments – the aim with this is to ensure availability of timely services and practical on-the-job learning for the leaders. In addition to this, info sessions are organized for leaders when there is a need to share information about a new or topical leadership matter. On top of the individual leadership development activities, also team development planning and facilitation support are available for leaders and their teams.

In the middle layer, development solutions specific to individual target groups represent programmes and individual development support tailored for the needs of each group. Their design follows the same principles that have been applied to the rest of the portfolio.

In the "Strategic leadership" box, the solutions are tailored for the needs of the more senior leaders with responsibility for organizational leadership and strategic issues, and who often lead other leaders. Aalto Leaders' Dialogue is a regular interactive workshop for the senior academic and service leaders. It is a forum for active discussions on leadership-related matters, as well as for communicating about topical issues. Aalto Leaders' Dialogue is one of the main vehicles for the joint sense making

of Aalto University's academic leadership culture. Management teams are supported with tailored development processes which typically last between 6–12 months. These processes are designed to support the everyday work of the management team, and thus support learning on the job at the team level as well as enhance the effectiveness of the management team. Aalto Strategic leader programme consists of three modules that take the participants from strategic and organizational levels to team and individual leadership. This programme is also built on the basic principles mentioned before: discussions and networking among peers are encouraged, and the participants are invited to assume a role in the organizational dialogue about the joint leadership culture. Executive coaching is available to individuals, and people in this target group often participate in mentoring – acting as mentors or taking part in peer mentoring.

5. What Are the Future Avenues of Academic Leadership?

During the first 2–3 years of the existence of Aalto University, dozens of academic leaders have taken part in a variety of leadership development activities. But what are the visible results of these actions? The feedback from the participants has been mostly positive. One of the challenges probably is that those who are participating are typically leaders who are interested in developing their leadership skills anyway. How to reach those leaders who are not?

Another – and a more important, but also much more difficult – question is related to the real impact of the leadership development activities. As Day (2011) points out, it is difficult to isolate the impact of the leadership development activities from a host of other interrelated elements. Leadership development is also a process that takes time. At the individual level it is, at its best, a process that continues throughout the adult life span. At the organizational level, the changes are slow and the steps may seem small. But it is only through these small changes and visible, successful cases of new type of leadership behavior that the organizational leadership culture will evolve. The exciting thing about this process is that nobody yet knows what the end result will look like. When developing academic leadership, we are not navigating a boat to a pre-defined harbor, but we are facilitating the process i.e. giving the community of academic leaders the tools they need in order to discuss and to make decisions on which harbor they want to sail to and how to get there together.

On the other hand, we do already know that the academic leaders across the organization do wish to create an academic leadership culture that is based on dialogue and networking – both inside and outside the organization. As dialogue and networking are also some of the key elements in the development of academic leadership, Aalto University is clearly moving ahead in enhancing the core elements of the network-centric Knowledge Triangle culture.

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About the author

Henna Tomperi holds a Master's degree and is presently finalizing her Doctoral Thesis on ethical team leadership. Henna's key qualifications are in the areas of strategic competence development, leadership development, management team development, facilitation, and change management. Henna currently works as Head of Leadership & Competence Development at Aalto University with responsibility for the development of leadership capabilities – especially academic leadership – across the organization, as well as for promoting the development of professional competences in the University's service functions. Her team is also in charge of activities related to employee well-being, supporting internal changes as well as HR communications. Prior to joining the University, she gained 15 years of experience as a human resources development professional and as a leader herself in companies such as UPM-Kymmene and Nokia Corporation. In 2009 she won the European HR Award by EAPM (European Association for Personnel Management) with her article "The Brave New HR".

Tuija Hirvikoski
Laurea University of Applied Sciences
tuija.hirvikoski@laurea.fi

III. The Knowledge Triangle Promoting Innovation and Multidimensional Learning

Abstract

Higher education institutions play a pivotal role in the well-being of their regions by creating and transferring new knowledge to their students and regions, thereby increasing both students "and regions" capacity to absorb latest knowledge and foster innovation. To optimise both educational and RDI impacts, the Knowledge Triangle (KT) is important. It is about creating and strengthening the interaction and synergy between research, education and innovation and paying due attention to the linkages between them. The KT, however, requires changes in the design and delivery of education programmes. It also calls for new mechanisms and interfaces for collaboration among various regional stakeholders. Learning by Developing (LbD) together with the LivingLabs (LL) model exemplify these changes and mechanisms in practice. The article explores LbD and LL as a university case (i.e. Laurea University of Applied Sciences) and an example of the KT.

Keywords: The Knowledge Triangle (KT), Learning by Developing (LbD), LivingLabs (LL), collaborative research, development and innovation (RDI)

1. Introduction

Higher education institutions (HEI) are conducive to the socio-economic development by contributing to human capital and innovation in the world of work and the wider economy. Traditionally, the contribution has materialized through linear processes (from basic research to education and laboratory work, innovation and commercialisation). In the frame of the KT, this article, however, concentrates on the non-linear and collaborative modes of learning and innovation practices in between a HEI and

its region. In the interdependent global context, the challenges have turned severer and subsequently new collaborative tools and mechanisms have been fostered and experimented with.

In the context of a complex, interdependent global economy, corporations in Europe are specialising in services and high value-added production sectors. At the same time, the evolving principle of shared value creation (Porter & Kramer, 2011) calls for creating economic value in a way that also creates value for society (Kulkki, 2011). Similarly, the EU Horizon2020 challenge-based third pillar, that is, better societies, emphasises the need to take the societal problems themselves as a starting point for corporate and university RDI work.

As Kulkki (2011) explains, grand challenges and shared value creation call for convergence[1] of disciplines and collaboration of firms, academia, public agencies, regions and cities with people and citizens. "This collaboration may cover activities from research to market with a new focus on innovation related activities, such as piloting, demonstration, test-beds, living labs and support for public procurement and market uptake." (Kulkki, 2012, 24)

From the viewpoint of HEIs and their contribution to lifelong learning, creative collective action implies that people are seen as an inspiring partner bringing their values and creativity to problem solving. This may, however, require what Nonaka and Takeychi (2011, in Kulkki 2012) describe as distributed leadership, where wisdom is embedded in every individual and collective practice and action.

2. The Learning by Developing model in conjunction with the university driven LivingLabs

In the complex global context that transforms at an accelerating speed, higher education institutions form the core for new collaborative RDI and multidimensional learning mechanisms for the benefit of people, organisations and regions. In Finland, traditional universities and universities of applied sciences (UASs) together constitute the dual higher education system and a continuum of knowledge creation and transformation, in which the UAS sector has three legislative tasks: education, RDI and regional development. Education in a UAS is based on its working-life oriented RDI work complementing the basic research of the traditional universities. Many of the Finnish UASs operate as living laboratories and develop and apply the related methodologies enhancing multidimensional learning and innovation (Kantola & Hirvikoski, 2012; Living Lab ammattikorkeakoulussa, 2012).

2.1 Living Labs and related concepts

Westerlund and Leminen (2012) define "living labs as physical regions or virtual realities, or interaction spaces, in which stakeholders form public-private-people partnerships (4Ps) of companies, public agencies, universities, users, and other stakeholders,

[1] "Convergence as a research design merges distinct methodologies, technologies, tools, processing principles, and other elements of research designs into a unified whole." (Kulkki 2011)

all collaborating for creation, prototyping, validating, and testing of new technologies, services, products, and systems in real-life contexts. They are used for the development of communities for the use of innovation."

According to the European Network of Living Labs (ENoLL), the Living Labs are citizen-driven open innovation ecosystems in real-life settings in which innovation is fully integrated into the co-creative, co-design processes for new technologies, products, services, and societal infrastructures. First developed by William J. Mitchell at MIT in 2003 to study people and their interaction with new technologies in a living environment, the Living Lab model was introduced to Europe by Nokia and adapted to the needs of ICT research and development. From there, the method spread, gaining a specifically European version as a user-centric development of the Open Innovation paradigm, based on the co-design of innovative ICT applications in local, often rural, communities.

Initially regarded only as micro-level test beds, Living Labs are currently evolving into new regional learning environments and macro-level innovation ecosystems. According to Wessner (2007), innovation ecosystems capture actors like large and small businesses, universities, research institutes and laboratories, intermediating organisations, as well as venture capital firms and financial markets. In the innovation ecosystems, knowledge and innovation are created and brought to market with the help of public policies that strengthen the links within the innovation ecosystem and improve innovation-led growth. Also rules, regulations, and incentives as well as shared social norms and value systems are crucial variables of innovation ecosystems. In Laurea, the Living Lab approach has been developed and implemented from micro level to the most extreme macro-level in parallel to the practice-based LbD action model enhancement.

The integrative LbD model has gradually been evolving since early 2003 in resonance with the KT and such "transdiscursive" (Miettinen, 2002) concepts as the Knowledge Creation Mode 2 (Gibbons et al., 2008), the Triple Helix of Academia, Industry and State (Etzkowitz &Leydesdorff, 1998), the Entrepreneurial University (Etzkowitz, 2004), the Science II (Hollingsworth & Müller, 2008), The Living Laboratories (ENoLL), the National Innovation System (Miettinen, 2002; Lundvall & Borras, 2005), the Regional Innovation System (Kautonen, 2006) and the Innovation Ecosystem (Bahrami &Evans, 1995; Wessner, 2007; Hämäläinen 2005, 2006, 2007) (Hirvikoski 2009).

The axiomatic nature of the innovation system and Triple Helix has been, however, criticized by Miettinen (2002). He argues that these concepts are "loose" and lack scientific preciseness; nevertheless, these "transdiscursive" terms are powerful when used to reorganize and guide discourses within research communities and in policymaking. Their emergence and development is dependent on the interaction between the two.

2.2 LbD Action Model by Laurea UAS

Laurea UAS has a nine-year continuous tenure as a Centre of Excellence as nominated by the National Evaluation Council due to its student-centred LbD action model integrating RDI with learning and regional development. "The LbD action models views

learning as a tool for achieving competence, which in turn is demonstrated as new ways of action. Lbd provides students and lecturers with genuine encounters with the changing requirements of working life and a collaboration model for functioning as innovative partners" (Raij & Niinistö-Sivuranta, 2011, 6).

The LbD model has been collectively developed and applied within Laurea and with its regional and international partners, and its development still continues as an educational, managerial or service innovation, depending on the context and viewpoint of its user. Today, through Laurea's shared leadership practices, the entire university with its almost 8,000 students and staff members and their personal connections with the world of work, is mobilised to the collaborative RDI.

The LbD model, in conjunction with the LivingLab approach is based on innovation co-creation among various stakeholders within the Helsinki Metropolitan area and internationally. Or, as Pirinen (2012) defines it: "the integrative model refers to the student-centred integration of higher education, research and development (R&D) and regional development in the viewpoint of actualizations of study units with funded R&D projects and within regional R&D actors such as regional innovation system and clusters."

Consequently, Laurea became an active participant in the international project field of business, security and eHealth research. Laurea offers a broad range of research related to service business and is already prominent in the international forums of service design, user centricity, and customer focus.

2.3 Lbd Action Model has its roots in Pragmatism

The LbD model has its roots in pragmatism (Dewey, 1929), which is an action-oriented philosophy of science, viewing reality in the state of constant transformation, and man as an active conductor of transformation, either by thought or action. In the frame of Burrell and Morgan's (1979 in Taatila & Raij, 2011) interpretative and functional paradigms of social sciences, the LbD model was perceived to fall into the category of interpretative paradigm, which "sees the social world as an ever changing place", where "students should learn the process of discovery and self-sufficiency as much as the facts that are discovered" (Taatila & Raij, 2011, 832).

Laurea's strategic choice to integrate regional development, education and RDI led to renewals in designing its educational, research and managerial activities. As a consequence, a new competence-based curriculum (Kallioinen, 2007) and the LbD action model were developed and implemented in practice at the Laurea Living Labs Network (including e.g. SID BarLaurea, Redlab, SID lab networks, SID lab security and, Active Life Village, CIDE, Medical and Care Simulation Centre, Laurea Business Centre, P2P).

As the mission of UASs is praxis–oriented, the curriculum defines competence as the integration of knowing, understanding, acting and situation management, including knowledge written in theories and models, or embedded in skills and abilities, as well as moral knowledge and experiential knowledge (Raij & Niinistö-Sivuranta, 2011).

Through the joint international RDI projects, the domestic and international students benefit from an interesting and competitive learning environment that boosts

their professional and academic career progress. The LbD model focuses on learning outcomes for the highly skilled, creative, enterprising and flexible workforce with critical thinking capabilities. Prominently, according to the national statistics, the LbD has provided Laurea graduates with great employment and start-up opportunities.

2.4 The collaborative LbD as a living laboratory or an "orchestration table"

Based on Laurea's experiences, it is evident that a HEI can play a crucial role in formulating and implementing regional innovation strategies in partnership with the local authorities, businesses and citizens.

Metaphorically, the collaborative LbD projects operate as regional learning living laboratories, which can be associated with an orchestration table (Figure 1), around which the different players, such as public, corporate and third-sector actors, as well as universities together with end-users gather in order to swarm around the common phenomena and problems. Apart from the actual RDI work, the integrative process consists of social interaction, knowledge sharing, collective intelligence, learning and problem solving, and the build-up of related sheared meanings. In the Living Labs, the co-creation of innovation and innovative activities bring the concepts of science close to citizens and the users' real-life expertise close to researchers, designers and politicians. Also, the stakeholders' roles as designers, researchers, enablers, or users can vary depending on the project type.

Throughout the feedback loops between the collaboration stages of interlinked university and UAS-driven RDI projects, commercialisation and innovation policy, additional, systemic learning and changes may follow both in the wider society or industrial clusters.

In all this, the students are equal partners, developing and creating new professional knowledge and skills whilst growing towards their own fullest potential as human beings. As there is a constant demand for self-organising actions, the model fosters creativity, entrepreneurial competences and critical thinking. Consequently, together they form the bases for learning regional Living labs and people-driven dynamic societies that do not shy away from the challenges but rather organise themselves around them. (Kantola & Hirvikoski, 2012)

Through its internationally funded projects and by operating as an orchestration table, Laurea can offer its best co-operation capability also to the international partners and consequently an access to one of the world's most competitive and advanced metropolitan areas. As a result of these principles and in accordance with the regional Smart Specialisation strategy, HEIs in various countries can foster the enriching and mutual cooperation between their regions and their regional learning Living Labs.

Laurea aspires, together with its regional and international partners, to construct better RDI results and improve their commercialisation and usage in organisations and within society. The RDI results, co-created within the frame of LdD, may be turned into innovative marketable products and services by the corporate sector, whereas the public sector may utilise them in their strategies and operations.

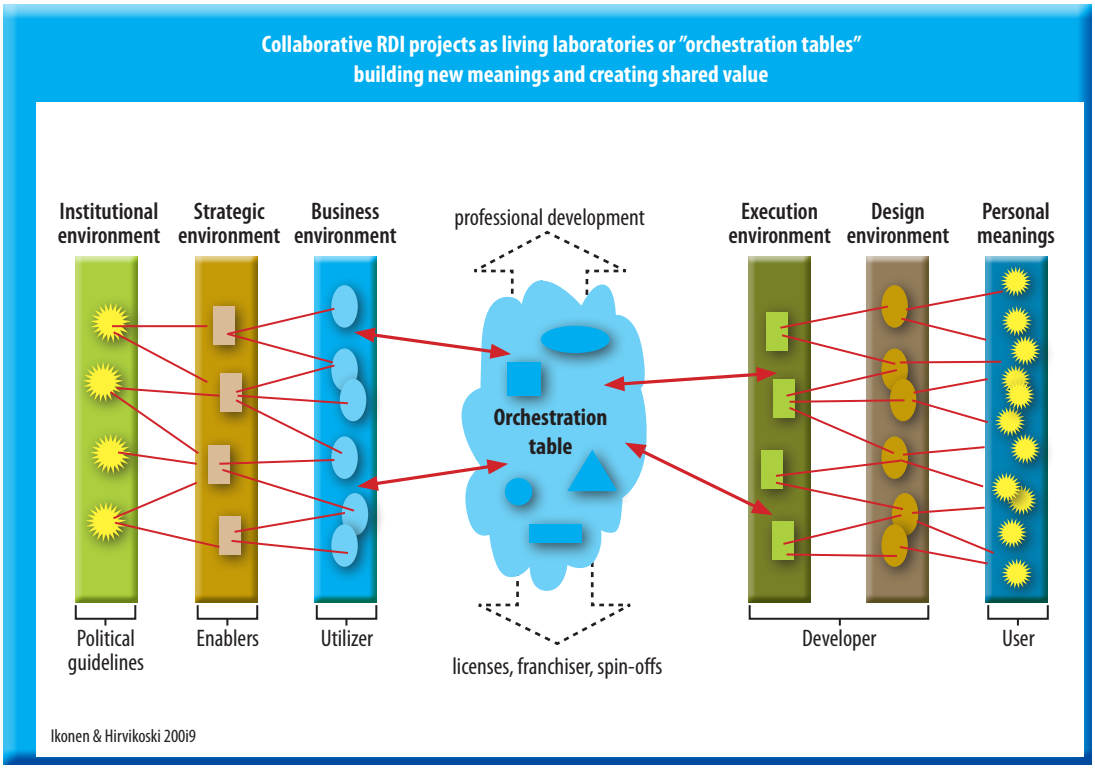

Figure 1. Collaborative RDI projects as living laboratories or "orchestration tables" building new meanings and creating shared value.

2.5 The stages of the LbD wheel

From the point of view of learning, the development projects, rooted in the world of work, reflect the ever-changing reality where learning takes place when participants create, cultivate and test new ways of action and new habits. The stages of the LbD are enabled by the new learning possibilities that are created as the RDI project progresses. The needed knowledge, skills and methodological tools are obtained, experimented and developed through diverse workshops and laboratory environments. The action model comprises the several complementary stages, as illustrated in Figure 2. (Raij & Niinistö-Sivuranta, 2011)

In partnership with the students, developers and researchers, the teachers prepare, organise, facilitate, implement and develop the LbD stages. As evaluators, teachers focus on competence evaluation and the project evaluation.

2.6 The collaborative development projects

The LbD assignments may originate from the Laurea RDI portfolio, with externally funded projects mobilising a wide range of local and international actors for joint problem-solving, and research and development work. These projects carry a sub-

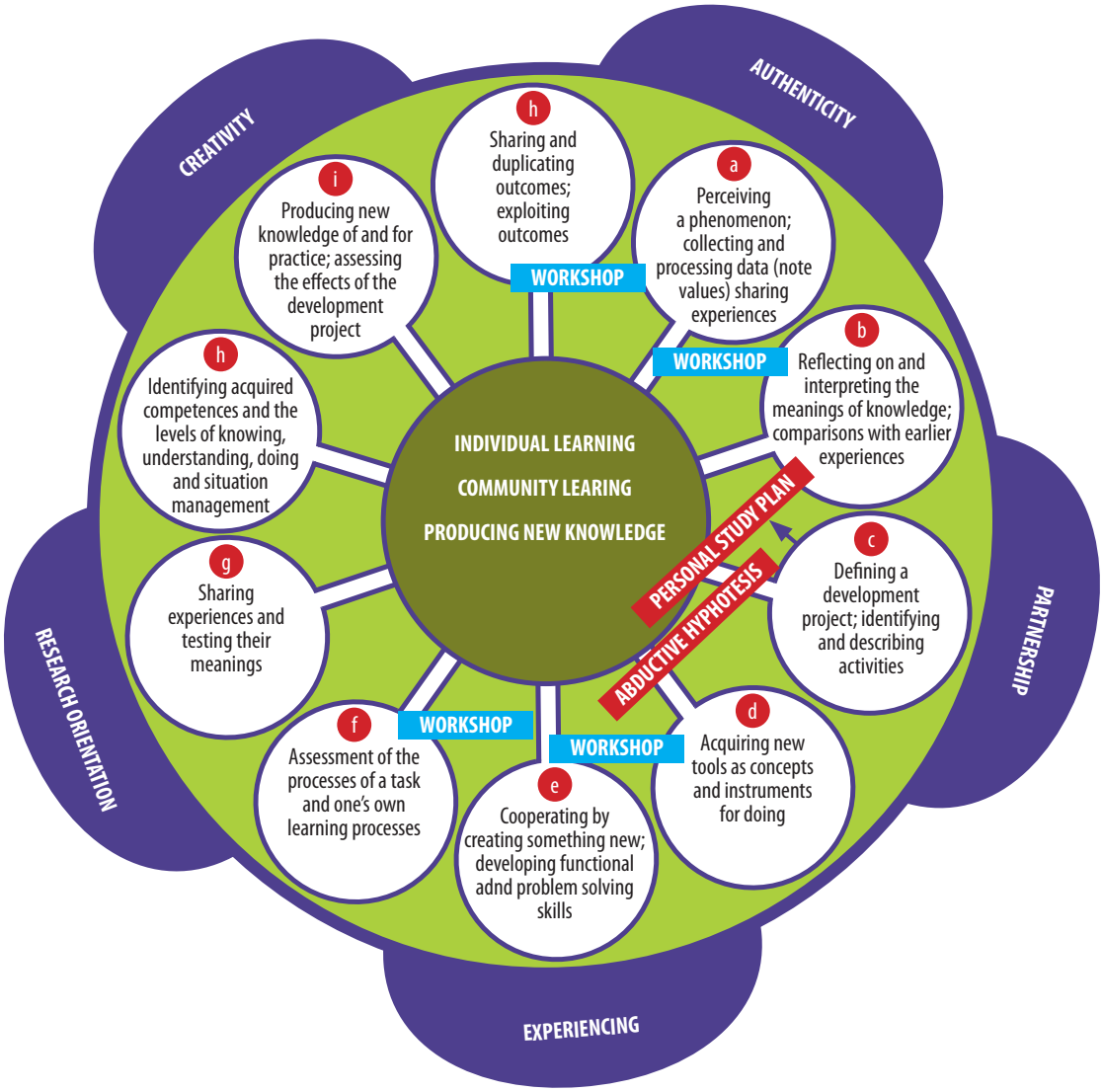

Figure 2. The stages in the LbD wheel (Raij et Niinistö-Sivuranta, 2011)

stantial amount of leveraging power for developing e.g. new service innovations (such as the Caring TV® or the People Value Canvas presented by the Express2Connect are examples of the Local Digital Agenda) or boosting socio-economic progress in Helsinki Metropolitan area's sub-regions (e.g. Koulii and Symbio Living Lab). The externally funded RDI projects also operate as a long-term learning environment and bases for the regional competence development continuum.

The LbD projects may also serve as minor knowledge-producing commission and joint-learning activities, originating usually from one firm, public organisation or third-sector player. If successful, these commissions often lead to a productive partnership between Laurea and its client organisation. This has been the case e.g. when conducting LbD pedagogy in the clinical contexts together with the Helsinki University Central Hospital (HUCH) (Aholaakko, 2011).

It is in accordance with the LbD principles that successful projects also originate with students and citizens. In the security and ICT project, SATERISK, the idea and foundation were elaborated by Laurea students and further led to a long-term international RDI collaboration with European firms and authorities. Today, SATERISK is merely one project in a wide range of externally-funded project ecosystems (see more in detail Pirinen 2012).

As partner organisations are pivotal for LbD, Laurea Business Lab has initiated a partnership programme to manage its local partners. As a consequence, the business students successfully deepen the partnerships on behalf of the university, whilst the programme syllabus supports student's' experiential learning. Moreover, "the Lab represents a hybrid model of partnership management", a model which enables centrally managed relationship programme coexisting 'with dispersed, private partnerships'". (Ylikoski & Kortelainen, 2012, 355)

2.7 Open and user-driven innovation

Many Laurea LbD projects fall into the category of open innovation (Chesbrough, 2006) or demand- and user-driven innovations (von Hippel, 2005), where firms and public organisations develop, experiment and pilot with customers for new products, services and businesses and citizens improve their living conditions (e.g. Loppukiri in Helsinki). In the open and user-driven RDI, LbD applies e.g. action research, ethnographical methods, service design, participatory observation, interviews and focus group methods. Laurea researchers have also widely contributed to theoretical and methodological development in this field.

As a consequence of open and user-driven innovation processes, each and every individual can also learn to innovate. This is important because in the era of innovation democratisation calling for a variety of complementary innovations, there is no monopoly but many innovations have seen daylight thanks to everyday laymen actions. This argument is supported by the Innovation Europe survey (2004), according to which only some 4% of innovations are based on academic research whilst the most significant sources of innovation are customer contacts, company networks and the like. Moreover, an on-going survey by Von Hippel (2010, in Kulkki 2012) indicates that 70% of innovations come from the markets and customers.

Based on Rogers' (2003) innovation adopter categorization, this paper suggests that learning to innovate may also be vital for generating new markets and behavioural patterns in the civic society, as those who learned to innovate, may either become the "leader-users" that create new ways of consuming and solving problems, or they may join the "early majority" adopting novelties. In the long term, models like LbD might help the HEIs not only to produce a high level of education but also improve citizens' innovation competences, i.e. grasping the essence of a problem, exploring the problem at hand in wider contexts, drawing conclusions from observations, visualising the possible solutions so that others can follow, and acting on them.

With the help of distributed leadership, people equipped with these competences and a strong intent, form the core of the people-centred, self-renewal societies and

working organisations, where individuals contribute to the sustainable and all-inclusive growth and development for a better world.

3. Conclusions

This paper advocates that the LL and the LbD models together epitomise the KT-related transformation in designing education, research and management in UASs. Moreover, together they operate collaborative RDI and joint value creation mechanisms or "orchestration tables" in their regions.

Based on the case university's (Laurea UAS) experiences since early 2000 and the related evaluation results, it is argued that collaborative RDI projects can be successfully orchestrated in a multi-stakeholder context. Most importantly, the student-centred model provides an attractive multi-dimensional learning environment for individuals, working organisations, regions and the wider society. The model has provided Laurea graduates with great employment and start-up opportunities.

This paper suggests that throughout models such as LbD and LL, higher education can contribute to open and user-driven innovation and the development of people-centred self-renewal societies and working organisations.

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About the author

Tuija Hirvikoski has earned a PhD in Industrial Management (Innovation and Innovation Ecosystems), an MSc in Education and an MSc in Administration. Her research interests center on the Finnish education and innovation ecosystems as well as creativity and innovation. As a director at Laurea University of Applied Sciences, she is responsible for export and the internationalisation of Laurea's research and development operations. Since the early 1990s, Hirvikoski has played a vital role in enriching the Helsinki metropolitan area's joint value co-creation among universities, companies and the public sector. She has promoted cross-border co-operation related to user-centred and knowledge-intensive innovation ecosystems through, for example, Finnish technology centres, European Network of Living Labs, Sendai-Finland Wellbeing Centre, Helsinki Information Technology Association and the talent cultivation program for Smart Living Industry in Taiwan.

Ellen Sjoer
Senior Researcher, Delft University of Technology
e.sjoer@tudelft.nl

Bente Nørgaard
Head of Section, Aalborg University
bente@plan.aau.dk

Marc Goossens
Director & Executive Officer, European Society for Engineers and Industrialists (SEII)
seiimg@abuco-consult.com

IV. Drivers and Barriers in Implementing the Knowledge Triangle

Abstract

The fierce European efforts to reform the university system stem from growing awareness that an efficient orchestration of education, research and innovation, the three corners of the Knowledge Triangle, is critical for societal and economic change. Continuing Education forms one of the most important ways in which the Knowledge Triangle serves both individuals and organizations in today's industrial fabric. It appears that actor-constructed – or tailor-made – Continuing Engineering Education (TM-CEE) is one way for universities to play their central role in linking together research, education and innovation. But, some barriers have to be broken down, efficient drivers have to be found and a specific methodology has to be implemented.

This article considers the various aspects of Continuing Engineering Education (CEE), in relationship with the expected evolution of universities and the need for sustainable development. It shares two stories of TM-CEE addressing small and medium-sized enterprises, one from the Netherlands (Sjoer, 2011) and the other one from Denmark (Nørgaard, 2012), describes the collaborative process of negotiating and designing the courses, and brings out different perceptions of the reality of such a collaboration. By identifying the main barriers and the key drivers of TM-CEE courses development, it shows that, from this viewpoint, the Knowledge Triangle can be used as a conceptual tool and leads to some conclusions about the different forms of TM-CEE and the ways they can best be implemented.

Keywords: best practices, learning process, lifelong learning, future role of universities, sustainable development, tailor-made continuing engineering education (TM-CEE)

1. Introduction – Are Traditional Universities Endangered?

Recently, some researchers (Drucker, 1997; Tapscott, 2009) have predicted that "traditional" universities are at the dawn of demise and will soon be relics of the past. They based their prediction on the outbreak of what they called the "digital generation". Their view is probably exaggerated: there is little doubt, however, that universities will have to adopt new ways of providing their students with the always changing and increasing knowledge that governs the sustainable development of our well-being. New pedagogical concepts for facilitating professional development form part of these new ways. Large universities that regard their prime role to be a centre for research, with teaching and yielding value out of knowledge as an inconvenient afterthought, could be endangered.

Kant argued in one of his latest works (1798) that *"Universities should handle the entire content of learning by mass production, so to speak, by a division of labour, so that for every branch of the sciences there would be a public teacher or professor appointed as its trustee"*. One century later, this concept was to be restated and applied to industry by Frederick W. Taylor, with his famous division of labour, which put its stamp on the Industrial Age.

A new era has now begun, an Age of Knowledge, in which the key strategic resource necessary for prosperity has become knowledge, that is, educated people and their ideas. The main drivers are globalization, multiculturalism and the Internet. In the light of this new era, universities can be seen as widespread organizations that are at the core of the innovation web; they possess a reservoir of examined knowledge and have each year an influx of new students, "young brains", who can challenge the incumbent staff and contribute to innovation through using real-life case studies.

But, unfortunately, this knowledge reservoir is not fully benefited from by European universities. Further, as European universities are not acknowledged for their cooperation with industry, one can wonder what the practical use of academic research in Europe is.

So as to respond to these developments, universities will have to rely on a networking process: not only at university level, both globally between various universities and internally between their various departments, but also with industrial companies – often small- and medium-sized enterprises (SMEs) – with governmental institutions (the Triple Helix model) and maybe also with the civil society (the Quadruple Helix model). This networking process can be viewed as an amoeba and existing institutions may adopt different roles.

It is in order to foster this major change in European universities and enhance Europe's competitiveness that the concept of the Knowledge Triangle has been introduced by the Lisbon Agenda at the dawn of the 21st century.

1.2 The Knowledge Triangle

1.2.1. What Does the Knowledge Triangle imply?

The Knowledge Triangle is particularly useful as a conceptual tool for thinking up these new ways. It links together Research, Education and Innovation, with special platforms and processes on its three sides and orchestration tools at its heart, as illustrated in Figure 1.

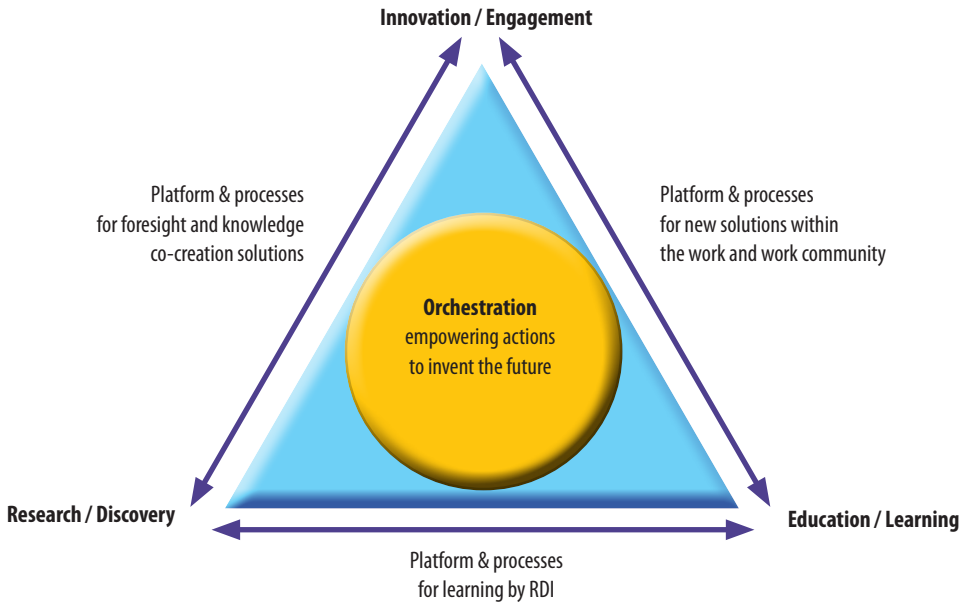

Figure 1. The Knowledge Triangle, adapted from Markkula (2011).

It replaces the traditional one-way flow of information from research to education and from educators to students, by a two-way circular motion between the three corners of a triangle that, besides research and education, also includes innovation, which is the "poor relation" of many universities.

Recently, insights have been voiced about ways in which Higher Education Institutions (HEI) are being asked to respond more directly to the social and economic needs of their ecosystem by building on a Triple Helix of innovation and on the Knowledge Triangle (Hazelkorm, 2010).

1.2.2. Three Generic Strategies in the Knowledge Triangle

How are we to interpret the two-way circular motion between the three corners of the Knowledge Triangle? (Tangjaer, 2009) summarizes three generic strategies to that effect:

- a strategy of transmission, from one part to another, where universities broadcast knowledge in order to accelerate its use (e.g. through curricula and conferences),

- a strategy of translation, where universities mediate knowledge, adapting it to a specific use in a practical context (e.g. consultancy) and
- a strategy of transformation, where universities manipulate knowledge in order to shape a given practical or theoretical knowledge for new use.

Whichever the strategy, its formulation must include some information about the university, such as:

- Identity: competences, specificities, mission within the Knowledge Triangle.
- Localization: creating meeting places or hubs, adapting and putting the Knowledge Triangle into effect in the university environment.
- Learning: having a portfolio of projects (as they will not all succeed), creating new competencies.
- Structures: a network that is open to all stakeholders.
- Politics: finding the right alliances and operating in the right arenas.

2. Characteristics of TM-CEE

2.1 Historical Background

In 1996, the OECD published its "Lifelong Learning for All" approach, along with the slogan "from cradle to grave". The same ideology was adopted for the European Year of Lifelong Learning, which had a major political impact at European level by placing lifelong learning in the centre of the stage. The plans of action "Leonardo da Vinci" and 'Socrates' were adopted along with the continuation of the European Social Fond (ESF) – these actions should contribute to and ensure high quality of education. The European Union's contribution to the global debate on lifelong learning was characterized by the same broad "from cradle to grave" approach as the OECD's. Decision nr. 95/2493/EF stated that "The purpose is to encourage personal development and initiative, their integration in the workplace and in society, their participation in democratic decision making and their requirements to adapt to economic, technological and social change". In May 2009 the European Council adopted the strategic framework for European Cooperation in Education and Training (ET 2020), in which one of the four long-term strategic objectives is "making lifelong learning (and mobility) a reality" which translated into the EU-level benchmark indicators that are set to foresee "an average of at least 15% of adults (age group 25–64) participating in lifelong learning" by 2020.

2.2 Positioning TM-CEE

In the framework of cooperation between universities and industry, Continuing Engineering Education (CEE) is not just a collateral way of spreading knowledge, which universities might or might not adopt and practise, but forms part of a global and inescapable process of lifelong learning that universities will have to tackle if they want to develop their role in society.

This also applies to industry and to other stakeholders of the Knowledge Triangle:

- Professional engineers have a continuous need to update and renew their knowledge: CEE is no longer optional.
- Providers of CEE must continuously adapt in a proactive way to the quickly changing needs of their lifelong customers.
- As symbolized by the Knowledge Triangle, CEE is under an obligation to lead to concrete results for society (innovation).

During the last decades, research on CEE in company context has resulted in different best practices. Larsen (2002) argued that "learning at the workplace is often a more effective, more flexible and more economical alternative than to be put on a school bench and, moreover, research shows that, in many cases, people learn more, precisely, from on-the-job learning". This article narrows down the above concepts to courses that are individually designed to match company strategy and meet employee preferences for competence development. As CEE is expensive and time consuming, it is important for most businesses to find courses that fulfil their needs as far as possible. Such courses are labelled her as TM-CEE courses.

In essence, this article aims to address the following key issues pertinent to TM-CEE:

- What is it in theory, from the Knowledge Triangle viewpoint?
- How does it work in practice? And what are the drivers and barriers in this form of cooperation between universities and enterprises?

2.3 Key Themes in Developing TM-CEE

Before describing some key themes in the development of **tailor-made** CEE, its main difference with customized CEE (Nørgaard & Fink, 2008) must be underlined. In the latter activity, the education supplier starts with a programme, or a set of programmes, which he has at his disposal, and adapt it to the needs of a particular customer or of a certain category of customers; a thorough collaboration process between the two parties is not necessary and is often left out. In TM-CEE, on the contrary, the education supplier starts with an analysis of its customer's or partner's competence needs and builds a programme that responds to these needs, even if it has to look elsewhere for a part of that programme. A thorough collaboration process is absolutely necessary.

In developing TM-CEE, some key points are to be considered:

- In most CEE programmes, even customized ones, the knowledge provider offer curricula that are conceived for individual participants, and, if these participants work in a company, it is up to them to see that the knowledge gained benefits their company (which is what most of them fail to do). On the contrary, in TM-CEE, the company and the knowledge provider agree on definite learning outcomes ant it is the company itself which delegates some of its engineers to act as **co-creators of knowledge;** so, it is up to these

engineers to prove equal to their company's expectations. In other words, TM-CEE offers to companies a better control of the learning process and exerts higher pressure on both the participating engineers and the academic partner to show results (this implies a shared responsibility).
- TM-CEE can create a synergy between the tacit knowledge of both partners, in addition to the usual exchange of explicit knowledge, in the meaning expressed by Nonaka (Nonaka et al, 1991 & 2008).
- TM-CEE is essentially a mode of production of knowledge based on diversity networks, where problems calling for knowledge are defined in terms of their application, not within a well-defined domain of **scientific** knowledge, and where usability is more important than validity.
- In terms of strategy in the context of the Knowledge Triangle, TM-CEE corresponds much more to a strategy of translation than to a strategy of transmission (see section 1.2.2.) and, as such, can help universities to implement their strategy of transformation.
- TM-CEE can more easily put the emphasis on learning skills, research methods and problem-solving techniques; it can also generate less resistance to change.

2.4 The Role of Universities in the Knowledge Triangle

Universities possess excellent assets that can contribute to TM-CEE implementations in the context of the Knowledge Triangle. They are able to detect weak signals, as defined and explored by Hiltunen (2010), and so help companies to more effectively develop their strategies, as participants in TM-CEE are confronted with the weak signals at an earlier stage (research-innovation platform). Industrial companies, in contrast to universities, have no easy access to the required and most value-adding tools to meet most of their competence needs. By implementing TM-CEE, education contributes more strongly to innovation (innovation-education platform). Cooperation between enterprises and universities through TM-EE helps to put research results into practice, an issue that brings out the need for new research-based knowledge and for new and better concepts for using both existing and new knowledge. These new ways of knowledge co-creation will provide the regional industrial fabric with indisputable competitive advantages (research-education and research-innovation platforms).

One might therefore wonder why universities, with their great potential both in knowledge and in experienced staff, have not yet succeeded in an activity where many private training companies have been thriving for many years. Two practical cases, one from the Netherlands (Sjoer, 2011) and the other one from Denmark (Nørgaard, 2012) will help establish that TM-CEE could offer an essential way for universities to materialize their important role in the ecosystem, compensating that way for the lack of good examples of what the Knowledge Triangle means in university practice and how its principles are applied in real-life cases.

3. A Case Study from the Netherlands

This section presents a practical example showcasing such activity in the Netherlands at the Delft University of Technology, in partnership with the University of Limerick (Ireland), the Instituto Andaluz de Tecnología (Spain), the Wroclaw University of Technology (Poland), the Università di Palermo (Italy) and ICDC, a knowledge-broker between universities, organizations and enterprises (Sweden). The project aimed to provide engineers in small and medium-sized enterprises (SMEs) with blended learning in Robust Design Methodologies (RDMs), which aim at lowering the variations in processes and products.

The principles and theoretical development of Robust Design Methodology, and its practical implications for industry, have been broadly investigated in scientific journals, books and conferences. However, results from regional surveys reflect the scarce use of such a methodology in European industrial companies, even if most of them recognize its strategic importance (Germyr et al, 2003; Antony, 2002). This limited use in European SMEs, as compared with the USA and Japan, is a serious problem, since SMEs are of strategic importance for Europe's competitiveness and the use of RDM has proved its capability in improving their operational productivity and efficiency – and thereby saved money – in different industrial sectors. Therefore, the aforementioned universities applied for a European grant in the call for Lifelong Learning.

In this project, called LearnRDM, an extended needs analysis was conducted in order to determine the use and perception of RDM on the one hand, and the characteristics of learning at the workplace on the other, of SMEs in the manufacturing industry, using a questionnaire and conducting 47 in-depth interviews. On the basis of the results, the need for and the interest in developing a strategy for the robustness of processes and products in such companies became clear and, in the next step, a flexible learning model was devised and tailored to support the individual requirements of each of them. It was tested in 75 companies (Sjoer et al, 2010). This case focuses on the question: **"How does TM-CEE work in this case (from a Knowledge Triangle viewpoint) and what are the drivers and barriers, in a pedagogical perspective, in this form of cooperation between universities and businesses?"**

In short, the main barriers identified in the survey were the following:

- RDM is perceived by SMEs as an academic methodology, difficult to apply in an industrial context.
- RDM being based on statistical methods, which are not much used in most companies (particularly in the field of process/product design), European SMEs do not feel capable of quickly launching an RDM project (e.g., respondents in Sweden were not interested in learning basics in statistics in order to implement RDM).
- SMEs regard communication with the academic world as necessary, but they perceive it as "not simple".

- SMEs also regard the necessity of identifying and measuring the critical parameters for the process, and of designing the experiments, as the main obstacles to the diffusion of RDM.
- The involved academic staff found that European SMEs are "extremely goal oriented", i.e. they focus on producing and delivering their products in time; this is why most of them think that RDM will increase the delivery time, the workload and the cost of investments.
- The academic staff also learned that the working environment is often hectic, with employees being frequently interrupted, which makes working together more difficult.
- The 47 interviews with engineers and managers in SMEs revealed that they were not used to a systematic approach to learning, e.g. aligning business goals with learning objectives, and hence to searching for learning offerings or, in Knowledge Triangle terms, learning partners or networks. Formal courses have their preference, since there is time for learning, personal contacts and feedback, although, as also recognized by other sources, transferring and using the acquired knowledge at work is often a problem.

From the point of view of the Knowledge Triangle, it is clear that the proposed **innovation** with the involvement of the university is not likely to succeed. Learning is seen by engineers and managers in SMEs as an individual activity, instead of a cooperative undertaking with external partners; it is perceived as having to be a self-study or an external course or workshop; and when this is not possible, additional staff with the necessary knowledge should be hired. Furthermore, they prefer "home-grown solutions", although there are also some good examples of cooperating solutions, as "running in packs". Another important issue is that they perceive no real need for learning or doing research in cooperation with the university.

The academic staff involved in the project showed fixed ideas about how useful RDM could be for this sector and about what a course should look like. They possess high-quality knowledge, recorded in articles and books. They believe that all that is needed is to show how valuable and useful that content can be, and to transform it into practical work. It was interesting to see how they dealt with the results of the survey: most of them wanted to hold on to some basic – or statistical – knowledge, when others wanted to make it more attractive by adding case studies. The problem is clear: too much focus on the content, no knowledge of the learning processes of adults, a rather old-fashioned idea of e-learning (both among professors and company engineers); in short, there was, to begin with, no real basis for learning and innovating together.

Nevertheless, the project turned out to be a success, because of both the flexibility that was built in the pedagogy, and the establishment of a relationship between university and industry. In the next step of the project, a flexible learning model based on the following principles was devised: first, the learning goals should be matched with the business strategy of the SMEs and the delivery method should be derived from these goals; second, an authentic assignment should form the core of the learning model, so that the next step might be the formulation of a pilot project; and third,

the requirements for offline and online (cooperative) facilitation would have to be determined. The problem is that, in SMEs, there is a lack of time and attention to think and conceptualize methods enabling engineers to accomplish tasks differently the next time. In the learning offerings, the blended learning model should support the business goals and provide the opportunity to complete a learning cycle.

Pedagogies (in intake, pilot project, coaching and mentoring) were implemented in different ways from one stage to another. Various plans were executed. Some participants worked with an improvement project for their own company, others benefited from a learning arrangement completely online. A positive issue is that all actors agreed on a truly different way of working together. The words they applied and the views they harnessed about learning, innovating and conducting research moved on slightly in the way described in literature about the Knowledge Triangle and open innovation. Yet, many aspects can be improved. The learning environment should focus even more on the learning process of actors instead of its content. A suggestion was made to establish the learning goals or any need in a community of practice. Let the participants interact through a forum or via social media, and that should be the starting point to any content – either from universities or from other partners. Conversations and content could be tagged, so relations can be demonstrated between content and conversations even without anyone explicitly marking down their relation. The university staff might want to focus on moderating this dialogue, for instance, to consider the incentives to encourage participants to ask questions. To make the platforms of the Knowledge Triangle sustainable, awareness has to grow to help all parties understand that both universities and industry have much to learn from a joint innovation activity, and that their work, on both sides, could benefit from it, provided that they could together identify ways of supporting, accepting and implementing the learning and innovation process in the workflow of all future users.

4. A Case Study from Denmark

4.1 Background

At the Aalborg University CPD (Continuing Professional Development) Unit, TM-CE courses have gained ground during the past 10 years. Interviews conducted between 2000 and 2008 revealed that businesses lacked time for traditional continuing education and, on that account, they required courses designed to match their specific needs in order to save time. In today's tougher economy, it has become important for businesses to find continuing education courses that can equip employees with the exact skills they need, in a cost-effective way. The old saying "When business is busy, there's plenty of money but no time – and when there is time, there is no money" has certainly materialized. Regardless of the reason – money or no money; time or no time – TM-CE courses are in demand. The CPD-Unit made a subsequent attempt to meet the demand by developing a concept for TM-CE courses, inspired by the Aalborg PBL-Model (Kolmos, 2004). The challenge, however, was to use a modified PBL concept in order to combine professional learning (informal) with academic learning

(formal). In the overall conclusions of theit research about learning at the workplace, (Ellström & Høyrup, 2007) pointed out thet "the most effective on-the-job learning takes place when formal and informal learning are integrated".

The emerging concept was called Facilitated Work Based Learning (FWBL). It evolved during the years 2001 to 2007 as a spin-off from different pilot projects on continuing education: see for instance (Fink et al, 2005). During collaboration with businesses, it became obvious that a similarity existed between the Aalborg PBL Model and the way businesses develop products through problem-oriented and project-organized processes. An idea was developed to involve academic staff from Aalborg University (AAU) to act as initiators and facilitators in company in-house projects identically with student projects at university. The idea was to encourage knowledge transfer and build-up facilitating learning processes related to employees' everyday work; not to help them complete their project but to develop the related competences. The devised concept was FWBL and an attempt was made to describe it as a five-phase process covering the entire course from the initial contact with the business to the evaluation of the learning objectives. This case study starts by digging deeper into the concept of FWBL. Next comes the application of the concept in the Via Nord project with SMEs in Denmark. Then, the results are compared with another European project on competence development in SMEs. And finally, the drivers and barriers of TM-CE courses are identified in the Conclusions section.

4.2 Methodology

The research frame in this article is inspired by action research (Lewin, 1946), where facilitating action and reflection on action are the foci. Action research is a participatory process. As (Czarniawska, 2007) points out "action research requires a detailed and in depth study of the cases by introducing different techniques for doing fieldwork". The different techniques adopted to collect the data consisted primarily of interviews and discussions, and secondarily observations, e-mail correspondence between the actors of the cases, and data of a more descriptive character. Finally, statistical data were calculated on the cases in process. The criteria for validity and reliability in this research process followed the principle that the results of the research were valid and reliable if they were recognisable and authentic to the people involved in the research, even if not to others (Zuber-Skerrit & Fletcher, 2007).

4.3 Facilitated Work-Based Learning

FWBL typically follows five progressive phases. However, the content of each phase was not clear-cut for all FWBL courses, as the distinctive trait of FWBL is their individualities. The FWBL courses are designed not only to match the competence needs of the company but also to meet the preferences of the individual employee. FWBL can be characterized as a partnership between three parties – the company, the learners and the university. This partnership is important for the success of the FWBL course. All partners are equally responsible, which means that commitment from all is essential. This fits well into the Knowledge Triangle concept that is high on the European

2020 agenda and also the focal theme of this publication, in this that each of the three actors represents one dimension of the Knowledge Triangle

The five progressive phases of FWBL process are as follows:

1. Forming contacts

The contact between a company and the university is often new for both parties, or at least the situation might involve novices in the field. To ensure a fruitful collaboration, it is highly important to make sure everyone is involved and in agreement. Therefore, the time spent on harmonizing wishes, expectations and requests is often well spent.

2. Defining the learning objectives

The process of defining the learning objectives is essential to the success of the FWBL course. The academic staff will, in dialogue with the strategic management, identify the specific learning objectives for the process.

3. Drawing the learning contract

The learning contract is negotiated and signed by all three partners to create a feeling of ownership and to commit all on an equal basis. The learning contract will, as a minimum, consist of:

- a description of a theme or project to which the course is connected
- a definition of learning objectives
- an agreement on the methods
- an agreement on the time frame
- a definition of the success criteria for the learning process
- a description of the process and the evaluation

4. Implementing FWBL

When the learning contract is signed, the FWBL course is ready to begin. The contents, scope, substantive area, and time frame of the FWBL course depend on what the three partners agreed on.

5. Evaluating the outcomes

Evaluation will have two targets: first, to ensure the quality of the FWBL course and the learning process, and second, to make sure that the learning objectives are accomplished.

To further develop the concept of FWBL, the CPD Unit needed more experience. Owing to the good intentions from both the EU and the local municipality providing funding, in addition to the demand from businesses, funding for continuation was applied for to initiate the project "Viden i Anvendelse i Region Nordjylland" (acronym Via Nord). The overall goal of the project was to develop TM-CEE courses within three years in 80 SMEs located on the outskirts of Northern Jutland in Denmark. The idea was to introduce an FWBL concept where the company, employees and university staff collaboratively identified and negotiated learning outcomes that matched

the competence strategy of the company and at the same time fulfilled the preferences of the employees.

In retrospect, it was an ambitious goal – some may even say unrealistic. Nevertheless, the Via Nord project was launched but it soon became obvious that it would be a challenge involving SMEs in the collaboration processes, not to mention the academic staff at the university. The experiences with this concept in the project Via Nord are described below. The data were collected through interviews and discussions, observations, and e-mail correspondence between the actors, but with a constant focus on implementing changes by developing TM-CE courses

4.4 The Via Nord Project Set-up

This report covers the first three phases of FWBL: the contact phase, definition of the learning objects, and preparation of the learning contract. The Via Nord project was structured around three groups of partners: the SMEs, the Business Service, and AAU, each representing different roles in the project. The SMEs were identified as the end user and also the beneficiary of Via Nord, since the political incentive to support the project was to raise competence levels in the SMEs. To join, SMEs were required to comply with the criteria set by the European Commission which define an SME as an organization employing less than 250 employees, yielding an annual turnover not exceeding 50 million euros, and/or reporting a yearly balance sheet value that does not exceed 43 million euros. The SMEs should preferably be located on the outskirts of Northern Jutland since the grant requires 80% participation from rarely populated areas in periphery.

Business Service (BS) units are local organizations the task of which is to support trade in any possible way. Their tasks are defined in collaboration with the municipality and the local politician. BS units were important to the project because they had in-depth knowledge of the local SMEs, and Via Nord was regarded as yet another option for the BS to support the SMEs. With their knowledge of the local SMEs, the BS was able to rank the SMEs according to their suitability for and interest in joining Via Nord.

AAU, as the applicant, was the project manager and main driving force behind Via Nord. All the academic staff involved were AAU employees undertaking facilitation (teaching) and research in connection to the project. The heavy administration related to an EU-funded project (salary documentation, time scheduling, certification, reporting etc.) was also undertaken by AAU.

The description above of the three partner groups may mislead one to think that they were homogeneous groups with the same goals and interests but that is not the case. Within each partner group, there are numerous differences of interest, which made Via Nord an extremely complex project.

In October 2010, the project midway status report revealed decreased levels of optimism. By then the project had been moved from faculty level to administration level at AAU. Contrary to expectations, staff involvement faced challenges due to full-time employees having to balance between existing and new activities. Further, staff numbers had been cut from five to two, resulting in lack of secretarial support. More

devastatingly, as illustrated in Figure 2, only seven SMEs out of an initial population of more than 200, finally engaged in Via Nord, which was a huge drop-out (the figures in the squares are the number of SMEs involved at each activity level of the process).

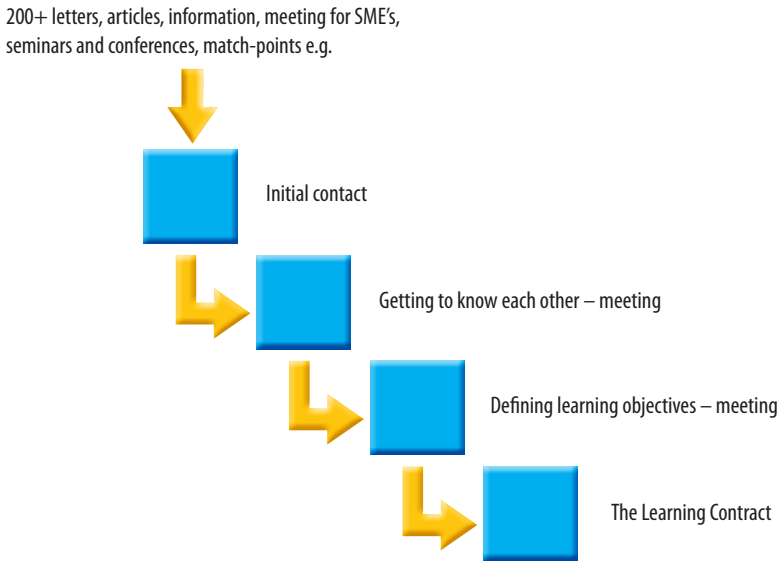

Figure 2. The number of SMEs in the first phases of the FWBL process in the Via Nord project.

In each of the four activity levels, different perceptions and realities of the collaboration process were identified. Each partner groups' (SME's, AAU and BS) involvement in the process is described below.

4.5 TM-CEE Courses: Project Goals and Identities

The purpose of Via Nord was more fragmented then merely increasing competence levels in SMEs. The different targets augmented in the three partner groups (SME's, Business Service units, and academic staff). For the SMEs, the purpose could be identified both for the SMEs as companies but also from the perspective of the employees, and these may not always match. An improvement in employee competences would only be the means of the target for most companies – their actual purpose would be increased earnings. The employees might also specify a different purpose besides competence development. Some might be forced by the employer to participate, others might see it as an opportunity to expand their knowledge and thereby enhance job security or their attractiveness in the labour market, either to apply for a new job or to be more qualified for the job they already had. But whatever the reason, the purpose must be clearly specified. Too many SMEs were not able to identify their needs but still they wanted a TM-CE course because it was a good deal – competence development for free was their target. None of them made it to the actual course because without clear course content and leaning objectives it is truly difficult to maintain the driving force to continue the process. (Illeris, 2009) emphasizes that acquisition is a matter of content and driving force (motivation, feelings and will):

"The learning content will always reflect the character of the psychical commitment which has mobilized the mental energy which is necessary for the learning process to take place." Furthermore, "adults are not likely to get involved in learning that they do not get the meaning of or that they have no interest in" (Ibid.). In other words, the purpose of TM-CE courses has to be 'need to know' instead of "nice to know".

The Business Service (BS) units also had different reasons for joining Via Nord; however, one common purpose for all of them was to provide services to SMEs in their local areas. But the ways in which they introduced the service was manifold. Only one of the BS had a strategy with an aim at promoting competence levels in their local areas and this particular BS was active in locating SMEs. They had acquired substantial knowledge of the SMEs, which was helpful in identifying SMEs for the project. Other BS had different agendas. They saw it as an opportunity to establish contacts with employees with higher education from 'liberal' businesses (law firm, dental clinic, surveyor etc.), which they had not had any previous contact with. The motivations of the academic staff were no less fragmented. But the purpose had to be viewed in light of some common barriers within the university structure, culture and processes. The incentive structure did not match such new activities as teaching continuing education. As the structure contained discouraging elements, it, on the contrary, prevented the activity. Even though AAU had a tradition of collaboration with the surrounding SMEs in the peripheries, it was not always able to see what they should "use" the AAU for. Finally, the university processes for running these kinds of projects were not yet fully developed.

Besides the more common barriers influencing the academic staff, there were several individual considerations. First of all, lack of time was probably the most common one since academic staff were already employed full-time by the university and therefore it would only load them further or it would reduce their time for research. Also, the task of collaboration with SMEs was new for many academic staff and caused some uncertainty, which also influenced the purpose. Some of the academic staff were keen to have student project groups to take on the job, which naturally fit much better into the incentive structure and would make more efficient use of time. In general, the academic staff were helpful and willing to participate at least in the first meeting with the SME, in spite of meager payment and a lack of time.

The activities within Via Nord also helped those involved assume new identities. The BS strengthened their identities as the consultants who brought the university to the SMEs and set up the meetings. The SMEs acquired an identity as companies collaborating with the university and the employees also took on a new identity as learners at their jobs. The academic staff had new identities as continuing education teachers, which, unfortunately, does not hold a high status at AAU due to the non-existing support of the area.

4.6 Barriers and Drivers

Conceptualizing the different worlds of TM-CE courses shows that what is possible in one world in not necessarily possible in another. The FWBL concept was introduced in the Via Nord project to 81 SMEs, but only seven actually took on the implementation.

The key characteristic determining the success of TM-CE courses was the ability to identify specific needs for competencies that could not be acquired through a traditional course. Furthermore, the integration of the TM-CE course into a development project in seemed predictive of positive outcomes in TM-CE course development. Finally, the involvement of employees and academic staff in goal setting promoted learning outcomes.

Other barriers and drivers are identified in the following listings.

1. The barriers identified

- University communication was overly academic and the interest of the SMEs was not their starting point.
- The university structure, culture and processes did not support the activity of teaching continuing engineering education.
- SMEs had difficulties identifying themselves with the concept, because of lack of knowledge and also as they found the start-up phase time consuming. They were more accustomed to course catalogs.
- SMEs had no strategy for competence development to connect the CEE activities to.
- Both parties reported bad experiences from previous collaborations.

2. The drivers identified

- The university tradition in collaborating with the community obliges the academic staff to contribute.
- The lack of time of the academic staff can be compensated for by involving student projects.
- Unmet needs for CEE in the traditional market open doors for tailored CEE.
- Local Business Services and municipalities can prove to be great partners if they engage in strategies that promote increased competence levels (higher education) in their areas.
- Tailored CEE projects allow the actors involved to assume new identities. An SME could view itself as a company that collaborated with the university, and a university teacher could regard him/herself as the faculty member that participated in continuing education activities.
- Heterogeneous actor groups with different styles bring added value in the academia – SME interface.

5. Lessons Learned

These field experiments yielded several lessons to learn, notably the about the nature and interpretation of the barriers that were met and of the drivers that were found. Nevertheless, when attempting to understand where the drivers and barriers in TM-CEE stem from, one needs to adopt a fundamental approach. According to Laborit (1974), the two most fundamental levers, or triggers are pleasure-seeking, on the

one hand, and fear, on the other hand, and it leads to the recognition of a dominant position. This means that human motivation is carved by fear and hope, the fear of losing a dominant position and the hope of gaining a more dominant one. So, when taking a decision significant for the future, and knowing that, due to the multiplicity of levels, strain will be caused by the clash between fear of discomfort and hope for a better, yet riskier future.

Another interesting approach for understanding the difficulties met in implementing TM-CEE is what (Spinosa et al, 1997) calls a "disclosive space": any organized set of practices for dealing with oneself, other people, and things that produces a relatively self-contained web of meanings. He also describes the three characteristics of a "world", as listed by Heidigger in "Being and Time" (1962), – namely equipment, purpose and identity – as "a totality of interrelated pieces of equipment, each used to carry out a specific task, undertaken as to achieve a certain purpose ; and, finally, this activity enables those performing it to have identities. Later, Dreyfus & Spinosa (1999) added a fourth characteristic, style, defined as "the way in which all the practices ultimately fit together, thanks to coordination, and so give grounds for making human activities meaningful".

This shows the importance of the role assigned to everyone in society and of the symbolism of the mask, as has been recently presented by (Goossens, 2011). This is also, maybe, why the greatest challenge in developing TM-CEE in universities will be to define and "flesh out" the role of the "Conductor", who is able to find the drivers, establish a trustful relationship between the parties and develop satisfactory solutions (see the centre of the Knowledge Triangle in Figure 1).

In a more pragmatic way, the barriers and drivers encountered in the implementation of TM-CEE can be divided into different categories, first whether they lie on the university side, on the company side, or in the relationship between both of them (the language difference, the gap between theoretical and professional approaches, and the difference in time perspective), and second whether they are linked with the real environment where the various actors have to operate, or with mental and often unconscious lack or failing that limits understanding the reality.

As a **first point** worth to be emphasized, the analysis of both cases revealed that many European industrial companies, particularly SMEs, do not have a long-term strategy, essentially because such a strategy concerns the future and the future is uncertain; it is therefore obvious that it cannot be determined on the basis of explicit knowledge. The rare top managers who define a long-term strategy do it on the basis of their tacit knowledge, a special blend of experience and intuition. But most of them claim that tacit knowledge is unreliable and that defining a long-term strategy is not worth the time and efforts it would require. As a result, defining learning objectives becomes extremely difficult and even unnecessary, because if only explicit knowledge matters, it is much easier, whenever there is a need for it, to invest in a formal course "à la carte". But, on the other side, deciding to develop TM-CEE in a university is also a question of strategy, which involves many administrative procedures, new staff, investments, etc.

A **second point** emerges from the Dutch case, where engineers in industry said that they had difficulty understanding the statistical language used in RDM. This is

not an isolated case, as also decision-making methods and forecasting procedures have been criticized in a similar way in industry. Why is it that RDM is much more successful in the USA than in Europe? The fact is that, in the USA, there is a tradition of close relationship between universities and industry: many university professors have a work history in industry and some industrial managers come and give courses in universities. But, one finds in the same case that "the university staff has fixed ideas about how RDM can be useful". Actually, this is a common phenomenon: all individuals harness fixed ideas, to a varying extent, but the problem is that we only see other people's fixed ideas, and not our own ones.

A **third point** in the analysis is linked with the statements by the SME engineers of the Dutch case, on the one hand, that communication with the academic world is "not simple", and on the other hand, from the academic staff, that European SMEs are "very goal-oriented" and that their working environment is "hectic". As similar observation has been made also in the Danish case. As (de Maret, 2007) claims, academic culture is geared towards production of knowledge, scientific excellence, academic freedom and free dissemination of results, while business culture is geared towards production a wealth, profitability and appropriation of results. It is hard to find a common denominator. Actually, these two remarks about European SMEs illustrate well the difference in viewpoints, as well as their prevalence.

A **fourth point,** revealed by the Danish case, is the remark about the lack of rewarding system of the university staff involved. We are touching here on the internal barrier of the administrative and financial structures of universities. More generally, many professors consider that they must first devote themselves to research, with teaching as an inconvenience. Academic staff is also looking in that direction, since the chance of promotion depends on research. So, an in-depth change in the mindset of university professors and managing staff has to be carried out, a real "pedagogical reform". Concurrently, one has to mention that most people working in industry have a poor image of universities; for them, professors and their assistants are working in their ivory towers and are unable to obey the strict requirements of industrial and economic activities.

6. Conclusions

The Knowledge Triangle, it has been said, aims at fostering a faster transfer of knowledge into concrete and useful innovations, – be it academic, industrial or societal – by implementing specific platforms and processes between the three corners of the triangle and carefully orchestrating their working. Above all, this challenge concerns European universities but wherever and whenever a platform is launched between two organizations with the aim of establishing some form of cooperation, clear involvement of both partners and mutual understanding are absolute prerequisites.

There are several reasons to believe that tailor-made Continuing Engineering Education (TM-CEE), as a platform between universities and industrial companies, is a particularly appropriate process for meeting the challenge of the Knowledge Triangle. But its implementation in real-life cases can be confronted with considerable, though not insurmountable, difficulties.

TM-CEE can be successfully implemented to the satisfaction of the partnering companies, if some critical barriers are overcome, because many companies show willingness to cooperate and flexible pedagogical approaches have been devised. If we want TM-CEE to become more widespread, emphasis must be put on overcoming the barriers that impede its spreading both vertically (in the industrial fabric of a given region or country) and horizontally (into regions, countries and/or global ecosystems where it has not yet been developed). In order to better identify these barriers and improve the pedagogy of TM-CEE, further best practices must nurture our experience.

Nevertheless, some reservations must be expressed to not put the cart before the horse: the education partners have a long way to go towards each other if they want to cooperate on regular bases in the way outlined by the Knowledge Triangle. The fundamental challenge is a change of mindsets regarding the way we think, learn, manage knowledge, conceptualize, mobilize and, more generally, define our role in society.

It is surprising to observe that, in a given country or region, university staff in engineering departments, on the one hand, and engineers in industry, on the other hand, , do not understand each other anymore after having worked a few years in different environments, although they have more or less received the same higher education. This proves how much the accumulation of tacit knowledge can change our perception of the world.

Engineers know how machines work, from the smallest, such as an electronic chip, to the largest, such as the Large Hadrons Collector at the CERN in Geneva, depending on their speciality. How is it, then, that they do not know how their brain, that marvellous little machine they use every day, works. It seems that, with regard to such matters, there is a gap in engineers' curricula.

Further, recent research shows that openness to particular values, defined as underlying behavioural mechanisms, is significantly correlated with performance in professional training, as opposed to discipline and sticking to deadlines, which have not much impact. (Hensel, 2010). Taking such matters into consideration, both in engineers' curricula and in specific training courses, could stimulate innovation and renewal processes in organizations, which is the main goal of the Knowledge Triangle Model, and particularly tailor-made Continuing Engineering Education, as a privileged platform for the cooperation between universities and industries.

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About the authors

Ellen Sjoer, PhD, works as a researcher and lecturer at Delft University of Technology. She is specialized in life-long learning, corporate (e-)learning and knowledge management. She has contributed to various national and international projects concerning lifelong learning and university-industry cooperation such as Weknow, Learn RDM and Eugene. In addition, she is in charge of the research program 'Sustainable Talent Development' at The Hague University of Applied Sciences.

Bente Nørgaard is a PhD fellow from Aalborg University. Since 1999 Bente has worked within the area of continuing engineering education at Aalborg University. She has been involved in several national and international research projects but her primary focus has been tailor-made continuing education and conceptualising the Facilitated Work Based Learning model. For the past years, Bente has researched the process of identifying learning objectives in tailor-made continuing education and most recently with a broader perspective on the tailor-made process she has researched how actors involved in the courses organise and coordinate the activities.

Marc Goossens holds an MSC in nuclear physics. He has worked extensively in industry in applied R&D tasks, in university as an interface with industry, in insurance as a broker, and as a self-employed trainer for engineers, before retiring in 2008. He has served as Director and Executive Officer of SEII since 2005, where he works on a voluntarily basis with a focus on engineering education at the European level. He also harbors a special interest for cognitive sciences and philosophy.

Wim Van Petegem
Director Teaching and Learning, KU Leuven
wim.vanpetegem@dml.kuleuven.be

V. Lifelong Learning Strategy Development

How a European University Can Set Its Agenda for Lifelong Learning

Abstract

We are currently moving towards a global knowledge-based society, driven by digitization with a growing importance and influence by innovation, entrepreneurship and citizenship. Lifelong learning is considered an all-permeating success factor in preparing and further developing our human resource potential for this new era. Therefore, lifelong learning is high on the agenda of many organizations at different levels in our society. Also universities (and other higher education institutions) are facing the challenges of new learning and learner needs and are questioning their role in lifelong learning, in creating and sharing knowledge for the future. They have to review, refine and/or develop their strategies for learning, and especially lifelong (and life-wide) learning, in order to better implement their three-fold mission, i.e. research, education and service to society.

This article explores the European landscape and ways in which a lifelong learning agenda is set in order to respond to current needs in society. In the context of the European Higher Education Area, the role of universities with regard to lifelong learning is further defined. The challenges faced by both institutions and governments are identified and formulated as recommendations to consider. The article concludes with a university case description, i.e. KU Leuven, which went through a process of adapting its vision on teaching and learning, including a lifelong and life-wide dimension.

Keywords: Lifelong learning, strategy development, international collaboration, university policy

1. European Landscape for Lifelong Learning

The concept of lifelong learning (LLL) has been around for more than 50 years now. As it is beyond the scope of this article to go back in history that far, this work sets its starting point in the year 1996, when the OECD published its "Lifelong Learning for All" approach, "*from cradle to grave*". The aim was on strategies for lifelong learning to *"respond to the convergence between the economic imperative dictated by the needs of the knowledge society and the societal need to promote social cohesion by providing long-term benefits for the individual, the enterprise, the economy and the society more generally".*

The same year 1996 was also the European Year of Lifelong Learning,[1] which had a major political impact at European level by placing lifelong learning centre-stage and by involving new players in a field which until then had been reserved for specialists. The EU's contribution to the global debate on lifelong learning was marked by a broad concept embracing the same 'cradle to grave' approach which does not subordinate learning to economic imperatives and gives full place to such issues as personal growth, participation in the democratic decision-making process, recreational learning, and active ageing.

In March 2000, the European Council formulated its Lisbon Strategy,[2] aimed at making the European Union (EU) the most competitive economy in the world and achieving full employment by 2010. It was based on innovation as the motor for economic change, on a "learning economy", and on social and environmental renewal. In response, the European Commission published a Memorandum on Lifelong Learning[3] to foster the debate at European and Member state levels to reach these goals. It was recognized that LLL was a key to growth and jobs, as well as an instrument in enabling European citizens to participate fully in society.

Although national governments are responsible for education and training, political cooperation was considered imperative and this has led to the Education and Training 2010 work programme launched in 2001 and its follow-up, the strategic framework for European cooperation in education and training ('ET 2020'),[4] adopted by the Council in May 2009. What is striking is that *"making lifelong learning and mobility a reality"* is identified as one of the four long-term strategic objectives, translated into the EU-level benchmark indicator that *"an average of at least 15% of adults (age group 25–64) should participate in lifelong learning"* by 2020. A number of instruments have been developed to support European citizens, learning providers, companies, guidance counsellors and educational authorities and allow them to fully exploit the potential of the European lifelong learning area and the EU-wide labour market, since *"The challenges posed by demographic change and the regular need to update and develop skills in line with changing economic and social circumstances*

[1] See: http://europa.eu/legislation_summaries/education_training_youth/lifelong_learning/c11024_en.htm

[2] See: http://europa.eu/scadplus/glossary/lisbon_strategy_en.htm

[3] See: http://europa.eu/legislation_summaries/other/c11047_en.htm

[4] See: http://ec.europa.eu/education/lifelong-learning-policy/doc1120_en.htm

call for a lifelong approach to learning and for education and training systems which are more responsive to change and more open to the wider world. While new initiatives in the field of lifelong learning may be developed to reflect future challenges, further progress with ongoing initiatives is still required, especially in implementing coherent and comprehensive lifelong learning strategies".

To make this happen, the European Commission has also integrated its various educational and training initiatives under one single umbrella, the Lifelong Learning Programme (LLP),[5] replacing previous education, vocational training and e-Learning programmes which ended in 2006. The European Commission's Lifelong Learning Programme enables people at all stages of their lives to take part in stimulating learning experiences, as well as helping to develop the education and training sector across Europe. With a budget of nearly 7 billion euros for 2007–2013, the programme funds a range of projects and actions including exchanges, study visits and networking activities.

Together with the Lisbon Strategy and all its related initiatives, 47 countries are implementing the Bologna Process in Europe. It is the process of creating the European Higher Education Area (EHEA), based on cooperation between ministries, higher education institutions, students and staff from the countries involved, with the participation of international organizations.

Lifelong Learning has been on the Bologna Process agenda from the very beginning and gained particular prominence with the Prague Communiqué[6] in 2001 which stated that *"Lifelong learning is an essential element of the EHEA. In the future Europe, built upon a knowledge-based society and economy, LLL strategies are necessary to face the challenges of competitiveness and the use of new technologies and to improve social cohesion, equal opportunities and the quality of life"*. In the succeeding communiqués, higher education ministers returned to the theme of LLL and highlighted various areas that contribute to building the culture of LLL in the EHEA. They underlined the necessity to enhance the development of flexible learning pathways, to create opportunities for the recognition of prior learning, to establish national qualification frameworks and to build closer cooperation between higher education institutions and various external partners, including employers. In April 2009, the higher education ministers, who met in Leuven and Louvain-la-Neuve highlighted in their Communiqué[7] in particular the importance of lifelong learning, widening access to higher education, and mobility. They call for policies supporting LLL through adequate organizational structures and funding mechanism.

The Communiqué also intends to further specify the concept of LLL, stating that *"LLL involves obtaining qualifications, extending knowledge and understanding, gaining new skills and competences or enriching personal growth. LLL implies that qualifications may be obtained through flexible learning paths, including part-time studies, as well as work-based routes"*. And most recently, when the ministers met in

[5] See: http://ec.europa.eu/education/lifelong-learning-programme/doc78_en.htm

[6] See: http://www.ehea.info/Uploads/Declarations/PRAGUE_COMMUNIQUE.pdf

[7] See: http://www.ehea.info/Uploads/Declarations/Leuven_Louvain-la-Neuve_Communiqu%C3%A9_April_2009.pdf

Bucharest[8] in 2012, they again recognized that *"LLL is one of the important factors in meeting the needs of a changing labour market, and higher education institutions play a central role in transferring knowledge and strengthening regional development, including by the continuous development of competences and reinforcement of knowledge alliances"*.

2. A Definition of University Lifelong Learning

Lifelong learning is a complex concept, with many important dimensions. In addition, there are also different opinions about what lifelong learning really is or should be, evolved over the past 50 years of its history.

In its "Lifelong Learning for All" the OECD adopted *"a more comprehensive view that covers all purposeful learning activity, from the cradle to the grave, that aims to improve knowledge and competencies for all individuals who wish to participate in learning activities"*. Four main features are distinguished: 1) a systemic view (learning opportunities all over the entire lifecycle, from pre-school education until post-retirement, covering all forms of formal, non-formal and informal learning), 2) centrality of the learner (meeting learning needs rather than supply-side driven), 3) motivation to learn ("learn-to-learn") and 4) multiple objectives of educational policy (like personal development, knowledge development, economic, social and cultural objectives). The European Commission initially used a much narrower definition, describing lifelong learning as *"all purposeful learning activity, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence"*. This definition was later adjusted to its current version, with similar accents to the OECD description: *"Lifelong learning should be understood as all learning activity undertaken throughout life, with the aim of improving knowledge, skills and competences within a personal, civic, social and/or employment-related perspective"*.

To realize this lifelong learning process, it is clear that many partners need to be involved. In order to offer people and organizations the opportunity to acquire the necessary knowledge and competences to manage their professional, economic, social and cultural tasks in a rapidly changing society, a strong interplay between many different actors in the field of education and training is required. Universities are crucial partners in this dialogue.

Yet, in spite of the ambitions of the EU and national governments, the actual implementation of lifelong learning still remains in its early stages and a clarification on the role of the university is often absent. Except for the infrequent references in the Bologna process, there are few indications of the particular expectations of universities in all these European-wide LLL strategies. Two European networks in particular, the European University Association (EUA) and the European University Continuing Education Network (EUCEN) have detected this gap and have taken the initiative to bring forward a generic scenario on university lifelong learning.

[8] See: http://www.ehea.info/Uploads/%281%29/Bucharest%20Communique%202012%281%29.pdf

[9] See: http://www.eucen.eu/BeFlex/index.html

In the BeFlex project (2005–2007),[9] EUCEN built a picture of the state of play at present in university lifelong learning. As a result of a benchmarking exercise, it was stated that "ULLL is a field of enormous complexity and diversity" and, therefore, a working definition is required that reflects this diversity in the present situation:

ULLL is the provision by higher education institutions of learning opportunities, services and research for:

- the personal and professional development of a wide range of individuals – lifelong and life-wide; and
- the social, cultural and economic development of communities and the region.

ULLL is at university level and research-based; it focuses primarily on the needs of the learners; and it is often developed and/or provided in collaboration with stakeholders and external actors.

A follow-up project, BeFlex Plus,[10] created a new update on ULLL and further studied how universities could be supported (in terms of recommendations) in the development and implementation of regional strategies for ULLL.

Overall, LLL in higher education appears in many different types of learning and varies from one country to another. The provisions most strongly associated with LLL include non-formal courses for individuals offered by higher education institutions alongside their formal degree programmes, and formal degree programmes provided under various flexible arrangements different from traditional full-time schemes (such as part-time programmes, weekend courses, open and distance learning, e-learning). Other types of activities consist, for instance, of tailor-made provision for external partners (e.g. industry), public lectures, seminars, conferences, targeted guidance and counseling services, open access to higher education resources (libraries, but also open educational resources).

3. A Charter on Lifelong Learning

In 2008, upon request from French authorities, the EUA joined this debate on the role of the university in the lifelong learning process by elaborating on a European Universities' Charter on Lifelong Learning.[11] It is written in the form of commitments in the first instance for universities in addressing the development and implementation of LLL strategies. Universities should commit to:

1. Embedding concepts of widening access and lifelong learning in their institutional strategies.
2. Providing education and learning to a diversified student population.
3. Adapting study programmes to ensure that they are designed to widen participation and attract returning adult learners.

[10] See: http://www.eucen.eu/BeFlexPlus/index.html

[11] See: http://www.eua.be/fileadmin/user_upload/files/Publications/EUA_Charter_Eng_LY.pdf

4. Providing appropriate guidance and counselling services.
5. Recognizing prior learning.
6. Embracing lifelong learning in quality culture.
7. Strengthening the relationship between research, teaching and innovation in a perspective of lifelong learning.
8. Consolidating reforms to promote a flexible and creative learning environment for all students.
9. Developing partnerships at local, regional, national and international level to provide attractive and relevant programmes.
10. Acting as role models of lifelong learning institution.

However, it is well understood that these commitments are hardly realized by European universities if not accompanied by concerted actions of governments and regional partners in providing appropriate legal environments and funding. So, the Charter also includes a set of (often forgotten) commitments for governments at all levels. They should commit to:

1. Recognising the university contribution to lifelong learning as a major benefit to individuals and society.
2. Promoting social equity and an inclusive learning society.
3. Including lifelong learning objectives in the missions and work of national quality assurance agencies and systems.
4. Supporting the development of appropriate guidance and counselling services.
5. Recognising prior learning.
6. Removing specific legal obstacles that prevent many potential learners from returning to higher education.
7. Ensuring autonomy and developing incentives for lifelong learning universities.
8. Encouraging partnerships at regional level with local authorities, employers and agencies.
9. Informing and encouraging citizens to take advantage of lifelong learning opportunities offered by universities.
10. Acting as role models of lifelong learning institutions.

This Charter on LLL is now a well-recognized agenda for LLL in many countries and higher education institutions all over Europe.

4. Towards a New/Renewed LLL Strategy

The above perspectives, especially the ones by EUCEN and EUA, offer an interesting starting point for universities to define their own position, within their regional or national context. Once the role of university lifelong learning is clarified, the next crucial step is to find the right strategy and corresponding business models in order to implement policies and structures to enable the necessary change. EUCEN for-

mulates this exercise as "how to move from university lifelong learning to lifelong learning universities?", which was also the theme of their Spring Conference in 2009 in Leuven.[12] Currently there are a number of European projects that signal that universities with different profiles seek for opportunities to revise, develop and enhance their strategic LLL approaches, in interactive discussion with colleagues from all over Europe.

The EUA, in a consortium together with the European Association of Distance Teaching Universities (EADTU), the European Access Network (EAN) and EUCEN, addressed the strategy topic in a LLP project, called SIRUS (Shaping Inclusive and Responsive University Strategies).[13] This project supported Europe's universities engaged in LLL, by implementing the commitments made in the European Universities' Charter on Lifelong Learning. It assisted them in developing their specific roles as lifelong learning institutions forming a central pillar of the Europe of Knowledge.

A similar project called USBM (University Strategies and Business Models for LLL),[14] coordinated by EADTU, worked on the same question in a collaborative setting of open universities, conventional universities and associations in distance education. USBM aimed to present, analyze and share current and intended institutional strategies and business models (including examples of good practice) for ULLL.

A last project to be highlighted here is EUGENE.[15] It is a thematic network of engineering universities and their stakeholders. One of the lines concentrates on developing concepts and tools to help universities in their LLL practices and processes and thus on helping European working life to meet the requirements of fast changes towards the new business logic of global industrial value networking. The focus of this project is on a) processes in the university-industry cooperation interface, b) innovation management and leadership, and c) ICT and project management for university productivity. In addition to these projects, there are also a number of regional/national initiatives.

4.1 The Experience of KU Leuven in Developing a LLL Strategy

Inspired and motivated by the international dialogue on (strategies for) university lifelong learning, KU Leuven[16] decided to join this debate. Aspects of lifelong learning are already part of the Strategic Plan of the university (2007–2012)[17] and many successful initiatives are taking place throughout the university. In 2009, the Academic Council of KU Leuven adopted a new 'Vision on Teaching and Learning'.[18] This vision defines the educational activities of the university within the scope of its mission. With regard to lifelong learning, it states that *"its educational programmes are integrated*

[12] See: http://www.eucen.eu/node/3547

[13] See: http://www.eua.be/pubs/Engaging_in_Lifelong_Learning.pdf

[14] See: http://www.eadtu.nl/usbm/

[15] See: http://www.eugene.unifi.it/

[16] See: http://www.kuleuven.be

[17] See: http://www.kuleuven.be/overons/strategischplan.html (in Dutch)

[18] See: http://www.kuleuven.be/onderwijs/beleidsinfo/index.html (in Dutch)

in Flemish, European and worldwide networks for lifelong and society-wide learning. Thus, KU Leuven shares its strengths and traditions, is open to the contributions of others and collaborates with its partners to foster quality and solidarity". As such, lifelong learning is the responsibility of the faculties (all teaching staff is potentially involved), with a small central support unit (currently embedded in the Media and Learning Unit, formerly known as AVNet) for tasks such as general communication, advice on didactics, and use of educational technologies. At the satellite campus in Kortrijk, a slightly different approach is taken, with one centre organizing continuing education for the entire region.

During 2010–2011, a set of policy notes further refined the Vision on Teaching and Learning to ensure its implementation. One of these policy notes is an integrated strategic vision and action plan to reinforce the position of the university in terms of knowledge transfer to lifelong learners in the region. The external drivers for this exercise were the European emphasis on lifelong learning as explained above, and its translation into Flemish actions (Vlaanderen in Actie – Flanders in Action),[19] where De lerende Vlaming – the Learning Flemish is one of the priorities. The latter is – amongst other initiatives – described in the Decree on Flexibility in Higher Education, which all universities have to comply with. This decree aims at an increase in student mobility, the possibilities of lifelong learning (including accreditation of prior experiential learning) and the use of new forms of education (e.g. distance teaching, evening classes, ICT support), reaching new target groups and as such democratizing higher education. As a specific internal driver we could mention the (re-)positioning of the previous central support unit, only dedicated to continuing education, in a larger centre, the Media and Learning Unit. This integration certainly sparked the discussion in the university on what to head for with lifelong learning.

4.2 A Working Group on Lifelong Learning

In 2009, a specific Working Group on LLL was set up, chaired by the vice-rector Educational Policy. To ensure a good exchange of ideas between different stakeholders in the university, the Working Group consisted of people from across the university. For that reason the Group brought together representatives of the thirteen Faculties, staff members of the (central) educational support units, the director of Leuven Research & Development (the knowledge transfer centre) and the coordinator of the unit Study advise. In addition, an expert in lifelong learning from the Open Universiteit Nederland was invited to join the team. To guarantee full autonomy of the Working Group, the vice-rector decided not to participate in the meetings in person. He was informed about the developments on a regular basis by the Media and Learning Unit that coordinated the meetings of the Working Group.

All members of the Working Group had previous experience in organizing continuing education activities for their department, faculty or within their discipline. Some members also had research expertise in lifelong learning itself. The three members of the support units had knowledge of either the design of policy instruments or

[19] See: http://www.flandersinaction.be/nlapps/default.asp

the setup of support services for lifelong learning initiatives. The director of the unit on LR&D was invited to discuss the issue of regional development through lifelong learning, i.e. the idea that lifelong learning initiatives could be also a viable means to transfer research-based knowledge to the professional partners in the region, in addition to the support of current spin-off activities and other forms of entrepreneurship.

After an initial kick-off session, the Working Group started its activities in December 2009. A total of six meetings were planned for the first part of 2010. The ambition was to have the broad strategic goals ready by the summer of 2010, so that the Working Group could continue with the specifics of implementation in the fall of 2010. This objective was met, though the implementation plan was only partly realized, e.g. the strategic goals were presented to the Council for Education in June 2010, which adopted the strategy for lifelong learning and decided to give priority to an implementation plan for continuing education (as part of lifelong learning). In the second phase, all other lifelong learning initiatives instigated by the university will be completed. In 2011 the implementation plan for continuing education was discussed with the Council for Education and finally approved by the Academic Council in May 2011. This seems to be a long process, but this is the way important decisions are taken in KU Leuven university, step by step, with the support of all stakeholders, and approved by the different bodies in the university.

4.3 Definition of Lifelong Learning

As the first step, the Working Group had to come up with a definition for lifelong learning. Combining the definitions of the OECD, de EC, the EUA and EUCEN, the Group ultimately proposed to develop a strategy for lifelong learning for KU Leuven on the basis of the following definition:

> *"University Lifelong Learning is about the promotion of the attitude to want to learn and the competences to be able to learn, and the subsequent provision of learning opportunities, services and research for the personal and professional development of a wide range of individuals – lifelong and life wide, and for the social, cultural, ethical and economic development of communities and the region. University Lifelong Learning is always research based; it focuses primarily on the needs of the learners within their learning context and whenever relevant it is developed and/or provided in collaboration with stakeholders and external actors".*

On the basis of this definition, it was possible to assess to what extent KU Leuven was already realizing university lifelong learning initiatives and which elements were still missing.

4.4 Strategy Plan

The strategy is based on a SWOT-analysis of all current initiatives taken at KU Leuven, mainly with regard to continuing education. Nevertheless, this resulted in a global vision on what a university like KU Leuven has to offer in terms of learning opportuni-

ties for a broad range of learners (before, during and after the initial Bachelor of Arts/Master of Arts programmes). The main strategic goals were set as follows:

> **In 2020, lifelong learning as an attitude is embedded in the *culture* of the university and it is as such actively promoted towards society.**

This goal is considered the most critical one. A shared understanding and recognition of the importance of lifelong learning within the academic community is the basic foundation to successfully realize university lifelong learning.

> **In 2015, lifelong learning is a perspective from which *scientific research, education and service* to society are being strengthened and vice versa.**

This goal is about the provision of academic learning opportunities for the personal and professional development of a wide range of individuals or organisations. It implies, above all, a review of the current (typology of) offerings and new innovative scenarios for lifelong learning initiatives.

> **In 2015, the university actively uses synergetic *partnerships* at different levels to support the production and delivery of its educational offerings, and to reach out to new target groups.**

This goal implies the active search and use of synergetic partnerships for the design of and the offerings itself. In particular, this could be regarding our alumni networks, as we recognize that a better exploitation of their former ties with the university might lead to more learners and potential co-designers of the lifelong learning offerings.

> **In 2015, the university has an efficient and effective *support structure* in place, with clearly defined processes, responsibilities, competences and necessary means to realise the cultural, the substantive and the contextual embedding of lifelong learning at the university.**

The last goal refers to the structures, processes, people and finances that support lifelong learning activities.

This overall strategy plan was approved by the Council for Education in June 2010.

4.5 …And Its Implementation

As explained above, the first priority in implementing the strategy plan was given to the development of innovative ways to organize continuing education as the post-initial interpretation of lifelong learning. An implementation matrix was set up for different activities to be put in place, organized according to the above main strategic goals (i.e. structure, content, context and culture), and to the different levels in the process (management, organization and support).

In fact, two matrices were produced, based on two different implementation models. One matrix was based on a model where different faculties take their own LLL initiatives and are supported by a central unit, when necessary or relevant. Another matrix reflected more the particularity of our satellite campus in Kortrijk, where the size of the faculties is smaller and therefore, one single central unit is organizing LLL

initiatives for all different faculties. Apart from the organizational differences in these two models, you could also distinguish them on a more fundamental basis: in the first model LLL initiatives are set up based on scientific disciplines (as they exist in the organizing faculties), while in the second model LLL initiatives are more demand-driven (addressing regional needs – after all, that is the reason why KU Leuven has a satellite campus in the region). The two matrices and the corresponding set of activities were presented to the Council for Education and they agreed with the double approach. As a result, no choice is made between the two implementation models, and both continue to co-exist. In both cases, however, it was made clear that a one-stop contact and service point for organizers was recommended, wherever one was located in the university.

In the second phase, the other aspects of lifelong learning will be examined, e.g. how this strategy affects the initial programs, and what the university has to offer to students upon entrance to higher education. Presently, consideration is given to the organization of this task, in the midst of a major reform process to optimize teaching and learning services at all levels in the university.

5 Concluding Reflections

The success of the Working Group was highly due to the strong commitment of its members and the expertise all members could bring into the discussions. Nevertheless, all chances were benefited from to share views with peers in networks like EUA, EADTU, EUCEN, EDEN. KU Leuven was also fortunate to participate as a partner in several projects related to the development of its lifelong learning strategy. In this regard, the SIRUS project was launched just about in time. It provided an opportunity:

- to benchmark the strategy development process with other universities in a similar exercise,
- to present and discuss the intermediate and final results of the strategy process with peers,
- to share good/best practices with respect to lifelong learning initiatives and lifelong learning strategy development in other universities and
- to find common ground for a more European-wide approach on lifelong learning, including strategy development and implementation plans.

KU Leuven hopes to continue to share its experiences with the international community to further fine-tune its plans and make the university a more lifelong learning university.

About the author

Wim Van Petegem holds an MSc in Biomedical Engineering and a PhD in Electrical Engineering. He has worked at the University of Alberta, Edmonton (Canada), at the Open University of the Netherlands and at the Leuven University College (Belgium). 2001–2012 he was the head of the Media and Learning Center at KU Leuven. Currently he is Professor at KU Leuven (Belgium) and Director of the Teaching and Learning Department. He is actively involved in different networks of universities (like EuroPACE, EDEN, IACEE and the Coimbra Group), and serves presently as the President of SEFI. His current research interests are in the field of multimedia production, new educational technology, networked e-learning, virtual mobility, lifelong learning, open and distance learning, knowledge transfer and science communication. He and his team are involved as contractor, partner, coordinator, expert, or evaluator in many implementation and development projects mostly financed by the European Commission (DG Education and Culture). He is also heavily engaged in development cooperation with the South.

Aniko Kalman
Associate Professor, Budapest University of Technology and Economics
drkalmananiko@gmail.com

VI. Developments in Hungarian Lifelong Learning Policies as Means of Implementing the Knowledge Triangle

Abstract

A particular challenge for universities stems from political decision-making that requires significant results in the near term. Universities, as their operational structures and culture exist, are not yet ready for this. Huge development work is imperative for universities to be able to change their operational processes. The key stepping stone is the disassembly of silo structures and accomplishment of an in-depth collaborative working culture. This can be simplified by means of two principles: the Triple Helix collaboration model (universities-enterprises-public administration), and the Knowledge Triangle model (research-education-innovation) that accentuates the synergy between university's different functions.

The article presents the situation of LLL in Hungary and elaborates on the efforts put to Hungarian higher education regarding the development and enhancement of strategic LLL approaches, and the implementation of Knowledge Triangle. One example of this is the SIRUS project aiming to support universities in implementing the commitments made in the European Universities' Charter on Lifelong Learning. It also elaborates on the solutions and recommendations for strengthening the Knowledge Triangle and developing RDI in Hungary.

Keywords: higher education LL strategy, higher education network, training of trainers, EUA Charter

1. LLL in Hungary

1.1. The Goals of LLL in Higher Education

The goals of LLL in Higher Education (HE) will inevitably help universities develop research and innovation orientation with local and regional stakeholders, mostly in economic and social aspects, to open access to non-traditional learners and to generate better educational services with effective methods, tools and applicable curricula. Also, lifelong learning (LLL) will assist universities in recognising and developing their third mission towards society, mainly in local and regional contexts. Universities take part in the promotion of knowledge and skills/competencies most necessary in the labour market, and involve practitioners in education and training, in research and development. Similarly to other EU Member States, the ageing of the population also creates a need for a skills upgrade – in pursuit of enhanced productivity.

The universities in Hungary have turned the LLL agenda into a theme for discussion in the Hungarian Universities Lifelong Learning Network as frame for a public debate and move towards an international environment scrutinizing university lifelong learning. The most important changes in society that make it relevant to place Lifelong Learning high on the HE agenda, comprise the rapidly changing labour market demands for entrepreneurship, and the fall of traditional financing tools and methods. Further, research has been extended to new dimensions to promote development and innovation towards new industries, services and social affairs to challenge learning at and with HE for growth, stability and strong identity. Societies facing global and local challenges at the same time turn towards HE to become flexible and open in some aspect of learning in adulthood and in later life, too. The ongoing changes bring about discussions over new skills for changing jobs and motivate HE institutions (HEI) to react to these demands. According to the demographic trends distinctive for the developed countries, a continually narrowing intake pool of higher education could be predicted for the next years.

The increasing demand for training or education within the framework of Lifelong Learning constitutes another tendency related to LLL in Hungary. Its predominant element is the continuous retraining and further training of adults.[1] For the HEIs, it is an apparent opportunity to be involved and benefit from the advantages of this growing trend.

In order to maintain and enhance the quality of life in Europe, a constant upgrade of the workforce in terms of knowledge and skills is called for. Especially now, in times of financial instability and uncertain future prospects, focus should be put on finding a way out of the crisis, by building on knowledge and education and on relevant training for the European labour markets. This entails a strong commitment to higher education institutions in lifelong learning.

[1] As the expression used in Hungarian adult education.

1.2. The Role of the Hungarian Government in the Discussion on Higher Education Systems and Lifelong Learning

The role of the government is to initiate debate and programmes for HE to develop lifelong learning through means other than the implementation of the Bologna system. Also, the government and the Ministry in charge should approach aspects of university lifelong learning in cooperation with HEIs. HEIs have to be committed to the development of education and research and supported by more exchange and co-operation amongst Hungarian universities and distinguished universities in Europe and the neighbouring regions. Most difficulties occur in terms of balancing between the roles of politics/government and preservation of HEI autonomy in order to make them explore new avenues for research, development and innovation (e.g. the Science Building in Pécs will generate more research, resulting in quality education).

A rather apparent difficulty is the lack of funds and the low capacities of HEIs in innovation, together with a somewhat limited level of mobility of both teaching staff and students.

1.3. The Role of Higher Education Institutions in the Discussion on LLL and the LLL Strategy in HEIs

All higher education institutions have to have a long-term development strategy that addresses also LLL. In this sense, all HEIs are involved in LLL but to a different degree and in different forms. Most HEIs have further training institutions which are responsible for organising adult degree courses. The University of Debrecen was the first HEI which established a Lifelong Learning Centre in 2000 and this Centre assisted in the foundation of the MELLearN Association[2] in 2002. Universities of applied sciences are more active in adult education in a wider sense, offering a comprehensive range of non-degree courses. Several HEIs are members of the MELLearN network for LLL in HEIs. This association created a common strategy and also organizes common activities for the members of the Association.

In 2002, 12 Hungarian higher education institutions, supported by the governmental, formally established MELLearN Network (Hungarian University Lifelong Learning Network), as an initiative of the management of the University of Debrecen and the Lifelong Learning Centre of the University of Debrecen, within the frameworks of a THENUCE (European Thematic Network in University Continuing Education), European Socrates/Erasmus programme. The registered Hungarian higher education network acts as the Hungarian member of the international EULLearN Network (European University Lifelong Learning Network), currently operating with 19 members, generates and co-ordinates pedagogical, educational, and research activities of public utility.

The MELLearN Association is an affiliate member of the EUA, so it strongly proposes the development of a New National LLL Strategy based on the following 10

[2] Hungarian Higher Education Lifelong Learning Network (www.mellearn.hu)

points formulated in the EUA's Charter on Lifelong Learning[3] (EUA, 2008) issued in 2008 and accepted by rectors of European universities to oblige universities to:

- embed concepts of widening access and lifelong learning in their institutional strategies,
- provide education and learning to a diversified student population,
- adapt study programs to ensure that they are designed to attract returning adult learners,
- provide appropriate guidance and counseling services,
- recognize prior learning,
- embrace lifelong learning in quality culture,
- strengthen the relationship between research, teaching and innovation within the framework of lifelong learning,
- consolidate reforms to promote a flexible and creative learning environment for all students,
- develop partnerships at local, regional, national and international levels to provide attractive and relevant programs and
- act as role models of lifelong learning institutions.

The government recognises higher education as a main actor and promoter of adult and lifelong learning together with a great number of adult education and training institutions and organisations. It is an approach to follow major EU policies and independent EUA survey findings on higher education and lifelong learning. There are no special institutions for LLL. The Higher Education Act from 2005 and the related government act had special rules to support LLL, mainly by allowing credit transfer between different levels of higher education. The 3-year maintainer contract between state HEIs and the Ministry responsible for higher education could also be an efficient tool to stimulate HEIs to invest more in LLL.

HEIs are encouraged by the government, adult learners and employers to become more responsive to LLL, and the Hungarian Lifelong Learning Network, together with annual conferences and workshops, offer one platform to help HEIs to recognise this challenge.

The MELLearN Association acts as a catalyst between HEIs, the government and the economic field, involving stakeholders in the discussion about LLL and adult education. The Association has organised a conference annually since 2005, addressing the following topics:

- higher education and lifelong learning strategy,
- the role of higher education in adult education,
- the lifelong learning networking cooperation of higher education institutions as regional knowledge centres,
- adult education experiences and opportunities for the renewal of higher education,

[3] EUA: European Universities' Charter on Lifelong Learning, ISBN: 9789078997009, Brussels, 2008, http://www.eua.be/publications/eua-policy-positions.aspx Acquired: 13.11.2012.

- lifelong learning, innovation and the creation of values,
- the role of the Hungarian higher education in achieving the Knowledge Triangle (education-research-innovation),
- the Europe 2020 and the Education-Training 2020 Strategies and
- competition and cooperation: the Innovative higher education.

Adaptation of HEIs to stakeholder needs is encouraged by different institutional tools. Financial boards comprised also of employer representatives control the strategy of the institutions. The government also supports LLL through the 12 state-funded semesters available for students in higher education granted with state-funded status (or reoriented from fee-paying status based on their performance) and the 3-year maintainer agreement.

Most universities try to enhance access for adult and non-traditional learners by offering special programs, short-term training, or special lectures when disseminating scientific knowledge in special forms (e.g. University TV, lectures, night of scientists, special tours around university labs). The Knowledge Centre of the University of Pécs offers special programmes and a digital knowledge base to develop lifelong access to higher education. Recognition of prior learning is related to the credit system which is to help students get their previous studies in other higher education institutions, post-secondary vocational education training, or Bachelor of Arts and Master of Arts recognised and receive credits for them as part of their actual course. This process is administered by each faculty. However, RPL[4] referring to other forms of prior learning is not formally recognised.

Many HEIs in Hungary have programmes for adult part-time students, many of whom are learning while working at the same time. These are often HEIs that deal with the education and training of adult educators to promote and develop adult learning; the development of access requires a better infrastructure (such as development of library services, learning with practitioners towards more economic orientations, more scientific orientation with researchers to exchange ideas and look into ideas, models, experimental approaches to innovation methodology, practices). HEIs develop and offer several special courses based on former studies and work experiences.

Several MELLearN member institutions are involved in curriculum development and teacher training projects. One of them is the "Training of Trainers at the Budapest University of Technology and Economics" funded by the Social Renewal Operational Programme which can be presented as a good example for other HEIs. The general aim of the project was to contribute to the development of trainer competences that are necessary for the implementation of the requirements of the Bologna process, the European Qualifications Framework and the LLL strategy. The direct aim was the improvement of teacher competences in different fields. The project facilitated the realization of training for higher education teachers in methodology, use of ICT tools and methods, English professional language courses, and labour safety. (Kálmán, 2012).

[4] RPL: recognition of prior learning.

In addition to strains resulting from adult learners' inability to finance their studies and the deteriorating market conditions of the recent years, the Hungarian higher education system has also been challenged by many private and foreign competitors involved in adult training. The adult education market is highly segmented with a great number of competitors. Differentiation is based on the following aspects:

- customer's need for a degree,
- professional need for development,
- loyalty to the basic adult training institution,
- career status and requirement,
- size, type and nationality of the employer company,
- fees (overall costs),
- the prestige of the institution and
- level of requirements (strict or fairly easy).

In the near future, the expected decline in graduate admission will create an opportunity for using the available teaching capacity in adult courses. Nearly half of the institutions have set up a separate organizational unit for such purposes. These units have a strategic plan for their future operations.

2. The Introduction of the Knowledge Triangle in Hungarian Higher Education

In sum, the proposed plan in Hungary is to focus on the enhancement of coherent LLL, on the Knowledge Triangle according to the background of EU materials and European expertise, concentrating on the LLL network in Hungary, as well as on the development of networks with LLLs in neighbouring countries. The best national features and achievements in LLL must be taken into consideration and shared as best practices, actively involving EU-level expertise and focusing on such particular aspects of LLL as e-learning. In the search to strengthen the European dimension and a mutual approach to LLL, the networking becomes a platform for common activities and strategies to be developed in the LLL area. The knowledge and experience gathered on the European level will be applied nationally and regionally, through the application of the best practises and methods adapted in the participating countries.

Hungarian lifelong education will be enhanced by developing institutional LLL strategies, securing better access to relevant teaching materials, encouraging European and national cooperation, augmenting comparative research on topics related to LLL, opening doors for industry-academic collaboration, designing training programmes to disseminate and apply topical knowledge, and promoting synergies between teaching and research by encouraging higher education institutions to integrate research results in their teaching. As a larger-scale objective, all this will reinforce the link between education and society, bringing together public-sector, scientific and professional players, contributing to the European innovation capacity. The key areas embrace the Knowledge Triangle, university LLL management, LLL-centred teaching, work-based learning, social inclusion and citizenship.

The realization process calls for reforms and renewal in the higher education system to adapt to the changing conditions of Europe and the whole world. One of the strategic objectives is "Enhancing creativity and innovation, including entrepreneurship, at all levels of education and training" (European Commission, 2010). The related challenges, including digital competence, learning to learn, acquiring a sense of entrepreneurship, and ultimately implementing the Knowledge Triangle by establishing partnerships between different sectors, represent the most important topics presently in Europe. Hungary is committed to meeting these challenges, as it is essential for the achievement of a sustainable society.

3. Good Practice: Budapest University of Technology in the Sirus Project

Most European Higher Education Institutions and other Continuing Engineering Education providers have been actively contributing to European Lifelong Learning. However, the time it takes from realizing the need for major shifts in mindsets to getting them practiced is unfortunately long. The European University Association (EUA) involved 187 higher education institutions in its Trends 2010 survey "A decade of change in European Higher Education", and the results indicated that the development of institutional continuing education strategies that support educational provision in the lifelong perspective evolve slowly. In Trends III (2003), 35% of the participating institutions stated that they had developed an overall continuing education strategy (Reichert et Tauch, 2003). Six years later, there was a negligible increase to 39% (Sursock et Smidt, 2010).

At the European Universities Association (EUA) Autumn Conference on "Inclusive and responsive universities" in 2008, EUA members from all over Europe adopted and the European Universities' Charter on Lifelong Learning. The purpose of this Charter – written in the form of commitments from universities in addressing the development and implementation of lifelong learning strategies, with a set of matching commitments for government and regional partners to make – was to assist European universities in developing their specific roles as lifelong learning institutions forming a central pillar of the Europe of Knowledge.

The EUA,[5] in a Consortium with the European Association of Distance Teaching Universities (EADTU), the European University Continuing Education Network (EUCEN) and the European Access Network (EAN), launched the project 'Shaping Inclusive and Responsive University Strategies (SIRUS)', to support universities in implementing the commitments made in the Charter. The project was carried out with the support of the Lifelong Learning Programme of the European Union.

The underlying assumption of the project was that many universities had already contributed substantially to lifelong learning but that these approaches were confined by national legal frameworks and financial provisions, and were often not guided by institutional strategies for LLL. This project therefore offered to universities at

[5] Altogether 850 members: universities and national rectors' conferences in 46 countries.

different stages of LLL implementation, and therefore with different profiles and interests in LLL, an opportunity to develop and enhance their strategic LLL approaches in interactive discussion with colleagues from all over Europe. At the same time, it allowed them to contribute to the development of policy recommendations for the European Higher Education Area.

3.1. Project Aims

The project set out to reach the following aims:

- supporting universities in developing and enhancing lifelong learning strategies,
- implementing and testing the commitments adopted in the European Universities' Charter on Lifelong Learning,
- ensuring the wide dissemination of existing best practices in the field to universities, governments and stakeholders and
- contributing to the further development of policy recommendations.

3.2. Main Activities

The participating universities conducted two major activities in the framework of this project. First, they conducted an institutional SWOT analysis of their lifelong learning activities and shared the outcomes of this exercise with their peers in a meeting in June 2010. Second, the outcomes of this analysis led into a new or revised institutional LLL strategy, presented by the university in 2010.

3.3. Project Methodology

To allow direct interaction, analysis and exchange of ideas, the participating universities had been split into thematic working groups. This allowed to build a community of peers and facilitated the development of the institutional LLL strategy. A holistic perspective on LLL was guaranteed through plenary sessions with all thematic working groups and input speakers.

3.4. Thematic Networks

The selected universities were divided into four thematic networks, according to their priorities indicated in their application form.

- Network 1: Embedding concepts of widening access in institutional lifelong learning strategies, enabling currently underrepresented groups to participate in higher education.
- Network 2: Strengthening the provision of university continuing education, catering to the needs of adult learners.
- Network 3: Consolidating reforms in creating a flexible and creative learning environment, making the best use of new technological opportunities.

- Network 4: Strengthening the role of universities in their regional context, by fostering, for example, more intensive university-business collaboration.

Each thematic network addressed a particular aspect of the Charter, while sustaining a holistic perspective on lifelong learning. The Charter was drafted to clarify the contribution of universities to the lifelong learning agenda, moving away from the "classical" understanding of various continuing education activities already taking place at university level, towards a concept of inclusive and responsive universities.

In this sense, the relevant paragraphs of the Charter for the thematic networks should not be seen in isolation, but as part of the overall analytical framework. The networks therefore served as a forum for discussion of small groups of universities, from diverse institutional and geographical backgrounds focusing more explicitly, but not solely on their thematic interests. A compendium publication based on reports from the networks as well as examples of good practices and strategic approaches implemented during the project was released in 2011.

3.5 Priority Issues

This project offered universities with different profiles and interests in continuing education an opportunity to develop and enhance their strategic CE approaches, focusing on the following priority issues:

1. Embedding concepts of widening access and continuing education in the institutional strategy
2. Providing education and learning to a diversified student population
3. Adapting study programs to ensure that they are designed to widen participation and attract returning adult learners
4. Providing appropriate guidance and counselling services
5. Recognizing prior learning
6. Embracing continuing education in a quality culture
7. Strengthening the relationship between research, teaching and innovation in a perspective of continuing education
8. Consolidating reforms to promote a flexible and creative learning environment for all students
9. Developing partnerships at local, regional, national and international level to provide attractive and relevant programs
10. Acting as a role model of continuing education institutions

3.6 SWOT Analyses

All the 29 participating universities, selected through an open call, among them the Budapest University of Technology and Economics as the only HEI from Hungary, were invited to:

- perform a SWOT analysis, using the LLL Charter as a framework for discussion

- design and adapt their institutional LLL strategy based on the SWOT analysis results
  – in consultation with their institutional leadership
  – and benefiting from a peer review in the thematic networks
- deliver the institutional strategy to the final project compendium

Tables 1 and 2 present the results from Network 2, with Table 1 focusing on strengths and weaknesses and Table 2 on opportunities and threats.

Institution	Strengths	Weaknesses
Budapest University of Technology and Economics, Budapest, Hungary	**Institutional** • Flagship Technical University • Several decades of training experience for teachers • Service and resource centre approach in continuing engineering education **Education** • High quality technical training • Strong doctorate schools **Research** • Excellent research laboratories & special research centres **Human resources** • High rate (52.2%) of highly qualified professors **Internationalisation** • Extensive local and international relationships • Education in foreign languages is strong and recognised	**Institutional** • In Hungary lifelong learning is not part of the internal quality process • Weak lifelong learning and further training opportunities for university employees **Education** • Overloaded professors • Preparatory and bridging courses only for foreign students • Recognising prior learning is a weak point **Research** • Activities focus more on funding and not directly on the economy **Human resources** • Human resource management is more ad hoc than planned **Internationalisation** • Disparity in the distribution of educational capacity

Table 1. Strengths and weaknesses.

3.7 Institutional Recommendation: Future Focus at the Budapest University of Technology and Economics in Hungary

Institutional

- Build strategic relations with stakeholders/labour market
- Build a coherent framework for LLL to elaborate strategic plans
- Consolidate the university's position as a lead LLL deliverer

Education

- Develop ways and means for recognition of prior learning
- Plan and implement change to create a LLL learning environment

Institution	Opportunities	Threats
Budapest University of Technology and Economics, Budapest, Hungary	**Institutional** • Strategic relations with stakeholders/labour market • Provide top-quality qualifications recognised (internationally) by learners, stakeholders and the labour market **Education** • Better utilisation of the results of the activities of the BME • Invert student rate from the point of view BSc and MSc **Research** • Strengthen the relation between university and industrial laboratories **Human resources** • Provide systematic training (LLL) for staff **Internationalisation** • Raise further prestige and reputation. • Increase international student and teacher mobility	**Institutional** • The traditional central issue of LLL is how, when and why people learn. However, today the actual issue in Hungary is why a significant proportion of the people does not learn. **Education** • Demographical decline • Governmental regulations control the competition and do not support quality **Research** • Increasingly fierce competition for national and international funding **Human resources** • Non-academic activities are financially more rewarding so talented people choose these instead of research and education **Internationalisation** • Well-qualified students apply to other HE institutions

Table 2. Opportunities and strengths.

Research
- Strengthen the relation between university and industrial laboratories

Human resources
- Provide systematic training (LLL) for staff

Internationalisation
- Raise further prestige and reputation
- Increase international student and teacher mobility

3.8 Results and Recommendations of the SIRUS Project

The SIRUS activities have shown that 1/3 of the participating universities have a strategy that includes LLL, 2/3 of them consider lifelong learning an activity and they support the Trends 2010 findings.

Some advice were formulated for the implementation of LLL strategy:
- leadership essential in formulating the concepts of promoting LLL and WP become institution-wide strategies,
- adopting an inter-disciplinary approach, developing new teaching methodologies and engaging professors,
- strengthening student services,
- benchmarking LLL activities and

- using the Knowledge Triangle – strengthen the relationship with employers and researchers – for building partnerships.

The participating institutions listed the major challenges in this aspect:

- creating a strategy and an action plan that involve academics,
- improving the flexiblity in the provision of learning and widening access including the recognition of prior learning,
- providing targeted student services,
- developing partnerships and
- securing sustainable funding.

The initial reactions to the different strands of the European Universities' Charter on LLL indicate that some are more challenging to achieve. The greatest challenges represent the following topics: adapting study programmes to ensure that they are designed to widen participation and attract returning adult learners; embracing lifelong learning in quality culture; strengthening the relationship between research, teaching and innovation in terms of lifelong learning; and acting as role models of lifelong learning institutions.

The network reports and discussions brought forward some interesting issues concerning the LLL strategy. The participants agreed that the following topics are challenging to address: legal framework, governance (leadership and management), funding, access and widening participation, student-centered learning, and finally moving away from the periphery to the centre of institutional strategy.

Interesting questions emerged, for example, should LLL be solely seen as an income-generating activity and/or as an opportunity to generate knowledge and development in a regional context? How can/should LLL compete with research? What is the relationship between inclusiveness and excellence? The representatives of the universities argued that three groups of actors are considered essential for the implementation of a successful strategy: students, academics and the leadership. Therefore, it is essential to engage staff, students and other stakeholders. As a conclusion, they stated that the institutions have to identify their target groups and track the students before, during and after their studies to be able to intensify learning, they have to integrate technology smartly into student-centered learning, and finally they have to pay attention to the shift from knowledge transfer to skills transfer.

3.9 Recommandations of the Higher Education Lifelong Learning Network

1. Higher education institutions must play a significant role in the renewal of the national lifelong learning strategy with their specialised field-related association (MELLearN: Hungarian Lifelong Learning Higher Education Network). It is imperative that higher education institutions change their approach to this field and recognise that lifelong learning must become one of the major fields of university education.
2. Hungarian higher education and its institutional forums (Hungarian

Rector's Conference, Higher Education and Research Council, Hungarian Accreditation Committee) and organisations representing professional interest must create a common strategy concerning the role of higher education.

3. The harmonisation of the quality assurance system of higher education institutions and the set of accreditational requirements of Higher Educational Research Council is imperative, including the formation of a common methodology. Generally, it has been noted that the simplification and acceleration of accreditation must be enhanced. Further to this, the three levels of accreditation – that of the Hungarian Accreditation Committee, the Higher Education and Research Council and the institutional level – must be harmonised and their permiability created. (The demand for accelerated and simplified accreditation and registration by the Higher Education and Research Council of the programmes that have been accredited and approved by the institution or the Hungarian Accreditation Committee has been widely recognised and stated.)
4. As for the regulations, the following main criteria have been identified as being of primary significance: transparency and long-term effectivity, non-standardised solutions, greater institutional freedom, flexible transfer between training levels, and credit transfer and recognition.
5. The clarification of the common and differing features in the content of lifelong learning (LLL) and adult education was identified as a theoretical demand.
6. Quality assurance is of high priority in LLL. The basic problem is that there is no follow-up quality assurance and monitoring once a programme has been accredited. There is no information on how the conditions and requirements presented in the accreditation application are fulfilled after the accreditation has been granted.
7. Knowing the actual needs of the economy and adjusting the programmes both in their content and methodology accordingly – these are definitive for higher education's successful and effective work.
8. The PR and the content and spirit of marketing are highly important along with creating a marketing-conscious approach so that the market could understand precisely the actual content of the programmes.
9. Developing partner relations both within and outside Hungary is a significant requirement. An absence of these contacts will have a negative influence on both the qualitative and quantitative aspects of the training and education programmes.
10. Creating a system of joint and collaborative methodological development and research is highly important with respect to the method (andragogy), tools and forms of teaching, as well. The methodological and pragmatic questions of distance learning and e-learning are also considerable in this field.
11. The training of adult educators and an education programme in adult training are the fundamental bases for future success.

12. Interdisciplinary research activities must be launched and the necessary funds must be provided by way of tender applications and research proposals. (Besenyei, 2008)

4. Conclusion

Today's traditionally closed higher educational institutions should turn into open service-providing institutions. Their knowledge material must be passed on to other participants of the knowledge region and activated so as to drive the knowledge region.

This requirement means that research must be directed to the problems raised by everyday practice, in contrast with today's frequently selfish practice of research for research's sake.[6] Third-party commissions and tenders should not merely be taken as sources of income but efforts are to be made to solve the problems raised by practice. They must ensure profitable operation in the given region, the building of the innovation link with the business sector, and the widening of the range of offers, including the fields of PR and marketing. Building the relational element, i.e. networking, is an important stage as is also the development of existing ones. A differential handling of the partners (e.g. business players, innovation centres, local government, other training institutions, professional interest groups, chambers of commerce, other knowledge centres, governmental or EU-relations) should be an imperative with regard to their role and purpose of involvement.

[6] It is generally acknowledged that Hungarian research results are only utilised in practice at an extremely low percentage rate. This is characteristic of the whole of Europe. It is, therefore, understandable that in the "duel" between the US and Europe the strengthening of the practice-orientation of European higher education and research has become a focal point.

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About the author

Anikó Kálmán is recognized as one of the few experts in Hungary in the field of Andragogy. She has a PhD in Educational Science and the Habilitated Doctor qualification in 2007 in management and organizational sciences. She is currently: associate professor in adult education and lifelong learning and deputy head of the department of Technical Education at the Budapest University of Technology and Economics (BME), academic staff member at the Doctoral School of the Faculty of Education and Psychology at the Eotvos Lorand University, Budapest (www.elte.hu), executive president of the MELLearN Hungarian National University Lifelong Learning Network (www.mellern.hu), adult education expert at the Hungarian National Ministry of Social Affairs and Labour and at the Hungarian National Ministry of Education and Culture, expert to the Andragogy Committee of the Hungarian Ministry of Education, expert of the Tempus Public Foundation in the fields of vocational training, higher education and R&D. Fort the past decade, she has served as an international working group leader of projects and networks in more than 30 countries.

Jukka Viitanen
CEO, Hubconcepts Inc
jukka.viitanen@hubconcepts.com

Markku Markkula
Advisor to the Aalto Presidents, Aalto University
markku.markkula@aalto.fi

Carlos Ripoll Soler
Valencia University of Technology (UPV)
cripoll@vlc-campus.com

VII. Systemic Development of Regional Innovation Ecosystems

Modernizing the Triple Helix

Abstract

Regional innovation policy initiatives are driven by the fundamental aim of bringing together key actors within a given region or district for joint innovation activities. The Triple Helix model has been widely adopted to help identify the key linkages and core functions between the public sector, academia and private companies.

However, this and other traditional collaboration models and frameworks have evidently remained too generic and abstract, and consequently, produced only nominal results in guiding regional innovation processes. It is important to note that the true nature of regional innovation ecosystems (RIE) is necessarily much more complex than understood so far, and thus, needs to be addressed in a more comprehensive and systemic way to provide functional guidelines for the development of operative innovation platforms. The Triple Helix and other models need to be complemented with market aspects, demand factors, and increased participation of citizens as users and developers of innovation. The models need to be supplemented with smart orchestration practices bringing together key stakeholder interests, and extended to address the specific challenges related to the value system competition in global contexts.

This article introduces a systemic way to modernize the Triple Helix model by determining the relevant ecosystem elements and designing a comprehensive concept for the effective development and orchestration of RIEs. The presented tools help RIE actors to assess, analyze and re-define the key roles and critical success factors for the development of attractive regional platforms for shared innovation creation.

Keywords: regional innovation ecosystems, Triple Helix, innovation hub management, smart orchestration

1. Introduction

Research, development and innovation play key roles in Europe's recovery from the financial crisis and its achievement of the Europe 2020 Strategy targets of smart, sustainable and inclusive growth. The EU Committee of the Regions (CoR) encourages the regions to move towards open innovation, within a human-centered vision of partnerships between public- and private-sector actors, with universities and other knowledge institutions playing a crucial role. CoR calls for pioneering regions to form European consortiums integrating different capabilities to create ground-breaking societal innovations for Europe-wide use. The focus should be, in particular, on making full use of digitalisation and new key enabling technologies to modernise regional innovation policy (CoR 2011; CoR 2012).

This article presents answers to these CoR messages in practice, reflecting especially the experiences of the Hubconcepts Innovation Hub Framework,[1] the Energizing Urban Ecosystems (EUE) research program,[2] and the International Campus of Excellence initiative.[3]

The broad picture of these EU challenges, as well as guidelines for action by the pioneering regions in achieving the objectives of Europe 2020 Strategy is described in an article in the EU Open Innovation Yearbook 2012 (Markkula-Kune, 2012). The

[1] The Hubconcepts Innovation Hub Framework is a tool for analyzing the maturity and functional characteristics of the regional innovation ecosystems. It has been developed through extensive, 15-year engagements in planning and management of innovation environments around the globe. Its core practices and elements for analysis derive from collaboration with hundreds of science/technology/research parks, incubation environments, innovation centers and regional cluster programs in over 20 different countries, resulting in a comprehensive database on global best practices in innovation ecosystem management and related collaborative processes.

[2] The Energizing Urban Ecosystems (EUE) is a research program of RYM (Strategic Centre for Science, Technology and Innovation for Built Environment). The funding of this four-year program is EUR 20 Million, half of this from the Finnish industry and half from Tekes (The Finnish Funding Agency for Technology and Innovation). EUE program focuses on building solid foundation for the comprehensive understanding of the planning, design and management of the future urban ecosystems, and turning this accumulating intellectual capital and know-how into successful, global business processes. EUE program's scientific collaboration model combines academic and industrial research processes into same research framework. It brings together cross-sectorial, interdisciplinary research teams to study, develop, deploy and test hypotheses and accumulating knowledge for joint outcomes.

[3] VLC/CAMPUS is an extensive initiative for the establishment of an International Campus of Excellence in the metropolitan area of Valencia. It intends to lead, from its area of influence, a change towards a new socioeconomic model, one that is more knowledge-intensive and more prepared to enhance employability and productivity, converting the VLC/CAMPUS into a hub of knowledge of international excellence, through specialization of scientific-technological production in health, information/communication and sustainability. It also aims to improve the quality of training on offer, services and facilities, with an orientation towards student centrality and to promote attraction and retention of talent. Further, it leads, from its own area, the change towards a new social and economic model in the territory, more intensive in knowledge and a generator of employability and productivity and acts as reference model for those values and socio-cultural innovations that allow for a transition towards a sustainable economy and society.

following observations from the Yearbook provide a a starting point for the present writing: "So what does Europe need now? The target has to be bridging the gap between existing research results and actual practice. Structures and processes in cities and regions must be developed, even radically changed, in accordance with the latest research results." The following guidelines were defined for immediate action:

- "The focus must be on creating and implementing innovations on a practical level, based on values and mentality, in order to achieve concrete results for the well-being of citizens;
- Political decision makers should consistently demonstrate the courage needed to aim for the highest ambitions and bring forth something radically new;
- Regions and cities should create pioneer initiatives that are genuinely European by nature: multicultural, human-centered, focused on societal innovations and capabilities for creating better structures for the welfare society and laying the groundwork for the Digital Single Market development."

The pioneering activities of regional innovation ecosystems have largely centered on the mutually complementing challenges of fostering the local pools of know-how and knowledge co-creation, as well as managing and orchestrating the actions of stakeholder groups. The most attractive regional innovation ecosystems (RIE) have been built on a strong knowledge base, accumulating network of complementing innovation processes, and advanced combinations of innovation resources, especially talent, funding and infrastructures (Launonen & Viitanen, 2011). The top RIEs have managed to channel the accumulation of academic knowledge to joint innovation activities and to integrate the related outcomes with the market-driven commercialization processes.

The Triple Helix model (collaboration between academia-industry-public -sector) and the Knowledge Triangle approach (synergy between research-education-innovation) have been adopted to explain the related dynamics and to justify the interlinked relations of the collaborative stakeholder groups. They address the challenges in transforming the highly specialized talent pools into productive co-creation enablers and in harnessing the complementing processes for synergetic outcomes. However, this article argues that the traditional stakeholder group models and intra-regional analyses provide inadequate support for RIEs preparing for truly global competition.

The future top RIEs will be embedded in a more globalized, interconnected and collaborative context, where digitalization is a key driver of change, i.e. information, resources, talent and solutions can flow freely and effectively between mutually complementing and/or competing locations. The accumulation of innovation resources no longer endorses nation states, regions and/or organizations, but instead, they will increasingly build on mutual trust and interest and maximized utility of matching self-interest and collective outcomes.

Under these circumstances, the new role of decision makers becomes a critical success factor. They must prepare for continuous competition in creating the best preconditions for innovation culture and concentrate their efforts on setting up at-

tractive, functional and thoroughly interconnected platforms for effective knowledge and technology transfer and knowledge creation – as well as timely commercialization. Accordingly, it is important to address the globalization challenge in relation to overall RIE development and identify the key factors supporting a comprehensive management approach focusing especially on orchestration of new forms and mindsets for collaboration, networking and joint actions.

The RIEs need to complement the pure technology-push approach with a market-pull type needs analysis for penetrating a growing number of market segments. The future challenge for the development of RIEs lies in their ability to extend the impact and value of network collaboration closer to the marketplace, increasing the involvement of customers in the innovation ecosystems. The new dimension in this is the changing role of universities. To respond to societal challenges, universities need to develop new forms of knowledge flows between various innovation ecosystem actors from knowledge creators through knowledge users to final beneficiaries.

The practically free movement of skilled people brings down artificial national borders and provides an opening for a creative transfer of knowledge between the interconnected innovation ecosystems. Accordingly, we have to modernize our thinking on future development of RIEs and adopt a more systemic, ecosystem-level approach, which incorporates the extended Triple Helix model into the practical RIE orchestration approach.

2. The Triple Helix Model Extended to the National and Global Contexts

This article proposes that the appropriate way to create a picture of regional innovation ecosystem connections is to address the question of the respective roles within the system of key innovation actors. An applied Triple Helix model (Etzkowitz, 1997; Leydesdorff, 2006) captures the multiple reciprocal relationships of the public-private-academia innovation activities, where each performs its respective role while actively seeking value-added collaborative arrangements for upgraded, shared results.

The public sector provides funding and other resources as well as testing/piloting platforms for others and receives, in turn, know-how for managing its processes and applicable solutions for the public service provision. Academia focuses on its traditional strengths and creates scientific knowledge and other intellectual properties and educates R&D talent for the private sector innovation creation projects. The companies benefit from the public research results and accumulation of scientific know-how, as well as rely actively on public services in their daily operations. In exchange, they return private know-how to academia and contract research for further IPR generation, while participating in developing the public services and piloting their product-service packages in given social contexts (see Figure 1).

In the given, broader RIE development context, the conventional Triple Helix model needs to be embedded into applicable national and global innovation environments, which directs all the key actors to extend their related planning processes to national and global contexts. This extension in the planning approach brings into focus the

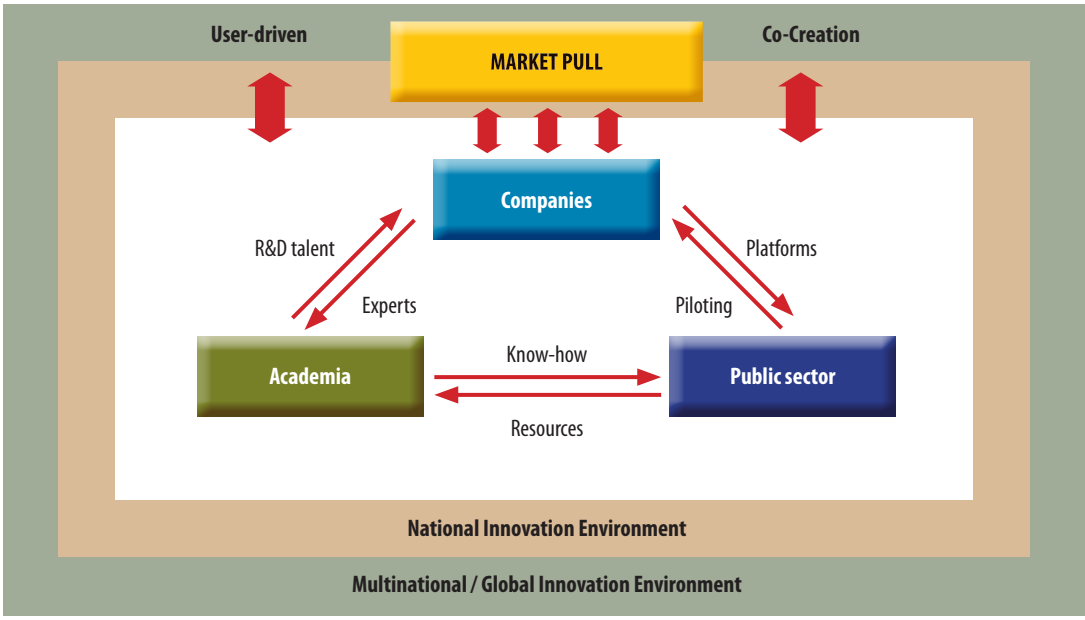

Figure 1. The Triple Helix model linked to the user-driven market-pull mechanism.

necessity to address the demand factors (market pull) parallel to the intended supply of knowledge and technical solutions (technology push). Benchmarking the globally leading innovation ecosystems (Launonen & Viitanen, 2011) and applying these experiences to the outcomes of the EUE research program give new evidence that locally optimized RIEs cannot produce the highest quality results anymore, as so much key scientific knowledge and so many technological inventions are generated almost exclusively in global settings supported by a practically free movement of talented people between competing value systems.

The target markets evolve rapidly and new needs arise in unanticipated combinations of new knowledge, which challenges the traditional innovation creation processes. Users and clients become active participants of the innovation processes themselves and dictate, in part, the future success of all innovation activities. Consequently, local RIEs have to navigate through several emerging options and engage in collaboration through joint platforms and contribute actively to the key global value networks.

The world around RIEs is moving towards an era of value network competition and advantage, where innovation and knowledge brokering take place in increasingly open, shared settings. Accordingly, the future success of any RIE is measured increasingly through its abilities to connect and manage:

- the inter-actor functional innovation processes,
- the strategic partnerships for regional partnerships,
- the complementing cluster activities for joint business development, and
- the accumulating talent flows.

In short, what matters is how well any given RIE can integrate the relevant local knowledge base with the global innovation creation power grid. Active networking relationships with other global top-runner environments boost local abilities to attract a continuous flow of global players (anchor companies, growth SMEs, ventures and first-class researchers) into collaborative innovation activities.

3. New Foundations for the Regional Innovation Policy and the Development of Specialization Capacity

Regional innovation ecosystem development takes time and builds on national policy makers' decisions on regulatory environment, nationally important infrastructure improvements, cluster formation support programs, incubator development, and related funding mechanisms for innovation activities. Depending on the existing national and regional structures, the impact of these policy actions can be anything from "the last little push in the right direction" to a comprehensive policy framework setting for innovation. But in any case, ecosystem development is highly dependent on public policy decisions and relies to a great extent on continuous support from the national, regional and local authorities. Figure 2 describes the three stages needed for creating an innovation ecosystem with regional significance. Organizing target-oriented transformation processes requires well-planned, conscious activities throughout all these three stages. The activities are partially parallel, depending much on the commitment of the key Triple Helix actors.

The pre-conditions for a positive start are (see Stage 1 in Figure 2): 1) a real potential for an innovation activity within the existing regional system and 2) a willingness to utilize this potential. It is important to start ecosystem planning with a comprehensive, honest assessment of the regional potential. This includes auditing:

- the existing built infrastructures (public, private, academic),
- the key technological strengths (own and acquired),
- the regional risk-taking capacity, and
- the usability of regional intellectual asset stock for private companies.

It is equally important to audit also the regional key actors and their role in the future development. This includes assessments of the cluster management capacity of the public office, willingness to provide platforms and funding for innovation activities, and ability to commit the required resources (infra, people and money) to international collaboration. Academia must be assessed for its overall scientific abilities (faculty structure, number of researchers, research output, number of centers of excellence etc.), its ability to create commercially interesting intellectual properties that create grounds for patenting or new business creation (start-ups and licensing), and its readiness to provide adequate services in R&D contract management and technology transfer.

The private sector audit should include a comprehensive industry analysis to identify the potential anchor companies, the promising growth companies and the dynamic start-up ventures that can complement the ecosystem with the commercializa-

tion talent required for regional prosperity. These sector-specific assessments can be complemented with a related human resource (HR) audit, where the focus is on the regional talent pool, its development and training. During audits, it is important to identify the potential gaps within the ecosystem and plan for actions to attract and recruit "glocal" talent to the emerging value network roles.

The analysis continues to "softer" elements such as cooperative interaction between the above key stakeholders. These are the preconditions for the necessary steps in creating the innovation hub system. Here the focus is on formalized collaboration platforms, forum activities specific to different industries and interests, and voluntary social networks, which serve as the glue tying the ecosystem elements together. The practical management of these activities is often decentralized to various associations, special interest groups (SIG) and non-profit organizations. Nevertheless, they are a key element for the potential success of the given RIE and should intentionally be managed as part of the whole.

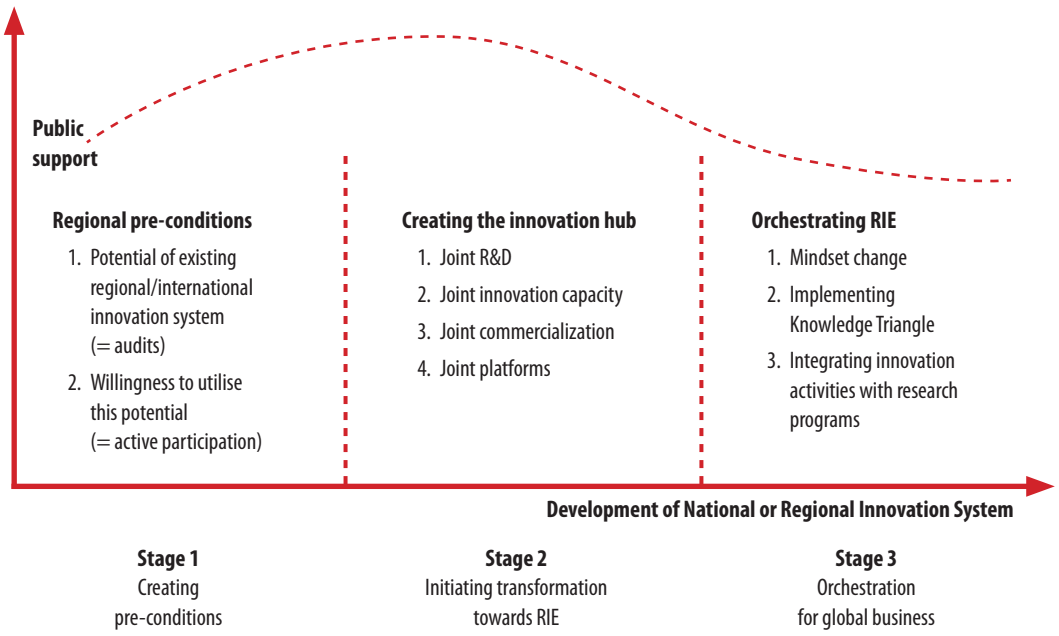

Figure 2. The development path of the regional innovation ecosystem.

If and when regional decision makers decide to upgrade their respective innovation ecosystems to be globally interconnected, the regional audits should be extended to analyze also the global role and targets of the ecosystem. The first notion is that to be globally competitive and interesting, the region must make sure the key results (quality, critical mass in numbers, relevance, degree of specialization etc.) of all of the above basic audits create an appropriate foundation for its global actions. In addition, the core hub management actor and key ecosystem stakeholders should have the ability to connect to (other) advanced global innovation hubs, provide the necessary services, e.g. outsourcing support, intermediary access, talent and IPR sourcing for global market entry, and find a role in the global value network collaboration. It

is also advisable to start early in planning for the location-specific questions such as international schools, tax issues, labor market conditions that arise from active global engagements.

4. The Interplay and Matching of Parallel Interests in the Regional Innovation Ecosystems

Stage 2 on the development path of the regional innovation ecosystem refers to the joint activities to initiate steps towards RIE. Hubconcepts Inc. addressed the challenge of the RIE development in their benchmark studies on all continents (Launonen & Viitanen, 2011). They have developed an innovation hub framework, which illustrates the key regional innovation ecosystem elements that are necessary for building up a successful regional innovation hub (see Stage 2 in Figure 3). These elements include:

- regional and national (innovation, education, research, economic) policy frameworks,
- physical infrastructures and service structures (basic, KIBS, coordination),
- the education system (from basic to university level education, researcher training, adult education, lifelong learning),
- research and development activities (public and private),
- cluster policies and programs (industry, regional capacity building),
- Living labs and Test beds (technical, learning, co-creation),
- incubation environments (entrepreneurial training, pre-incubation, acceleration),
- start-ups & Growth SMEs, and
- anchor companies.

Traditional management practices do not create necessary prerequisites for the comprehensive processes towards RIE. It is noted that even though each element (layer or driver) represents a significant development task of its own, it is only together that can they produce the true ecosystem, which can rise to the globalization challenge and take its place in the value network context. Accordingly, the core RIE orchestrators should be able to plan, organize, manage and further develop further the regional ecosystem as a complete set of interconnected elements where interplay and complementarities between the layers give the ecosystem its soul and strength.

The comprehensive RIE planning and management challenge stems arguably from the aim of combining the parallel interests of the innovative processes driven by the private sector (companies and forums), the public sector and the public-private partnerships. As noted, every framework layer is important and the missing parts cannot easily be substituted with compensating activities in other layers. Moreover, national and regional innovation policy frameworks put some regulatory limitations on the alternative available paths to be adopted. The related critical management issue can be found in managing collectively the various sectorial interests and interfaces. Stage 3 in Figure 2 on the development path of the regional innovation ecosystem labels this key activity as smart orchestration, which implies active cross-sectorial commu-

nication to reduce overall ambiguity, coupling the sector-specific needs and requirements for a unified ecosystem structure. All activities during Stage 3 should focus on the creativity and innovativeness atmosphere, in which increasing and making the entrepreneurial mindset visible is the key success factor. The other all-permeating success factors leading the joint development of the pro-innovation culture and shared processes towards global value network excellence are implementing the Knowledge Triangle and increasing the role of high-level research within the innovation ecosystem. Smart orchestration facilitates ecosystem integrity, creating a unified code in bringing together the parallel innovation processes and distributing the best-practice know-how on all innovation-related issues (e.g. technical and managerial).

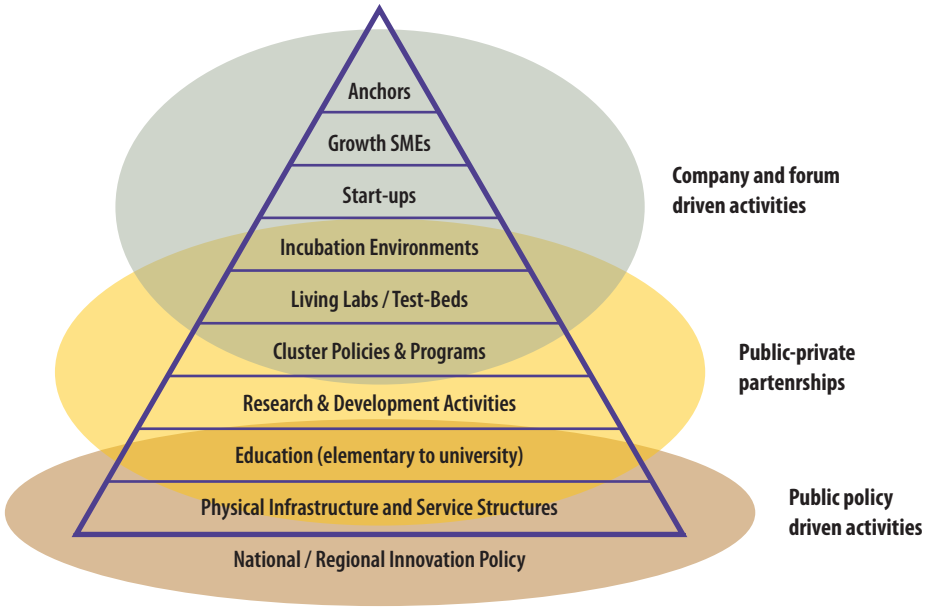

Figure 3. Modernizing the Triple Helix thinking in RIE context through the Innovation Hub Framework.

The innovation hub framework opens up the local Triple Helix model and extends the RIE development focus to embrace all core stakeholders uniformly. It addresses the core challenge of overall RIE orchestration, while tackling the specific issues of managing the inter-sectorial interfaces and balancing out the conflicting stakeholder group interests. More details about the practical use of the framework can be found in the Hubconcepts case studies on Silicon Valley (USA), Research Triangle Park (USA), Sophia Antipolis (France), Cambridge (UK), Otaniemi (Finland), Daejeon (South Korea), Kanagawa (Japan) and Shanghai Pudong (China).

5. The Comprehensive Bench-Learning Approach for the Functional RIEs

The above discourse has introduced an extensive approach to regional innovation ecosystem development, advocating coordinated planning and implementation of the key ecosystem elements and close interplay among the key innovation actors. The framework guides regional planners, political decision makers and core intermediaries to address the ecosystem development from a unified cross-sectorial point of view – as a complete regional master planning challenge to connect both public- and private sector interests for joint innovation actions. If managed properly, these collaborative actions can lead to mutually reinforcing arrangements for parallel innovation processes, and facilitate the efficient distribution of best practices throughout the ecosystem.

In this context the changed realities of the planning and management of RIEs require special talent and particular abilities to interpret and match the multi-domain interests under one unified management structure, in which orchestration is a key success factor. Someone must specialize in aligning the collaborative processes, network relationships and gradually developing common practices for effective innovation creation, accumulating the required experience, know-how and connections to one core entity for efficient ecosystem-level coordination. Consequently, orchestrated ecosystem development calls for the establishment of a dedicated hub management actor taking responsibility for facilitating the processes to defining a shared vision for the future of the ecosystem, a clear set of objectives for the continuous maintenance of network relationships, and guidelines for effective project coordination and resource allocations throughout the ecosystem. This innovation hub actor can focus its efforts on the ecosystem-level target setting, relationship management, and resource allocations.

In practice, these hub actors can take over the coordination task of hub planning and management functions, and concentrate their efforts on building up the necessary partnerships for systemic, reciprocal success. They can serve as the ecosystem management supporting the innovation actors in their joint activities:

1. draft the master plan for the entire ecosystem,
2. build up and complement local networks for quality service provision,
3. provide hands-on support for intra-ecosystem networking, information exchange and cross-domain communication.

They can orchestrate the joint initiatives and development programs, channel resources to the region and to local innovation actors, and build a positive brand image for the region (see Figure 4). In this way, the innovation hub actors serve others as true needs-seeds mediators, value system matchmakers and regional networkers.

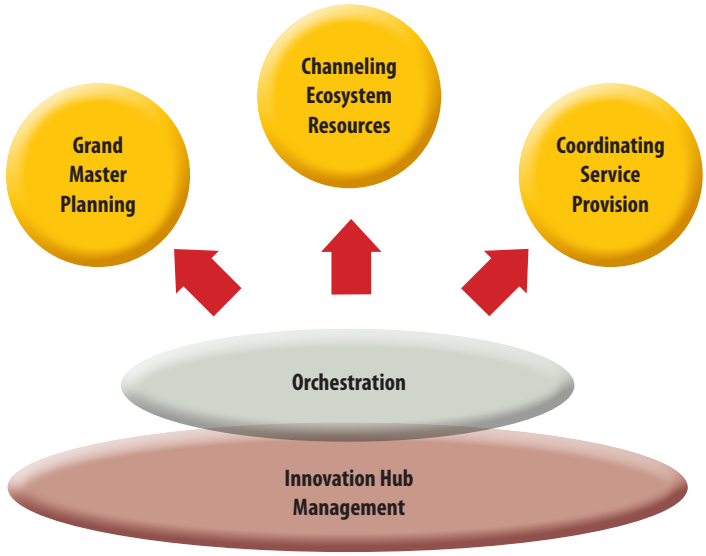

Figure 4. Smart orchestration with different hub roles.

5.1. Grand Master Planning

As argued above, future RIE development processes should be built on comprehensive regional master plans, where all the related ecosystem elements could be addressed concurrently to ensure their highest quality, reciprocal compatibility and relevance in the broader global context. These top-down plans translate general collaboration ambitions and ideas into practical development concepts, integrate diverse bottom-up innovation creation practices into manageable entities, and introduce comprehensive targets for elevated, ecosystem-level innovation outcomes (joint vision and shared targets). Accordingly, the best master plans include:

- guidelines and criteria for setting up and/or further developing the physical and institutional infrastructures,
- recommendations for the development of the regional service structures, and
- plans-related key programs for layer-by-layer upgrades and implementation.

If and when accomplished properly, the process translates into an extensive dialogue between the key decision-making parties to identify the full potential for mutual benefits, and brings together the complementing innovation practices for effective IPR creation, product/ service/solution combinations and timely commercialization.

5.2. Coordinating Service Provision

Innovation hub actors can serve ecosystems in several intermediary roles, facilitating cross-industry/domain collaboration and providing professional services in their own specific fields of expertise. They can:

- coordinate the ecosystem-level service provision (use of facilities, development of the KIBS network, upgrades in incubation and growth services etc.), and
- safeguard the set quality criteria for planned infra- and service structures (such as audits, evaluations, referrals).

They can guide, promote and support the other service providers in building up their respective businesses and make sure that all actors strive for top quality and global best practice. In many cases, this work is organized as an advisory service function, which assists collaborating stakeholders in cross-domain project planning and related contract management (including local service provision). These guiding actions can improve the overall process efficiency and optimize the flow of expertise, knowledge and talent throughout the ecosystem.

5.3. Smart Orchestration

As identified earlier, the coordination of parallel, partly even conflicting sectorial interests, and the orchestration of common collaborative interfaces have proven to be one of the most critical management issues for all innovation hub organizations. The public-sector actors focus on setting up the policy foundation and related regulatory framework to meet the broadest possible societal needs and actively promote innovation, cross-sectorial collaboration, while the private-sector actors plan to line up their in-house innovation processes for delivering the maximum commercial benefits. As neither party could accomplish their respective missions without the other, they are drawn to establish productive, mutually beneficial partnerships. However, they often lack the necessary understanding of the related key factors (including common terminology, need for sharing interests with third parties, facilitating work methods) that need to be aligned for truly fruitful outcomes. Hence, it is common that they look for interpreters, facilitators and coordinators to mediate the process, which usually means business for the hub organizations.

This key orchestration activity is called smart orchestration, which implies:

- active cross-sectorial communication to reduce overall ambiguity,
- coupling the sector-specific needs and requirements for a unified ecosystem structure, and
- leading the shared development of the pro-innovation culture and joint processes towards regional ecosystem excellence.

Smart orchestration facilitates ecosystem integrity and increases synergy, creating a unified code in bringing together the parallel innovation processes and distributing the best practices on all innovation related issues. The proposed management approach calls for an explicit shift of focus into managing the related, industry-specific interfaces for effective cross-sectorial processes, and a smart approach to addressing the associated hand-over of responsibilities, control and authority across domains.

5.4. Channeling Ecosystem Resources

It is natural to conclude that innovation hub actors could also play an important role in channeling and managing the ecosystem-level resource flows to support shared activities and collaborative processes. In most cases, ecosystems can benefit from a professional coordination function, which specializes in:

- core funding issues (e.g. options of public investment support, regulation and practice for public procurement, program funding for coordination)
- application procedures (domestic and multinational context), and
- channeling resources (both public and private) for effective combinations.

Self-evidently, accumulating expertise improves overall process efficiencies and facilitates practical coordination. Consequently, hub actors could play a key role in advising the other innovation actors in the planning and management of joint infrastructure projects, layer-by-layer development programs and related coordination of regional innovation creation processes. They can focus on securing and upgrading the required human resource pools for innovation, support regional project creation, and plan for an appropriate portfolio of the key science and technology and R&D infrastructure/service assets for all to share, while public officials, researchers and business (wo)men could focus on added value creation and optimized innovation processes.

6. Conclusions

This article set out to examine the modernization of the Triple Helix model in a way that meets societal renewal needs. The progressive (re)combinations of first-class master planning and community development create visionary foundations for advanced urban planning and visions, building up a common basis for open living districts for induced innovation activities. This approach connects science and technology policy's planning and management processes to the broader regional (or even national) development context and introduces the key concepts needed for creating shared, business-oriented innovation platforms and attractive living environments for induced innovation activities.

This article advocates that, in the future, every globally attractive innovation hub requires a core hub organization for taking responsibility for the key management functions in coordination, program planning and management, value network development and maintenance, and securing and upgrading the required human resources pool for the foreseen innovation activities. In doing so, the hub management team generates an attractive innovation ecosystem to support the hub members in their drive for global actions and reach. The well-functioning innovation hubs weld together the parallel socio-economic targets and private sector's interests in expanding their business opportunities.

It is believed that future success lies in a more comprehensive regional planning, a combination of parallel complementing management processes and real customer-

driven benefit analysis in a core ecosystem planning. Moreover, we see a shift to a more comprehensive regional master planning where real-estate development projects constitute only a part of the wider community and cluster initiatives, providing the required infrastructure for the changing future in living/business/innovation environments. This requires a systemic approach to the regional innovation policy. As a consequence, the management requirements within the local hub will change to better facilitate the hands-on coordination of the ecosystem activities, stakeholder group coordination, and management of the change itself. However, traditional management integrating strategy to operational processes does not guarantee desired societal progress. Orchestration, as described in this writing, creates the necessary synergy between different sectoral activities, which are traditionally carried out in separate projects and siloed working culture.

Accordingly, it is strongly advocated that regional decision makers should begin to address the innovation ecosystem development challenge in a more holistic manner and start systematic ecosystem-level development processes in close collaboration with key private-sector actors. It is recommended that regional actors start a systemic regional master planning process, where all related ecosystem elements are addressed concurrently (as implicated in the above innovation hub framework). This process should embrace an extensive dialogue between key parties to identify real potential for mutually beneficial practices and their implementation in setting up an attractive environment to facilitate targeted long-term innovation creation.

Consequently, the practical innovation regional planning and management challenge is in combining the parallel interests of the innovation processes driven by companies, the public sector and the public-private partnership. All key decision makers in both the public and private sectors must be brought together to design a shared future vision for regional development in a wider global context. These key parties should, then, agree on their reciprocal roles and responsibilities in implementing that shared vision and in their joint policy and targets for the related necessary investments. This collaboration would accelerate the respective ecosystem development processes to meet the tough globalization and digitalization challenges and create complete, locally optimized value systems for swiftly globalizing industry clusters. Smart orchestration opens new avenues for collaboration, both regionally and internationally.

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About the authors

Jukka Viitanen has a Ph.D. in Information Systems Management and M.Sc. in Marketing. His academic research has focused on strategic alignment and global network management specializing later on in innovation ecosystem management. Viitanen has extensive international experience in planning and managing innovation environments for global excellence. He has served several organizations in Asia and Oceania and participated in founding of the Finnish Science Institute in Japan (Founding Director), the Finnish Innovation Center – Finnode Japan (Founding Director) and Asia-Pacific Insight consultancy (CEO) during his 15 years abroad. Moreover, Viitanen has developed several governmental programs to facilitate cross-border technology transfer, SME market entry and S&T funding collaboration between Finland and its international partners. In his work, he has been responsible for drafting strategies, proposals and programs for international science and technology collaboration and cluster collaboration. Viitanen published a book in 2011: "Hubconcepts™ – The Global Best Practice for Managing Innovation Ecosystems and Hubs"; including analysis on science and technology parks, regional innovation ecosystems and innovation collaboration, based on case studies in Asia, Europe and North America 2008–2010.

Markku Markkula, MSc, works within Aalto University as the Advisor to Aalto Presidents, focusing on European Union strategy affairs. His previous university assignments comprised membership of Aalto University Transformation Team (2008–2009) and the Director of the Centre for Continuing Education (1985–1991) and the Lifelong Learning Institute Dipoli (1992–1995, 2003–2008) of the Helsinki University of Technology (TKK). Markkula is a member of the EU Committee of the Regions, CoR. He is the Chair of the EPP/CoR Task Force on Europe 2020. His CoR role includes being the rapporteur on the Role of Local and Regional Authorities in Achieving the Objectives of the Europe 2020 Strategy, as well as the rapporteur on the Horizon 2020. Markkula is a former member of the Finnish Parliament (1995–2003) with membership roles in the Committee for Education, Science and Culture and the Committee for the Future. As an MP his international role included the Presidency of EPTA Council, European Parliamentary Technology Assessment Network. He has served the global engineering community as the part-time Secretary General of the International Association for Continuing Engineering Education IACEE 1989–2001. He has been awarded the European Society for Engineering Education SEFI Fellow 1995. As a tribute to his achievements he was in 2008 elected to the International Adult and Continuing Education Hall of Fame. In Finland his role has included memberships in the boards of several companies and organizations, among others Tekes, the Finnish Funding Agency for Innovation and Technology. He has also served Finnish society as the Chairman of the Espoo City Council (1990–1992, 2010) and the Espoo City Planning Board (2004–2012), as well as the Chairman of the boards of the Finnish Association of Graduate Engineers TEK (1993–2005) and the Finnish Information Society Development Centre TIEKE (2000–2011).

Carlos Ripoll holds an MSC in Industrial Engineering and an MBA. Currently he is Director of the Universidad Politécnica de Valencia international Campus of Excellence (VLC/CAMPUS). He is former Vice-president of the Euro-Latinamerican Network for Continuing Education and former Secretary of the Working group for Continuing Engineering Education at the European Society for Engineering Education. He is also a frequent speaker at various international forums about Higher Education Management. Carlos has coordinated several European projects, like the European Universities Quality Management Tools (UNI-QM), recognized by the European Commission as a best practice in its field. He has also managed other projects in the area of work-based learning, such as Ergomach, financed by the European Commission, SINCERE, financed by the VI Framework Programme targeted to develop international networks in the field of Higher Education research, and EQIBELT, instigated to evaluate the influence of eLearning on Higher Education and its relation to quality.

Esa Viitamo
Research Fellow, BIT, Aalto University
esa.viitamo@aalto.fi

VIII. Productivity – Implications to Educational Services

Abstract

Competitive advantage in small knowledge-based economies draws increasingly upon the capabilities of their universities to provide sufficient amounts and the right qualities of human capital. This article suggests that state-of–the-art in service productivity provides a viable framework to tackle the issue more operatively. In this article, the productivity of the university education is addressed from the dual perspective of the service provider (the university) and the clients (the students). This implies that the productivity of educational services has to reconcile two main objectives. The first is scale efficiency, where the aim is to reduce unit costs of service delivery through replication and the economies of scale. The second is effectiveness, which denotes the customization of the services to the needs of individual customers. The analysis proposes the need for the education policy to be supportive of innovations that improve the productivity levels in the universities and the actions to attain the right balance between scale efficiency and effectiveness in the educational services. An improved match in the supply and the demand of educational services enables a more efficient allocation of the public resources.

Keywords: service, education, productivity, scale efficiency, effectiveness

1. Introduction

Aalto University contributes in various, concrete ways to the interaction between research, education and innovation, which are the key drivers of a knowledge-based

society. As one endeavor of this kind, Business Innovation Technology (BIT) Research Centre at Aalto has for more than two decades conducted multidisciplinary research at the interface between technology and human activities, with its aims high on achieving societal impact. In research areas such as supply-chain management and logistics, project business, and services innovation, BIT has established itself as a world-class leader. This article offers a novel, two-fold approach to services research by depicting how BIT activities contribute to the **Knowledge Triangle.** On the one hand, it manifests an innovative approach to the research of service productivity. On the other, it demonstrates the ways in which a university is striving to learn from its own research results, by integrating innovative productivity thinking into the services it provides to its students.

The expansion of the service sector is the most prominent feature of the present economic and societal evolution. This makes it increasingly important to develop novel approaches and tools in assessing the productivity of service activities of the private and public organizations. While the traditional manufacturing approach assimilates productivity with efficiency and input-output ratios, the analysis of service productivity, specifically in the knowledge-based services of university education, requires a careful apprehension of the customer perspective, and hence the outcome of the service provided. Based on a provider-user perspective, the discussion of service productivity here is generic and applicable to both private, market-based services and public services. In particular, the purpose is to provide some reflections on the public educational services. In this context the service provider (service organization) is the university with employed lecturers, professors etc. whereas the users (customers) are the students taking courses at the university. The discussion on service productivity in this article is divided into 7 sections. Section 2 makes a brief conceptualization of service activities that accounts for the specific characteristics of educational services. Section 3 discusses the key elements of service **transformation,** whereas Sections 4 and 5 highlight the central aspects of service productivity. On that basis, Section 6 outlines a generic framework to illustrate how service productivity can be operationalized in the context of university services. The main implications of the productivity framework are discussed in Section 7.

2. Service Conceptualization

In common language, **service** is usually understood as a value-adding process or the outcome of that process provided by individuals to other individuals. Professional discussions and analyses of services are attached to one of the three levels of economic aggregation. At the lowest level the focus is geared to individual **service activity,** which may concern an internal activity of an organization, or an external activity provided by organizations or individuals with other individuals or organizations. The activity level shows the highest complexity, as the definitions of service activities should capture the various dimensions and purposes of services in a comprehensive way. At the intermediate level, a service is equalled to the principal business activity of a **service organization** (the provider); the production and delivery of services to the

external clients. At the highest level of aggregation are **service industries** or sectors, which are defined by official, international standards.

A pragmatic approach to the definition of services is to identify the key distinctions between goods and services. Multidisciplinary research has suggested some specific characteristics as common attributes of all services. The underlying feature is the intangibility of the service process and the outcome, which entail the distinct characteristics of **perishability** and **non-storability** of the service outcome. Owing to these attributes, production and the outcome of services are subject to marked **uncertainty** in comparison to more tangible goods. More than material products, services can be **customized,** which also implies that **clients participate** in various ways in the design and production of the purchased services. Naturally also universities aim to consider the needs of their clientele, the student, in curriculum design. The examination of the distinct properties of services has resulted in a number of descriptive definitions for services (Parrinello, 2004). Many scholars (see e.g. Gadrey, 2002) have referred to the definition of Hill (1977): "A service may be defined as a change in the conditions of a person or a good belonging to some economic unit, which is brought about as a result of the activity of some other economic unit with the prior agreement of the former person or economic unit" (op. cit. p.385).[1] The definition suggests two necessary conditions for the existence of a service. First, the attributes of the targeted service, human or non-human should change through the service process according to the specifications laid in the service contract.[2] Second, to be a service, the process resulting in the upgrade should be performed separately by an independent service provider. Focusing on the service outcome, Hill's definition avoids the inherent problems associated with the intangibility of the process.

Over the 1970's and 1980´s, the essence of a service was well-captured by the cited definition of Hill (1977). Undoubtedly, technological change, such as digitalization of service activities and changes in the market environment (competition) may require refinements and implementation of a more generic definition of service. For example, information and communications technologies (ICT) enable packaging, storing and transmission of a growing number of knowledge-based services, which breaks the traditional concurrence of service production and consumption (Parrinello, 2004).[3] This is the case of many educational services, as well. It is maintained here that Hill's original definition of services still holds, but technology tends to displace traditional service functions and transform them into new forms of commodities, hybrids and intangible goods. In this case activities may enter into and exit from the **absolute** service definition by Hill.

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[1] In his later refinement, Hill (1999) emphasizes that services should not be identified with immaterial goods.

[2] Most often the change means an up-grade of the specific attributes of the object.

[3] While the service processes cannot be stored, the outcome of the service can, and will be, increasingly so. The technical advances that enable spatial separation of service production and consumption fosters the economic incentive to service outsourcing, respectively.

3. Transformation of Inputs to Outputs

Owing to their discontinuity and non-repetitiveness, service processes cannot usually be prescribed in terms of smooth neoclassical production function. Gadrey (2002) notes that the production function of most services can be analyzed as a combination of three sets of functions or **purposes** each associated with different types of technologies, organizations and efficiency criteria. **Informational functions** (1) are direct components of the delivered service management functions internal to an organization. This recognizes the fact that information and knowledge are essential ingredients of service output and input. The **functions of material logistics** (2) are by definition characteristic of specific services, such as transportation and retailing. The **direct service functions** (3) are associated with face-to-face contact with clients and involve care, assistance and advice to customers. Where the explicit form of the physical production function for services is not known or does not exist, service production can be described as a generic process where inputs are transformed into outputs. Characteristic of most manufacturing processes, transformation in services is also an irreversible process as the outcome of the process cannot be re-transformed back into inputs. For goods production, the transformation is inherently physical, leading to a new tangible outcome. Services transformation is directed to an existing object – physical or non-physical – resulting in an improved object state. Gadrey (2002) identifies four types of objects in service transformation:[4]

- goods and other technical systems which are owned by the customer and which the provider repairs, transports,[5] maintains and secures,
- coded and standardized information (including money in its pure symbolic form) which the provider transfers, processes or manages on behalf of the customer,
- the dimensions of the customer; body and health, intellectual capacities, spatial locations, and
- the collective knowledge and competencies of organizations which are improved upon request by the organization.

Where the last three types are standard cases in most knowledge-intensive services, the second and the third types are characteristic of educational services. The typology of service transformation and the relations between the key elements are illustrated in Figure 1. The objects of transformation are characterized by the **initial** state preceding the **transformation.** Service transformation, which the customer usually participates in, is conducted by an independent[6] service provider. The combination of **internal and external resources** (labour, capital, energy and information) expended

[4] Transformations conducted by customers themselves are excluded from the typology here. In other respects the typology is applicable to all service activities.

[5] In particular, transportation and communication can be understood as transformations over space or location.

[6] An independent service provider refers to a separate economic unit e.g. a firm (cf. Hill, 1977).

in the transformation defines the service production **technology** with respect to each type and object of transformation. The outcome of the transformation is visible in the **final state,** which may restore or improve the original state.[7] Examples of restoring transformations are health care and maintenance services, while an improving transformation is characteristic of knowledge-based services.[8]

The output of a service organization is determined by two dimensions, the quantity of services, which is often highly obscure, and the outcome of a single transformation process, i.e. the final state or quality. For the characterization of the quantity of services, Gadrey (2002) suggests a distinction between the **number of cases** and the **case-mix complexity,** which approximate the service output variation. While the index of the former measures the number of clients served within a unit of time, the index of the latter accounts for the degree of the complexity of a problem solved in each case of transformation. Hence, instead of pursuing economies of scale (cost-based strategy) with high customer flow (frequency), the service provider can increase output by reducing the frequency and solving more complex problems, as well. Optimally, the service provider may differentiate between customer preferences and select a mix of complexity of services showing the best **fit** with the capabilities of the service provider.

The third component of service quantity identified by Gadrey (2002) is **service intensity,** which is regarded as a residual consisting of the dimensions of quantity not captured by the index of case complexity. Service intensity refers to the amount of resources devoted to 'face-to-face interaction' with the customer (customer service), and together with the other two indices it determines the overall quantity of the services provided. In the light of this definition, effectiveness is a sub-dimension of complexity of the case (technical aspect) and service intensity (social aspect). For both components, effectiveness measures the extent to which the service (process and outcome) is tailored to an individual case or customer.

In Figure 1, the **outcome of a service** process is reflected by the final state, or quality, which determines the total value added distributed between the provider, the customer and society (Sundbo, 1999). A distinction is made between short-term and long-term outcomes, of which the latter may be unknown at the transformation stage. The quality of a service can be assessed objectively or subjectively. In the case of **objective** quality assessment, the specification of the contract **ex ante** is compared with the outcome of the service delivered **ex post.** Accordingly, the quality of the service can be defined as a degree of fulfilment of the specifications of the service contract. In economics, this is sometimes called **efficacy**.[9]

Objective quality assessment can be used for standard business services and product-related consumer services, e.g. maintenance. **Subjective** quality assessment is the norm, when neither the provider nor the customer can specify quality standards prior to the production and delivery. In subjective quality assessment, the customer

[7] Through the process of depreciation, the original state weakens and leads to the initial state.

[8] Note that transformation of information as defined by Gadrey (2002) is not included in the model here. Transformation of information improves the state of individuals and organizations, and this leads to an improved knowledge base of the customer.

[9] In many cases, there are only two consequent states, success with the realize utility, and failure, which implies an unchanged utility for the customer.

has certain expectations on the service **ex ante,** and these expectations are compared with the actual service outcome (Sundbo, 1999). Subjective quality assessment is characteristic of customized services and consumer services, which are usually differentiated across service providers.

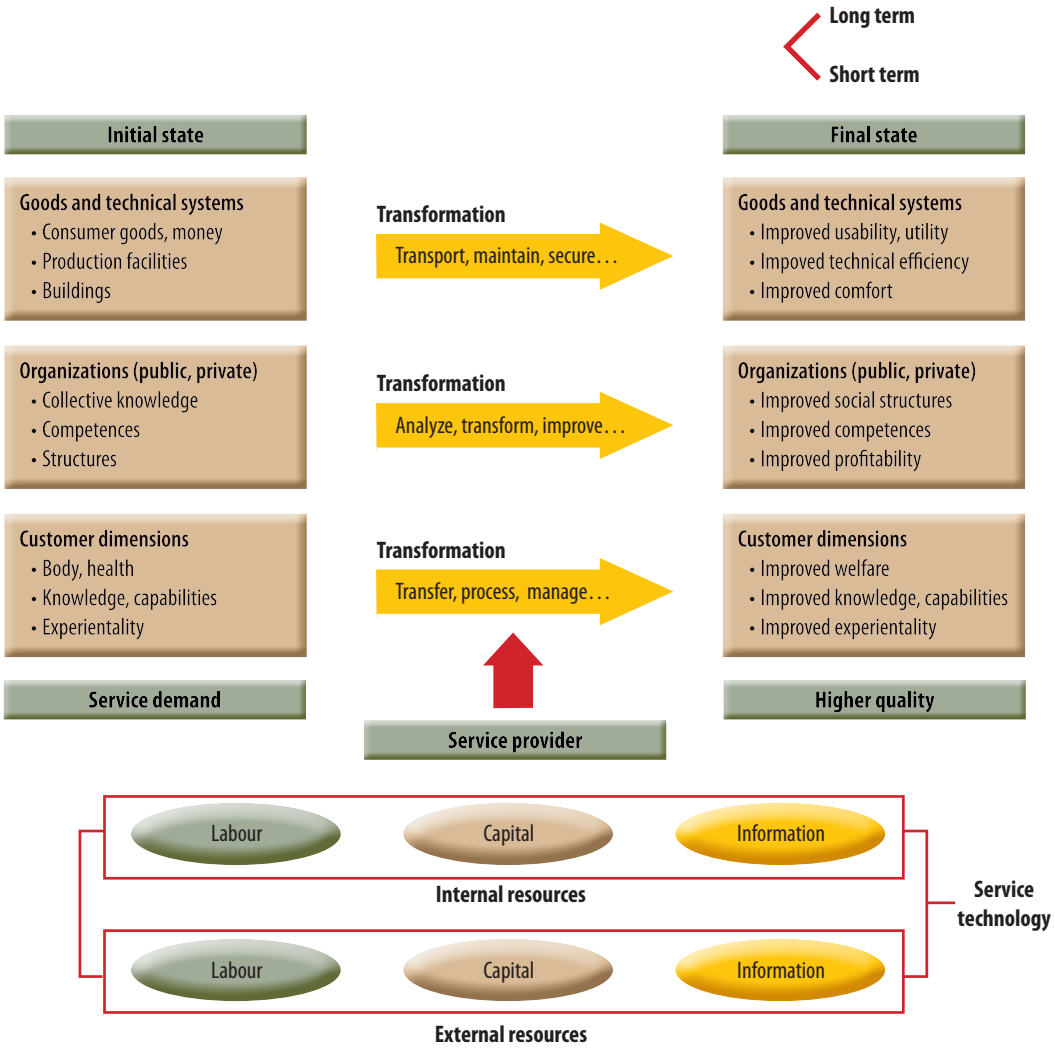

Figure 1. The main dimensions of service transformation.

By the same token, Gummesson (1998) notes that traditionally the analysis of quality has built on the dichotomy between manufacturing and services. The technology-based interpretation applied in manufacturing equals quality to the conformance to specified requirements. A customer-driven (subjective) interpretation prevails in services where quality refers to fitness for use. According to Gummesson (1998), the two definitions can be united in the concept of customer-perceived quality. It consists of technical or output quality (technical service), which is a matter of properly producing the core benefit of the service, and functional or process quality, i.e. the way in which the service is delivered (customer service). Conceptually, both types of qualities can be approximated by a utility coefficient, which measures the ratio between

the realized level of utility and the level of customer's expectations or the contract specifications.

4. The Meaning of Productivity

In general, productivity is a concept used for measuring the ability of a production process to generate the expected and desired outcome with the minimum usage of resources. While most analysts regard productivity as the most important source of competitiveness, it is often relegated to second rank, and neglected by those who are involved in the production processes (Djellal and Gallouj, 2008; Tangen, 2005). Moreover, those who use the term productivity, rarely define it explicitly. This reflects the fact that there is no unequivocal agreement on what productivity actually represents. Ghobadian and Husband (1990) suggest that systematic approaches to productivity can be divided into **three categories: technological, engineering and economic.** The technological approach, which is prevalent in the statistical analysis and industrial policy, looks into the ratios between the output and input in production. It is appropriate for intra-industry and inter-organizational comparisons.

From the engineering perspective, productivity denotes the relationship between the actual and potential (capacity-based) output of a process. On the basis of the **technological** and **engineering** approaches, and assuming that the commensurability problem of inputs and outputs can be resolved, the productivity of a production process can be expressed as a ratio between the quantity of output generated and the quantity of inputs expended in a certain period of time. This means that productivity is a function of time, and it can grow in three alternative cases: 1) the real output grows faster than the quantity of inputs, 2) more real output can be extracted from the given or decreased quantity of inputs, and 3) the real output remains constant or decreases less than the quantity of inputs.[10]

The perspective of (industrial) **economics** is more theoretical. It combines the engineering and technological approaches but at the same time it looks at productivity more from a perspective of economic efficiency and optimal allocation of resources. The three approaches are not contradictory, but they examine the same issue from different angles with differentiated needs to evaluate business performance. The general point is that productivity is a **relative** concept distinguishing variations in the productive performance with respect to a relevant benchmark (competitors or time). In contrast to mathematical definitions and indicators of productivity, verbal definitions provide a detailed description of productivity in a specific context. A descriptive concept may serve as a **norm,** a shared view of the strategic goal the organization is striving to achieve (Tangen, 2005). As verbal definitions in most cases cannot be transformed directly into a mathematical form, the persistent challenge is to construct productivity indicators that approximate the verbal definitions as accurately as possible.

The description of productivity at the organizational level by Bernolak (1997) **provides an appropriate template for the further characterization of productivity** in

[10] In a similar vein, there are three main cases where productivity decreases (Viitamo, 2007; Misterek et al., 1992).

services. According to Bernolak, "productivity means how much and how good we produce from the resources used. If we produce more or better goods from the same resources, we increase productivity. Or, if we produce the same goods from fewer resources we also increase productivity. The same applies to services. If we provide more services or better quality services from the same resources, our productivity has increased. Or, if we provide the same services and just as well, from less resources, we also improve productivity" (op. cit. p. 204). By "resources", Bernolak refers to all human and physical resources, i.e. people who produce the goods and provide the services, and the assets with which the people produce the goods and provide the services. The resources include land and buildings, machines and equipment, tools and raw materials, inventories, and other current assets.

Applicable to goods and services equally well, the productivity definition of Bernolak conforms to the generic interpretations of service by Vargo and Lusch (2004) and Penrose (1959). If the resources are understood as consisting of all human and physical assets, productivity results from the overall delivery of services by the resources which are used in the productive activities of an organization. As the definition of productivity is contingent on the use and availability of (qualified) resources, the organization's productivity is reduced if its resources are not properly used or if there is a lack of them. The use of productive resources is manifested in the quality of the output and how it is perceived by the customer (market). As quality assessment requires a benchmark, it is implicitly assumed that the relevant characteristics of the output can be prescribed objectively prior to the production or the relevant characteristics of the output is learnt and evaluated subjectively in the market. This results from replication, the routinization of activities (Nelson and Winter, 1982) in production and the transactions with the clients. With regard of the quality of the resources and the output the general implication for productivity is symmetric. A higher productivity of activities is attainable through a decrease of wasted and idle resources or through a higher volume and the quality of the output.

5. Efficiency and Effectiveness in Services

On the basis of the above discussion, the productivity of services needs to be interpreted holistically, to reconcile the producer's and the customer's objectives (perspectives). In general, given the specifications of the product and the service, the producer's (service organization) main objective is to attain the lowest possible unit cost of the production and delivery. To the extent that the input prices are also given,

[11] A detailed definition of efficiency is given e.g. in OECD (2001). "The quest for identifying changes in efficiency is conceptually different from identifying technical change. Full efficiency in an engineering sense means that a production process has achieved the maximum amount of output that is physically achievable with current technology, and given a fixed amount of inputs. Technical efficiency gains are thus a movement towards 'best practice', or the elimination of technical and organisational inefficiencies. Not every form of technical efficiency makes, however, economic sense, and this is captured by the notion of allocative efficiency, which implies profit-maximising behaviour on the side of the firm. It should be noted that when productivity measurement concerns the industry level, efficiency gains can either be due to improved efficiency in individual establishments that make up the industry or to a shift of production towards more efficient establishments" (op. cit. p. 11).

cost reduction implies the pursuit of **efficiency.**[11] The user, on the other hand, is primarily interested in extracting high utility and (perceived) quality from the product or service, given its costs or price. This other component of productivity is generally called **effectiveness.** Efficiency is principally focused on the **quantity,** the utilization of resources, and hence, the denominator (inputs) of the standard productivity ratio. Effectiveness instead, is focused on the outcome, the creation of value for the customer and the responsiveness to demand. Effectiveness of the product and service is thus manifested in the numerator (output) of the productivity ratio (cf. Tangen, 2005).

In reference to the neoclassical theory (Kreps, 1990; Viitamo, 2009), the efficiency growth of a service organization can be decomposed into three effects. Improved **operational efficiency** or **cost-efficiency** (1) implies cost reduction given the existing technology and the scale of production. Higher cost-efficiency reduces the waste of resources and moves the actual costs closer down to its average cost curve. Improved **scale-efficiency** (2) implies a move along the organization's average cost curve towards the point, where the average costs reach the lowest possible level.[12] In the presence of **economies of scale** this implies an increased volume of production. **Technological advance** (3), which reflects improved total factor productivity (TFP), shifts the average cost curve downwards. The neoclassical efficiency concepts are also applicable to a multi-product producer, which utilize the **economies of scope.**[13] In this case the producer needs to decide how to allocate resources in the various production lines to achieve high cost-efficiency and scale-efficiency (cf. Panzar and Willig, 1981).

While efficiency is characteristically **unambiguous,** bounded by the inputs, the output and the technology, this is not the case with effectiveness. It is "a more diffuse term and in most cases very difficult to quantify…such definitions lead to an interesting concept: there are usually no limits as to how effective an organization can be" (Tangen, 2005, p. 41).[14] As indicated by Jackson and Petersson (1999), however, sustainable competitiveness necessitates that productivity be assessed in relation to both components. This implies that the service organization – in making the production plan – has prior information (idea) on ways to attain effectiveness and to reconcile the goals on effectiveness with the organization's goals on production efficiency. Moreover, to be economically feasible and predictable for the service organization, effectiveness needs to have an upper limit.[15]

With regard to productivity, the focal issue is whether the service organization is capable to reach the desired level of effectiveness, given its technology, and the desired

[12] This point shows the maximum productivity and it is allocatively efficient.

[13] In general economies of scope over a given bundle of products and services prevails, if the average production costs in the integrated production are lower than the sum of the average costs in the separate production.

[14] Sometimes efficiency is defined as doing things right, while effectiveness is understood as doing right things (Tangen, 2005). From a perspective of service organization these expressions imply an optimal allocation of the resources and capabilities over the alternative uses (product lines) so that the cluster of the product lines is efficient. Consequently, doing the right things and doing things right define the equilibrium conditions for a multi-product firm. To account for the efficiency and the effectiveness of a single activity (service), doing things right and doing the right things should be defined in terms of the objectives of doing.

[15] The requirement that the desired effectiveness is technologically feasible means that it locates within the firm's production possibility set.

level of production efficiency. Hence, in a general formula, the overall productivity of the service organization can be presented as a function of efficiency and effectiveness, where the marginal productivities of both components are locally positive.[16] In this context, **effectiveness is interpreted technically from the producer's perspective as the degree of customization of the service to the needs of an individual customer.** Of the earlier definitions this shows the highest consistency with Neely et al. (1995), that is, effectiveness refers to the extent to which the consumer requirements are met. The decomposition of productivity into efficiency and effectiveness and their role in the production process is illustrated in Figure 2.

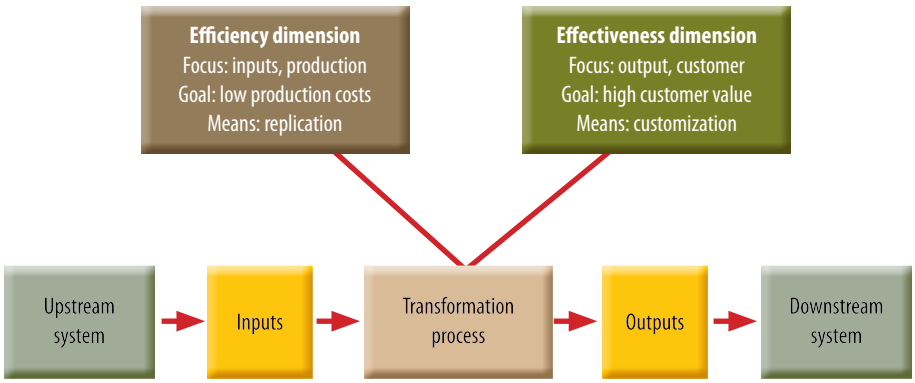

Figure 2. The general characterization of service productivity.

In the depiction of service productivity in Figure 2, service quality is equally important for efficiency and effectiveness components. Based on the notion by Vargo and Lusch (2004),[17] it is assumed that **customer-perceived quality is always the driving factor, and the willingness to accept a trade-off between standardization quality and customization quality, usually for a commensurate trade-off in price (inclusive of other sacrifices), is eventually a form of customization.** In the university context, the level of a customer's productivity equals to the perceived quality, which is a continuous combination of customization quality and standardization quality. For simplicity reasons, customization quality is assumed to be a linear function of effectiveness, while standardization quality is assumed to be a linear function of scale-efficiency. Thus, given the actual variation (differentiation) in customer preferences with respect to standardization and customization, customer satisfaction and productivity can attain compatibility universally.

[16] That is, given the level of efficiency, an incremental growth of effectiveness should lead to an incremental growth of productivity. The deduction is symmetrical for efficiency.

[17] Some customers prefer to engage in relatively high levels of co-production (tailoring), and some prefer to have the offering firms provide services more directly. When customers make trade-offs, they are not necessarily making value trade-offs. Goods and services are appliances, and the customer must add mental and physical effort to co-create value. This effort is part of the total cost of ownership and use of an appliance. However, because the firm does not pay for the consumer's effort, it does not enter into the firm's financial statement and determination of profit and productivity (cf. Vargo and Lusch, 2004).

6. Service Productivity in Action

The illustration of service productivity in Figure 2 assumes that the production possibilities of an established service organization, in this case a university or a single lecturer employed by the university, can be approximated by a continuous and concave functional relationship between scale-efficiency and effectiveness. This is further highlighted in Figure 3. The curve with symbol S indicates the provider's (university) constant and maximum levels of productivity. The continuity of the surface S reflects the inherent flexibility of service technology. The concavity reflects the impact of economic scarcity and the diminishing marginal rate of technical substitution (MRTS) between effectiveness and scale-efficiency (cf. Kreps, 1990). Accordingly, along the surface S, there is a trade-off in using the provider's resources most productively at any point of time: part of effectiveness has to be given up to obtain higher scale-efficiency. This holds for the moves in the opposite direction as well: sacrificing scale-efficiency for higher effectiveness. In this setting, the key issue is not only the level of service productivity and quality, but also the optimal employment of the provider's resources with respect to customer preferences on the characteristics of service quality.

Contingent on their flexibility and redeployability, a provider's resources can be used in the production of low number of customized services (point A in Figure 3), or high number of standardized services (point B in Figure 3). It is realistic to assume that the productivity surface S evolves through the provider's learning of and experience in ways to attain customer satisfaction in different types of customer segments. Productive outcomes are ultimately contingent on how the provider's (university) activities and the **resources** available to it are employed and how the customer (student) is involved and used as a productive asset. It is equally realistic to that customer participation in service production increases with the higher degree of service customization.

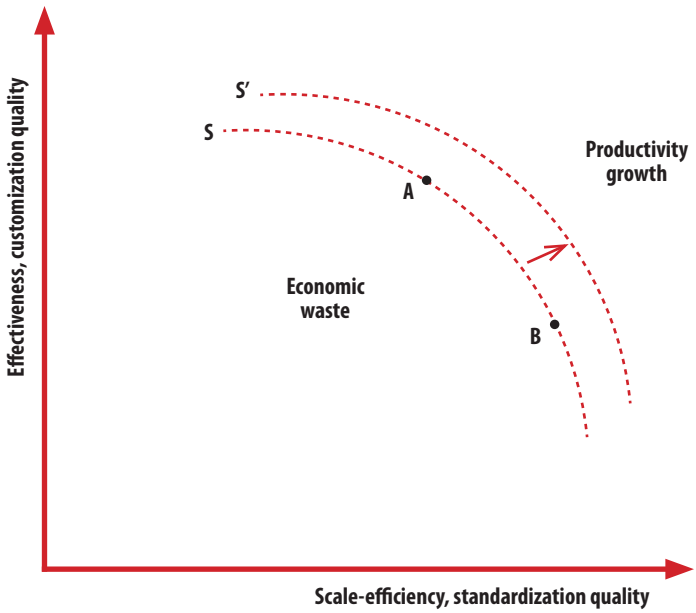

Figure 3. The graphical illustration of service productivity.

The surface (frontier) S also describes the best practice service technology available to the provider. The principal objective of the provider is to stay on the productivity frontier S, where the maximum level of productivity and the right balance between effectiveness and scale-efficiency for different customers and customer segments is reached. To exemplify, if the preferences of a student regarding a particular educational service change so that a higher level of customization is required, the lecturer has to allocate more resources to serve this particular student. In Figure 3, a move of symbol A to the left on frontier S illustrates this situation and customer type. The move implies a higher uncertainty in the service outcome and a diminished opportunity to utilize economies of scale (replicability and standardization) in the service provision. The lecturer's overall productivity may remain unchanged, however. This is possible if scale-efficiency is enhanced in the service of other students assuming a fixed amount of customer time and other resources. This implies that more standardized services are offered to the students of type B in Figure 3, i.e. point B moves to the right on the surface S.

In Figure 3, the area below the surface S is, by definition, inefficient (unproductive) and thereby reflects the waste of the university's resources. Correspondingly, the move towards S indicates an improvement in the use of resources and an increase in the **operative cost-efficiency** of the institution. Productivity growth which is manifested in technological progress and innovation may shift the education provider's productivity frontier outward from S to S´. For the exogenous factors inducing such a shift, Anderson et al. (1997) note that appropriate applications of **information technology** may improve both customer satisfaction and productivity simultaneously. It is realistic to assume that the outward shifts of the surface S are typically asymmetric and demonstrate the impacts of learning, improved skills of the service professionals, improved quality of the complementary inputs, or the re-organization of the service processes. However, the provider's strategy to increase its own productivity **unilaterally** does not necessarily generate the first-best solutions for the customer. This is the case if the improvements lead to the points on the productivity frontier S that are not preferred by customers A or B. Clearly, the smoothness and the continuity of the provider's technology, indicated by frontier S, is an empirical matter and depend on the industry charateristics. It is plausible to assume that through learning and a gradual routinization of processes, universities become more specialized (differentiated) in the production of specific types of services for specific types of student segments. In such a situation, A and B in Figure 3 represent the situation of two different providers (organizational units), the technology of which is approximated by the common productivity frontier S.

7. Concluding Remarks

The main implication of the above discussion is that the (re)creation of competitive advantage in service productivity requires constant balancing between the provider's and the customer's productivities. This holds for the service-oriented businesses and public services more generally. Moreover, as technological progress fosters the pro-

ductivity growth and knowledge creation, also encompassing the traditional labour-intensive services, it is clear that organizational adaptation (design) is required to appropriate the economic benefits of the technological progress. For instance, in the context of educational services the strategy that is based on scale-efficiency calls for a centralized and hierarchical organization, whereas the effectiveness-based strategy calls for a more decentralized and non-hierarchical organization and decision making. From the managerial perspective of a university, these two approaches must be integrated to attain high overall productivity of the resources and the in-house service activities. More generally, this article points out that the productivity of the services in universities is central to enhance the **Knowledge Triangle** at all geographic levels – regional, national and international levels. Through a higher utilization of universities' own research that facilitates the learning and the creativity of the personnel, universities can more effectively attain their societal goals. This stresses the importance of **dynamic capabilities** that are manifested both in the inputs and the outputs of university services.

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About the author

Esa Viitamo holds a PhD in Science and Technology and Licentiate in Social Sciences (Economics). His academic interests cover the topical issues in economics and business management including service productivity, innovation, as well as organizational design and industrial policy. They are also prominent in the cross-disciplinary approaches to industrial clusters and value chains that Viitamo is currently working on.

Ole Rokkjær
Project Manager, Aalborg University
or@learning.aau.dk

Bente Nørgaard
Ph.D. fellow, Aalborg University
bente@plan.aau.dk

Páll Jensson
Professor, University of Iceland
pall@hi.is

IX. Industry Needs versus Education

Definition of an Industrial Engineering Educational Model

Abstract

This article describes and discusses the project "Industrial Engineering Standards in Europe" (IESE). The project is funded by the EU Leonardo da Vinci Partnership program with partners from universities and organizations offering engineering education and continuing education in the field of industrial engineering. The project has two main objectives. The first is to use the European Qualification Framework (EQF) as a benchmark against the National Qualification Framework (NQF) of the partner countries and the Industrial Engineering educations offered by the partner institutions. What seemed to be a relatively straightforward task showed to be more complicated. Iceland, the Netherlands and Denmark have adopted the EQF approach with 8 levels – BSc, MSc and PhD as the top three levels. Ireland has adjusted to their national educational system with 10 levels, Germany is still discussing their NQF and Sweden has decided not to adjust to the EQF for the moment.

The second objective in the project is to conduct a survey among industries employing industrial engineering in order to investigate a possible gap between the educational programs and the needs of the industry for competences in the field of industrial engineering. A survey has been carried out in Ireland, the Netherlands and in Iceland and the results indicate gaps in various topics.

Keywords: Industrial engineering, gap analysis, continuing engineering education

1. Introduction

This article describes some of the results of a European Leonardo funded project called Industrial Engineering Standards in Europe – IESE (IESE, 2010). The project is collaboration between universities and organizations offering continuing education in 6 European countries: Denmark, Germany, Iceland, Ireland, Netherlands and Sweden.

The project is now in its closing phase and the work on the second objective is showing results. A survey has been carried out to compare the needs of skills and competences in the industry in the field of Industrial Engineering with the competences the educational programs are offering. Before we discuss the outcomes of the second objective, we will briefly introduce the field of Industrial Engineering.

1.1 Definitions of Industrial Engineering

The definitions of IE differentiate themselves little as far as the contents are concerned. The official definition by the Institute of Industrial Engineers (IIE) is according to the IIE website (IIE, 2010):

> *"Industrial Engineering is concerned with the design, improvement, and installation of integrated systems of men, materials, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical and social sciences together with the principles and methods of engineering analysis and design to specify, predict, and evaluate the results to be obtained from such systems."*

The Georgia Institute of Technology and U.S. News and World Report extended the definition to indicate that all sectors and branches can benefit from I.E. methods and tools in order to improve systems by optimizing processes. – In accordance with this, we define IE as:

> *"The branch of engineering that engages in the study of how to describe, evaluate, design, modify, control and improve the performance of complex systems, viewed over time and within their relative context."*

The key notion is systems and includes supply chain systems, financial systems, and health systems, among others.

2. Industrial Engineering

The tasks of Industrial Engineers are determined by the life cycle of the product or service, the level of interaction and the problems he/she is supposed to solve. In Europe IE is frequently defined as a field of activity, where the planning and the implementation of complex rationalisation schemes are carried out. The required fields of activities (besides a high level of social competence) typically centre round technical

solutions, work science, work organisation, operational topics and juridical questions. The overall targets are to improve the productivity, economic viability or profitability of the company or organization.

In the last 20 year IE has become more and more dominated by university graduates. The gradual integration of IE into the enterprise and as a recognized profession in Europe started mainly with continuing education organizations offering post-graduate education based on work science and industrial organization. These competencies enabled personnel of companies to find appropriate solutions for problems related to production, service or administration processes. Only around 1980 the universities in Europe started to offer degrees in IE. The curricula for a bachelor degree basically cover the following topics:

- production techniques,
- work science,
- work organization,
- logistics,
- work scheduling,
- cost accounting / cost calculation,
- material logistics,
- production methods,
- pork process organization/ simulation,
- pobotics and
- labour law.

2.1 Traditional Areas of IE Application

Today Industrial Engineering is concerned with dealing with (production-) systems, in applying methods and in developing / using appropriate tools for existing problems. This means improving systems by applying tools to optimize processes.

The Industrial Engineering responsibilities in many organizations are in the areas of

- work measurement (e.g. Cost reduction management),
- materials handling (e.g. automation / robotics),
- quality engineering (e.g. TQM-system),
- systems engineering (e.g. simulation and models),
- process engineering (e.g. value analysis),
- synchronous manufacturing (e.g. just-in-time),
- production planning (e.g. MRP – Materials Requirement Planning),
- customer satisfaction (e.g. development of new concepts based on customer needs,)
- human resources (e.g. ergonomics) and
- finance (e.g. project management and justification).

In the last 10–15 years, new areas of application have emerged in industrial engineering: Environment / Sustainability, Technology and Innovation are becoming more important because of the long-term effects of rapid technological development com-

bined with the pressure for increase in productivity and competitiveness in the world market. A major current influence is the "Green Economy".

2.2 Industrial Engineering Standards in Europe

As our project objective 1, (IESE, 2010), we proposed to use the European Qualifications Framework (EQF) as a benchmark standard, against which we can compare the Industrial Engineering Educational Programme (IEEP) for each participating country. In order to produce a more pertinent analysis we needed to include the additional criteria of a recognised IEEP standard. The deliverable for this objective will be a document comparing individual countries against EQF and recommendations for next steps in achieving harmonisation.

The standard Venn diagram model for IEEP currently in common use is prescribed by the International Labour Organisations (ILO) – diagram 1 below (Salvendi, 1991). This model has been in use over a number of decades and has been widely accepted as the industry standard across Europe and by many universities in the US. It was decided to use this model as the baseline reference for comparing the IEEP's which are currently being delivered in the partner countries. According to the model the areas that form the core topics of industrial engineering are, IE Base, Operations Research, Human Factors Engineering, Management Systems and Manufacturing Systems Engineering.

Figure 1. Venn diagram – ILO Standard for Industrial Engineering Educational Model.

2.3 Definition of subject categories for IE educational model

IE Base

Industrial Engineering is concerned with the design, improvement and installation of integrated systems of people, materials, information, equipment and energy.

Examples of IE base are:

- work measurement (time studies, work data),
- processes (business processes, value chain processes),
- workplace evaluation and design business,
- administration (costs, losses, profits),
- logistics (production, physical, material handling),
- organisation development (structure, definition of labour, tasks, responsibility),
- planning / steering (strategically, tactical, operational),
- project management (project plan, project team, time schedule),
- IT basics (information structure and use of data) and
- quality management (quality systems, performance monitoring).

Human Factors Engineering

Human Factors Engineering (HFE) is the discipline of applying what is known about human capabilities and limitations to the design of products, processes, systems, and work environments. It can be applied to the design of all systems having a human interface, including hardware and software. Its application to system design improves ease of use, system performance and reliability, and user satisfaction, while reducing operational errors, operator stress, training requirements, user fatigue, and product liability. HFE is distinctive in being the only discipline that relates humans to technology. Examples of Human Factors Engineering are:

- ergonomics,
- human interface engineering and
- behavioural science.

Operations Research

This is an interdisciplinary branch of applied mathematics and formal science that uses methods such as mathematical modelling, statistics, and algorithms to arrive at optimal or near-optimal solutions to complex problems. Examples of OR methods are:

- optimization models,
- simulation and
- network models.

Manufacturing Systems Engineering

Manufacturing Systems Engineering includes engineering assembly and batch production, flexible manufacturing systems, lean production, group technology, job production, kanban, and mass production systems. Examples of Manufacturing Systems Engineering are:

- production systems,
- maintenance systems and
- automation technology systems.

Management Systems
A management system is the framework of processes and procedures used to ensure that an organization can fulfil all tasks required to achieve its objectives. Examples of Management Systems

- general management,
- quality management (TQM),
- project management,
- management information systems,
- contract management,
- health & safety management,
- human resource management,
- business ethics and
- cross-cultural management.

3. Extended Model of IE Education

During the course of our analyses it became apparent that the ILO model currently in use does not adequately represent the curriculum being taught on modern day industrial engineering educational programmes. As a consequence of this finding and the amalgamation of all partners' educational programmes, a new curriculum model was developed (Figure 2 below), which in our opinion better represents the modern understanding of industrial engineering core topics. In addition to the original four core subject categories a further two have been added. These topics are Innovation & Technology and Environment /Sustainability. In the interest of clarity the IE Base category was renamed IE Fundamentals with a further sub-group category called Engineering Basics, which contains subjects like mathematics and physics common to all engineering disciplines.

Engineering Basics
Engineering Basics are the group of engineering subjects and skill sets common too, and essential for all engineering disciplines. Examples of these foundational subjects are:

- mathematics,
- physics and statistics and Probability Theory.

Innovation & Technology
In the context of Industrial Engineering, Innovation & Technology consists of specific fields of new technology being used for the improvement of integrated systems such as information technology, process technology, discrete technology, production technology, etc.). Examples of Innovation & Technology:

- innovation process and life cycle,
- speed of technological development,

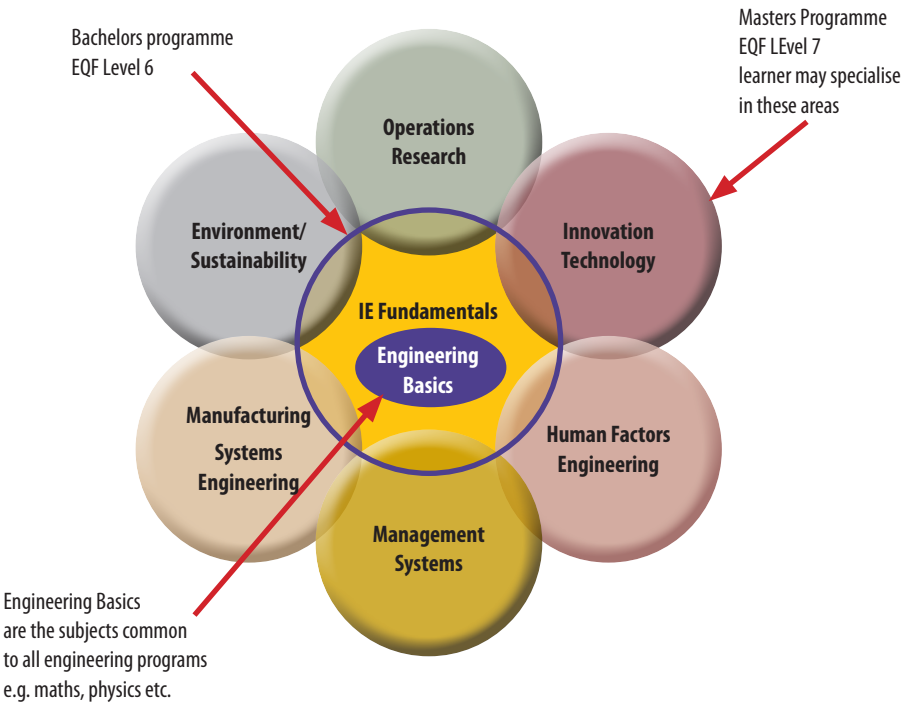

Figure 2. Venn diagram, IESE standard educational model

- information technology,
- manufacturing technology (discrete, process, etc.),
- nanotechnology and
- biotechnology.

Environment/Sustainability

This subject will provide expertise in terms of: energy usage, environmental performance and sustainability and the design and evaluation of building service systems. Examples of Environment and Sustainability are:

- policies and legislation,
- Energy Standard EN 16001,
- corporate energy policies,
- energy management and auditing,
- sustainable technologies such as wind, wave, solar, and
- sustainable technology integration,
- combined heat and power CHP,
- building management systems BMS,
- lighting and
- HVAC.

4. Comparison of IE Educational Programmes

The syllabi specification for all partners' educational programmes was documented and the individual subjects were mapped on to the IESE standard model. ECTS credit points were assigned to each subject category and a summary of all the educational programmes was produced, see Table 1 below.

The base metric used in this calculation was; one credit = 25 hours with the overall Bachelors programme totalling 180 credits.

As can be seen from the table, the educational programmes in the 6 countries are very different. It should be kept in mind that the results for the programs are based on different total number of ECTS credits and also, it should be kept in mind the differences between the legal status of the institutions, offering of fulltime or continuing education and the pedagogical approach of each institution. But still the diversities are striking. Looking at the average (right column) of the Table 1 it is clear that 3 sub-group categories (Engineering Basic, Manufacturing Systems and Management Systems) are superior to the rest.

The Engineering Basics covers up till 40% of the curriculum at the public partner organizations whereas the private partner organizations teach only 0% till 6% of Basic Engineering to their students because in the Netherlands and Germany the students enter the private programmes when they have already had the basic mathematics, physics and statistics. Management Systems come out with an average of 22% however the diversity among the partner organizations range form 3% till 40% of curricilum and Manufacturing Systems have an average of 23% with a diversity from 12% till 49% of the curricilum. The tendency is that the private organizations teach more Management Systems and Manufacturing Systems that the public partners. IE Fundamentals are more equally taught in all the partner countries.

The Human Factors Engineering is one of the areas that form the ILO – Standard for Industrial Engineering Educational Model (diagram1) but it has become clear that Human Factors Engineering has a very low priority in all of the partner countries. During our analyses it became apparent that the ILO model currently in use does not adequately represent the curriculum being taught of today's industrial engineering educational programmes and therefore two sub-categories were added; the Innovation & Technology and the Environment & Sustaniability. They both show an average of 5% of curricilum in our analyses but again diversities are found within the partner courtries. It appears that either Innovation & Technology or Environment & Sustainability are taught as the diversity range from 0% till 19%.

The second objective of this project is to conduct a survey among industries employing industrial engineers in order to investigate a possible gap between the educational programmes and the needs of the industry for competences in the field of industrial engineering. A survey has been carried out in Ireland, the Netherlands and in Iceland and the results are indicating gaps in various subjects.

The survey has been answered by approximately 50 companies in each country and the respondents percentages have been more than 35% in each country. The survey consists of 19 questions of which 5 are background information questions about the company. The companies are asked to rank the importance of the 8 different sub-

	IRE	DK	SE	IS	NL	DE	avg
Engineering Basics	22	40	37	34	6	0	**23**
IE Fundamentals	15	13	13	2	19	10	**12**
Operations Research	0	13	8	20	5	0	**8**
Management Systems	25	3	15	20	40	29	**22**
Innovation & Technology	0	13	0	4	0	12	**5**
Environment/Sustainability	19	0	8	2	0	0	**5**
Manufacturing Systems	17	12	15	16	30	49	**23**
Human Factors Engineer	2	6	4	2	0	0	**2**

Table 1. Summary of ECTS credits (%) per subject for education in IE.

categories of the IESE standard educational model and to benchmark the subject related to each sub-category against each other.

A reference syllabus was to be composed on basis of the results shown in Table 1. A syllabus for benchmarking and assessing industry needs against educational programme specifications in Europe but the data for composing a reference syllabus was not sufficient as we only carried out surveys in 3 countries. However the survey from the individual countries benchmarking industry needs against national educational programme show to what extent the curriculum taught are in line with the industry needs.

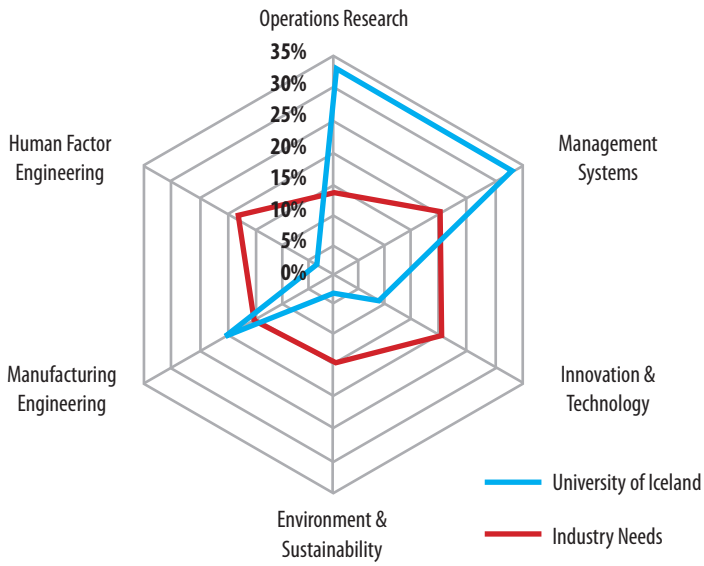

Figure 3. Syllabus of IE at University of Iceland and the Industry Needs in Iceland.

The results from Iceland could indicate that the curriculum should contain more ECTS on Human Factors Engineering, Innovation & Technology and Environment & Sustainability and teach less ECTS in Operations Research and Management Systems.

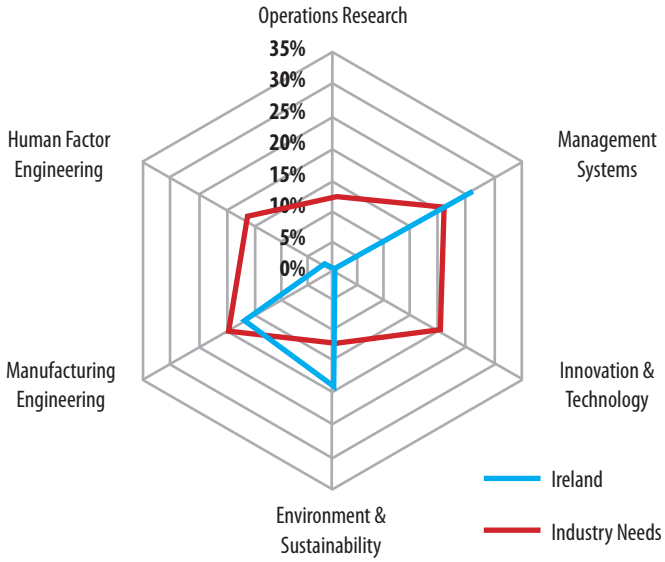

Figure 4. Syllabus of IE at the Institute for Industrial Engineering and the Industry Needs in Ireland.

The results from Ireland also shows that the alignment between the Institute for Industrial Engineering curriculum and industry needs are not a total match and again especially the Human Factors Engineering is under-represented in the curriculum.

5. Discussion

The first question to arise is whether the analysis shows the right picture. Further analysis of the results from Iceland validates the shape of the gap and leaves the interpretation to further discussion. The gap analysis should be discussed from at least two perspectives: from the industry point of view and from the educational institutions point of view. And maybe even more interesting would be the joint perspective of the two.

The industry perspective

The competition between manufacturers of today's products has reached a level which has never been seen before in history. Globalization of markets has increased tremendously leaving every company to be very sharp on its competences concerning not only the core activities of manufacturing but also concerning the positioning in the market and amongst competitors. Therefore any company will inevitably focus on obtaining the skills and competences that they expect will improve their position in the market. A relevant question to raise is whether the needs for competences stated by the companies in this survey can be seen as the real needs or as a search for the magic stick to keep the competitors behind.

One should on the other hand not neglect the statements from the industry. The driving forces of competition are at least to some extent the renewal of methods and technologies in combination with the skills and competences of the workforce. These

forces are moving with a much faster speed than research based development and will therefore point out directions for future research of the higher education institutions like universities.

A recent survey of graduates (faculties: Humanities, Social Sciences and Engineering & Science) from Aalborg University, Denmark (AAU) and the companies employing them is likewise showing a gap between the industry needs and the competences of the employees graduated from AAU. The needs are identified in a broad sense to be "more knowledge of how a company works" and "more understanding of running a business", and not very specific to the type of job. On the other hand the companies are quite satisfied with the fact that the graduates from AAU possesses the general academic skills that enables them to acquire the knowledge they need for solving the problems and tasks of the company.

The perspective of educational institutions

Higher Education Institutions serve several purposes in society, with research and education being the strongest. Candidates must be educated to obtain skills and competences to maintain the jobs of a modern society on a long term basis. In the fields of engineering the education will develop continuously to match the needs of the industry but will as all academic educations also target the general qualifications of the professional field.

It could be seen as a law of nature that the HEI will always be delayed in fulfilling the actual need of competences in industry but indeed there are many reasons behind this gap:

- Staff members seem to engage candidates with the same professional profile.
- The priority of research is rising.
- The "Publish or perish" policy is very strong.
- Changing study regulations and obtaining national accreditation is very time consuming.

6. Conclusion

A joint perspective of industry and education on the competence gap might be a more fruitful approach and an accessible path to respond to the competence gap. A better match between needs of the industry and the competences acquired by education can be obtained by establishing a more continuous dialogue between industry and HEI concerning the situation. It seems like HEI with strong capacities within certain technologies will also have a strong local industry utilizing the strength of research at the university.

The gap analysis also reveals a market for continuing professional development in the field of industrial engineering. All engineering jobs of today are depending on strong and specific competences and on a close relation to research in the many professional areas of industrial engineering. It is obvious that engineering consulting companies will offer services based on their experience and knowledge. But HEI like universities could and should offer continuing education far more tailor-made

and targeting the industry needs than it is done at the institutions of the partners.

A joint venture of establishing departments for continuing education at the HEI's might create the ideal model for a provider of up-to-date competences to the industry being able to forecast the needs and to be a platform of collaboration between teachers and researchers from HEI and management and engineers in the companies.

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About the authors

Ole Rokkjær holds a B.Sc. in Electronics Engineering and a Master in Learning Processes and is currently project manager and project administrator in Interregional Center for Knowledge and Educational Studies (INCEVIDA) at Department for Learning and Philosophy, Aalborg University, Denmark. For more than 20 years Ole has taken interest in competence development: in practice by teaching, in organizing, coordinating and managing larger Continuing Professional Development projects and by studying and developing models for CPD.

Bente Nørgaard is PhD fellow from Aalborg University. Since 1999 Bente has worked within the area of continuing engineering education at Aalborg University. She has been involved in several national and international research projects but her primary focus has been tailor-made continuing education and conceptualising the Facilitated Work Based Learning model. For the past years, Bente has researched the process of identifying learning objectives in tailor-made continuing education and most recently with a broader perspective on the tailor-made process she has researched how actors involved in the courses organise and coordinate the activities.

Páll Jensson, Professor of Industrial Engineering at the University of Iceland 1987–2011, after retirement there he joined Reykjavik University in 2011 where he is now a professor and department head of Engineering Management and Financial Engineering. He holds a PhD degree in Industrial Engineering from the Technical University of Denmark 1975. He was employed by IBM 1975–1977 and director of Computing Centre at the University of Iceland 1977–1987. Professor Jensson has a long experience of Operational Research and Mathematical Modelling of various economical and technical applications including Profitability Assessment. He has been active in teaching and research in Industrial Engineering since 1977.

Marc Goossens
Director, SEII
seiimg@abuco-consult.com

X. What Career in Industry for Engineers with a PhD?

Abstract

PhD degrees are not completed for art's sake, but rather to serve a societal purpose, to create new knowledge, either for educational purposes or for facilitating innovation activities in industry. This writing will take the reader on a historical tour to the origins of the PhD degree, and then describe the situation in the world concerning the number of PhD graduates, particularly in engineering. This article will also present the pros and cons of doctoral studies in science and engineering, by examining views that have recently been expressed. In addition, it will describe the policy of industrial companies regarding PhD graduates and explain why the possibilities of career are actually limited. After that, light will be shed on the problem arising from the contradiction between this limitation and the necessity of more innovation in Europe: Do PhD students have the right motivation? Do they possess sufficient transferable skills? Are their curricula adapted to the needs of industrial companies? Is there enough R&D in Europe? This article proposes that universities reorient doctoral studies in engineering, take a more holistic and aggressive view on the question, and then make their own way, slowly but surely, in full knowledge of the facts.

Keywords: engineering doctorate, careers in industry, necessary skills and curricula, R&D in Europe, transferable skills and related curricula

1. Introduction

This article describes and discusses career perspectives that are offered by industry to engineers with a PhD, although we also need those who focus on basic research. Before getting to the heart of the matter, it is useful to recall what a doctorate is and

what the different categories of doctorates are, and present their current situation in the world.

1.1 Back to the Roots: a Historical Perspective

The word "doctorate" comes from the Latin "doctum", supine of the verb "docere", meaning "to teach". It referred to Christian authorities who taught and interpreted the Bible.

There are presently two main types of doctorates:

1. Research Doctorates, awarded in recognition of academic research.
2. Professional Doctorates, more closely aligned with the practice of a particular profession.

The meaning of the word "doctorate" has changed over time and has also been subject to regional variations. If the first doctorates were Doctors of Divinity (or of Theology), two professional doctorates soon appeared in Medieval Europe: Doctor of Law and Doctor of Medicine.

Figure 1. Aquatint of a Doctor of Divinity at the University of Oxford. From Rudolph Ackermann's History of Oxford, 1814.

The situation changed in the early 19th century through the educational reforms in Germany, which started demanding contributions to research, attested by a dissertation, for the award of their final degree, which was labelled as Doctor of Philosophy (in short, PhD) because "philosophy" was the ancient name for "science". These reforms proved extremely successful and were imported to the United States, where the current triple structure of bachelor-master-doctor degrees in one discipline was created by fusing different European traditions. Later on, the degree made its way to Canada and to England.

This historical evolution resulted in most doctoral degrees in Science and Technology awarded in the world being research-based doctorates. The views and testimonies surveyed and gathered here about the utility for an engineer to acquire a PhD refer to this type of doctorate; some professional doctorates in engineering have begun to appear in North America, the United Kingdom and Australia, but they are still isolated cases.

1.2. The situation of PhD graduations in the world

Figure 1, drawn from figures published in OECD Science, Technology and Industry Scoreboard (OECD, 2011), compares the relative number of doctoral graduations in 2009 in engineering, expressed as a percentage of all graduations at doctorate level, to the number of all doctorate-level degrees, expressed as a percentage of the population in the same age cohorts, in 36 developed and emerging countries. If taking the values for the United States as a reference, the diagram can be divided into four parts.

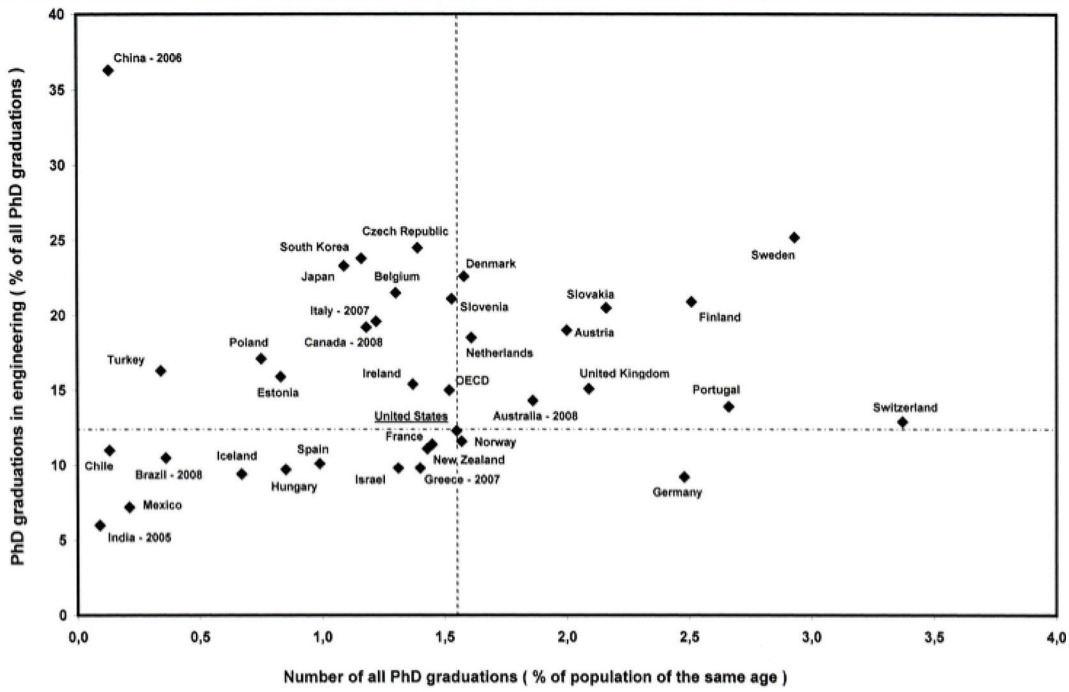

Figure 2. Relative number of PhD graduations (in 2009, unless otherwise specified).

The diagram shows that globally, the scores of European countries are rather good. This is corroborated by a report of the European Commission (Innovation Union Competitiveness Report; 2011), stating that: "The European Union has a higher number of graduates from the first stage of tertiary education than the United States and Japan, as well as a higher share of graduates in Science and Engineering".

2. The Pros and Cons of Doctoral Studies in Science and Engineering

2.1 Critical Views of Doctoral Studies

The following excerpts reveal views critical to doctoral-level education, evidencing ineffective resource use or mismatch between doctoral supply and demand. Universities provide an oversupply of PhDs when job markets are characterized by an undersupply of positions requiring PhD-level qualification.

Paula Stephan, Economist at Georgia State University in Atlanta (Nature, 2011):
"It is scandalous that US politicians continue to speak of a PhD shortage. The United States is second only to China awarding science doctorates and their number is growing. But no one should applaud this trend, unless Congress will put money into creating jobs for these people rather than just creating supply, because most doctorates are taking jobs that do not require a PhD. It is a waste of resources: we are spending a lot of money training these students, and then they go out and get jobs that they are not well matched for."

Laudeline Auriol, analyst for OECD (Auriol, A, 2010):
"A non-negligible share of doctorate holders seem to be employed, either in no- related or in lower qualified occupations. In 11 countries out of 20 for which data are available, one of these two indicators is at least equal to 10% and in some instances much higher, as in Austria (29,5%) and the Netherlands (20,5%)."

Andrzej Krasniewski, Secretary General of the Polish Rectors Conference (Nature, 2011):
"In Poland, more than half of students in engineering who begin a doctorate will not complete their PhD and, most of those who achieve it will end up taking jobs below their level of expertise."

But maybe the fiercest attack came from "The Economist", which published a long article entitled "The disposable academic: why doing a PhD is often a waste of time" (The Economist, 2010):

"One thing many PhDs have in common is dissatisfaction … There seem to be genuine problems with our system, which produces an oversupply of PhDs … But universities have discovered that PhD students are cheap, highly motivated and disposable labour, as they do much of the university research these days … One OECD study shows that five years after receiving their degrees, more than 60% of PhDs in Slovakia and more than 45% in Belgium, the Czech Republic, Germany and Spain were still on temporary contracts ; the relative number of PhDs taking jobs that are unrelated to their is 30% in Austria, 21% in the Netherlands and 13% in Germany … In engineering and technology, a PhD often earns

less than a Master … The interests of academics and universities on the one hand and PhD students on the other hand are not well aligned … Many PhDs find it tough to transfer their skills into the job market … Some university departments and academics regard the number of PhD graduates as an indicator of success and compete to produce more … Many of those who embark on a PhD are the smartest of their class and would have been the best at everything they should do in their field anyway … !"

2.2 Views Favourable to Doctoral Studies

Georg Winckler, Rector of the University of Vienna, gave a well-argued opinion in favour of PhD education during the June 2011 annual conference of the Centre for Doctoral Studies of his university (Winckler, G, 2011):

"PhDs are strategic tools and a vital resource in a knowledge-based economy, and Europe needs 700,000 researchers more in order to enhance its competitiveness! The many challenges that lie ahead of us require deeper knowledge and more flexibility. Universities must provide Europe with a new generation of highly adaptive experts in a globalized world. But, in order to achieve that, University-Industry cooperation is more than ever necessary, as a vehicle to enhance knowledge transfer."

In France, Martine Pretceille, University Professor and General Manager of Intell'agence, is categorical (Le Monde, 2011):

"The reference degree is PhD, not Master in Engineering, degree on which French enterprises usually leant. Now, we are in a knowledge economy and competitiveness is based on the capacity of enterprises to develop their research and innovations. PhDs are the ones who have the expertise to work in that field. The qualitative leap between a master and a doctorate is tremendous. But it is true that many PhDs are not well prepared for working in industry."

2.3 Could These Views be Reconciled?

At first glance, the two sets of views presented above seem diametrically opposed and by no way reconcilable. However, a closer examination reveals that they actually do not conflict with each other, because they address different phenomena. Some of the views expressed describe the desirable situation, or the ideal they would like universities to accomplish, through their PhDs in engineering, to foster the innovation capacity and, on the bounce, the competitiveness of European industry. The more critical views point out the ineffective exploitation of doctoral degrees in society, instead of criticizing the degree, per se. All critical views refer to the present situation of PhDs, namely their difficulty to integrate into professional life.

In other words, in the favourable opinions, it is the "on the bounce" that poses a problem and it seems, in fact, that the "production" of PhDs in Science and Technology is poorly aligned with career opportunities. Naturally, there is career potential in academia for engineers, but this is beyond the scope of this presentation. Admittedly

also, the number of positions of university professors with tenure that are opened every year is frequently minor to the number of PhDs applying for it.

3. The Policy of Industrial Companies about PhDs

The policy of industrial companies in the recruitment of PhDs tends to be more or less the same everywhere in Europe. In large industrial corporations, the recruitment of PhDs is linked to the volume of R&D for the following reasons: A PhD is generally not going to spend his or her entire professional life conducting research: he or she will have to move, at some time, towards managerial tasks for which he or she has not necessarily been sufficiently trained.

It is uncommon that new industrial processes and practices be created by individuals: enterprises are built and operated by groups, whereas PhD students often bear sole responsibility for their thesis subject matter. Regardless of the valuation of PhD candidates in their own universities, the Human Resources Manager will always rely on his or her personal standard of "soft" skills, while also taking the company policy and culture into account. Depending on their technical level and complexity, the diverse R&D tasks can also be successfully tackled by engineers at the Master's level, and then the mastery of soft skills of the candidate may be a more discriminatory criterion than the educational background.

Finally, Human Resources Managers are reluctant to hire PhD graduates, however good they might be, to have them work in a position for which they are overqualified, because there is then a significant risk of them leaving the company within a few years for a better qualified position elsewhere, or losing motivation for their work.

The policy is more or less the same in SMEs, except that it is usually the core activity of the company that determines if it is desirable or not to recruit PhDs. This yields a three-body problem – academia on one side, industry on the other side, and engineers applying for or having gained a PhD in-between. As a remedy, the following section will shed some light on the problem to invite possible solutions.

4. Shedding Light on the Problem

4.1 The Red Light: Motivation of PhD Students

It seems that many students who apply for a PhD do not know what their real motivation is, and even less what lies ahead of them afterwards. In a survey conducted at the University Pierre Mendès-France of Grenoble among some 400 of their PhD graduates (Mangemetin, 2000), it appeared that 37.5% of desired to become an academic when they applied for the PhD, 31.4% preferred to work in the private sector and 31.1% did not know what they wanted.

A student needs to have a good understanding of what the reasons are for becoming a PhD graduate (Bentley, 2006). If it is because he is afraid of entering the professional life or for some other personal motif, he had better quit. If it is because

he thinks he is going to earn more money, he had better quit also: other ways are generally more profitable and he is going to face a fierce competition to reach the best paid positions, particularly in industry, where Masters of Science have an advantage as they are already three years ahead in their careers.

In order to make a career in industry that is worth their PhD, graduates have to know well enough what lies ahead for them in their chosen line of activity; they have to be highly motivated for the line of work, possess valuable skills other than mere research, and be ready to learn much more during their careers.

4.2 The Green Light: Transferable Skills

The so-called "soft" or "transferable" skills are presently more and more valuable in the eyes of Human Resources Managers when they recruit engineers – be it Bachelors, Masters or PhDs– in industry, and they are now claimed everywhere in the job market. The European University Association, in the framework of a broader study, has presented a list of 11 skills which are highly rated at the time of recruitment of doctorate holders (Borrel-Damian, 2009).

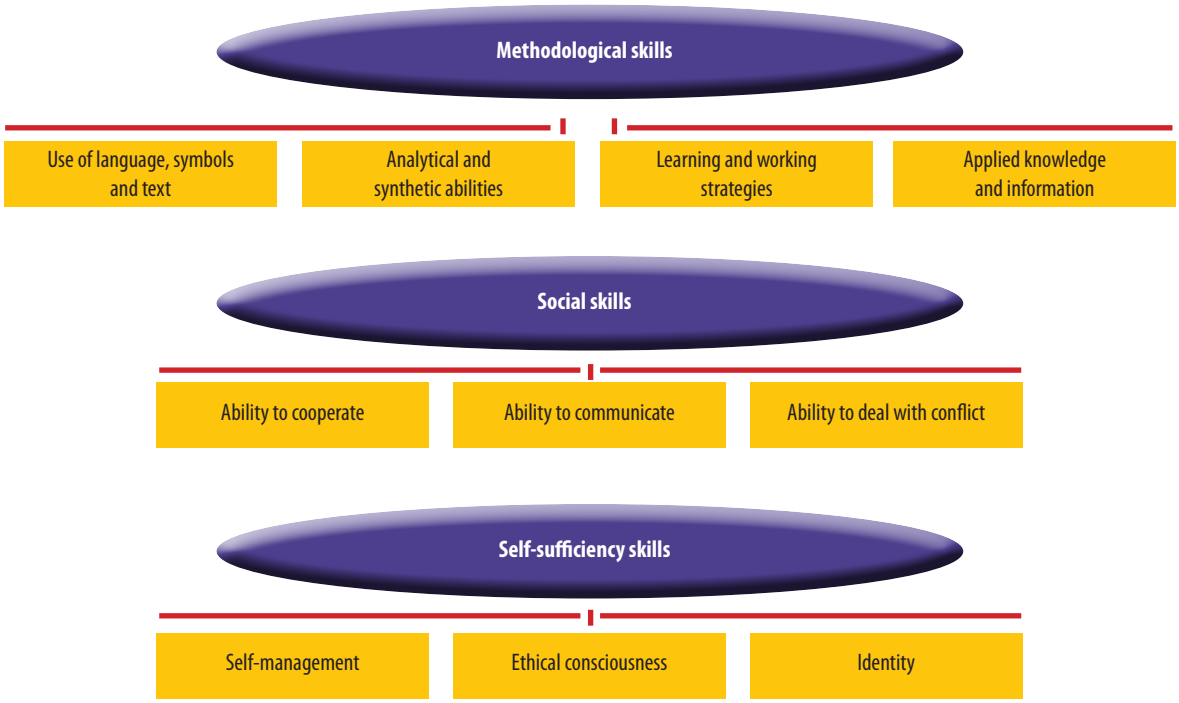

Figure 3. Skills teaching model at Zürich University.

Transferable skills have been defined as "those skills that are central to occupational competence in all sectors and at all levels" (DfEE;1997). This writing does not dispute the fact that having a good mix of such skills is desirable for the employability and career of engineers of any degree, but it should be pointed out that the plethora

of different lists and models makes them unusable, particularly as they presuppose (Holmes;1998):

- that the 'skills' terms being used have the same, unequivocal meaning for all parties, which is totally unsustainable, and
- that it is possible to differentiate between various levels achieved by the students in a given skill, which seems unrealistic.

The conclusion, concerning transferable skills, is that we are floundering in full subjectivity. Yet the fact remains that they do exist, that employers are resorting to them as criteria and that candidates will have to prove, one way or another, that they do possess a good mix of transferable skills.

There is one transferable skill that this article would like to stress, that is leadership. The seven pillars of leadership include (Cohn, 2011):

- Integrity: the fundamental leadership attribute that keeps everything else secure.
- Empathy: the fundamental ability to tune in to others and to motivate them.
- Emotional intelligence: it improves the connection between what we feel and the way we act.
- Vision: it starts with imagination and an inquisitive mind and provides direction.
- Judgment: the ability to zero in on what is important, see the whole chessboard and take decisive action.
- Courage: the ability of facing, mediating and shaping conflicts, sometimes at considerable risk to oneself.
- Passion: it creates positive energy and attracts followers, but must stay balanced with the other six attributes.

These qualities can give rise to other skills: innovativeness, for instance, requires the imagination to conceive a new vision, the judgment to ensure this vision is practical and can be implemented, the empathy to anticipate ways in which others will react to the new idea and to garner their support, and the courage to commit to a plan despite inevitable obstacles.

4.3 The Blue Light: Curricula for PhDs in Engineering

One argument for the importance of PhDs in engineering stems from the competitiveness of industry and Europe. When viewing professional abilities, there is a difference between potential ability, even derived from the best university, and proven ability, such as the one gained on the job, because the realities of the industrial workplace are quite different from research in university.

It is, naturally, interesting for universities to have as many PhD students as possible, first, because they carry out a significant part or the research work of the university, and second, because their number is a criterion for ranking and funding. As a result, the programmes have an incentive to attract students.

A collateral and perverse effect of such an attitude is that PhD graduates, when

postulating for a job in industry, try to sell their degree, not their skills and personality traits. A PhD degree has little value to non-academic employers, who want (Harvey, 1999):

- adaptive people, who can rapidly fit into the workplace culture, work in teams, communicate well, take on responsibility, perform efficiently and effectively,
- adaptable people, who can use their abilities and skills to make the organization evolve through bright ideas and persuade colleagues to adopt new approaches, and
- transformative people, who can anticipate and lead change and who have higher level skills, such as analysis, critique, and synthesis.

Such new professional doctorates are emerging in engineering, mainly in Australia and in the United Kingdom. It is too early to judge their impact, but there is no doubt that doctoral studies conducted in collaboration with an industrial company are much more profitable for future graduates and have a positive impact on university-industry cooperation, not only in the field of research, but also in the framework of continuing engineering education.

4.4. The Amber Flashing Light: R&D in Europe

Figure 4 presents the relative number of PhD graduations in engineering (OECD; 2011) as compared with the R&D intensity (Innovation Union Competitiveness Report; 2011) for the same countries and the same year.

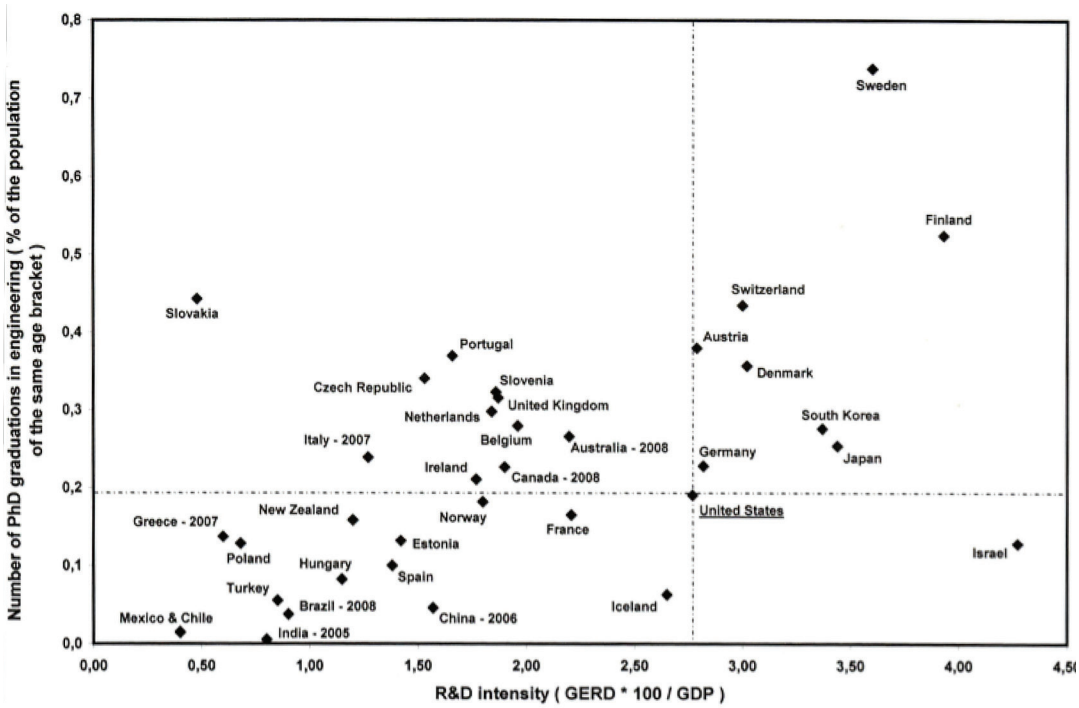

Figure 4. Relative number of PhD graduations in engineering as a function of the R&D intensity.

This diagram clearly illustrates that this time the position of European countries, compared with the United States, is far from good. Only Sweden, Finland, Denmark, Switzerland and, to a lesser extent, Austria and Germany are managing better. All other European countries lag far behind, particularly Spain, Estonia, Italy, Hungary, Poland, Slovakia and Greece.

In 2011, R&D intensity was expected to be of 1.8% for Europe – compared with 2.7% for the United States, 3.3% for Japan and already 1.6% for China – which is even less than the average value for the whole world, which revolves around 1.9%. Figure 5 visualizes this comparison (OECD, 2011).

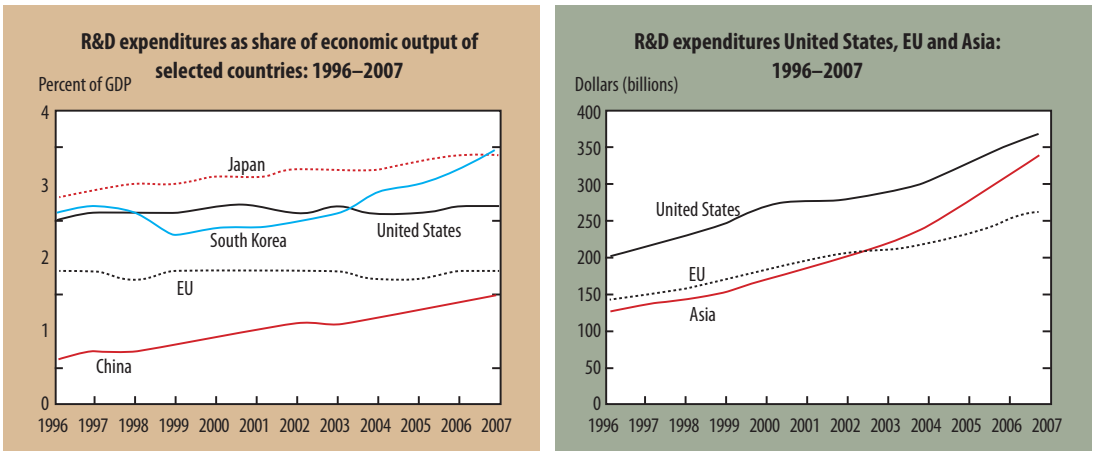

Figure 5. Comparison of R&D intensity.

These figures are incredibly low for the European Union, the governing bodies of which have set innovation as the main target for their competitiveness, with the Knowledge Triangle as a conceptual tool fostering knowledge transfer from universities to businesses.

One can go further and compare R&D intensity in the public and in the private sectors (Innovation Union Competitiveness Report; 2011). In Figure 5, the two dotted lines correspond to the average values for Europe-30 (that is, EU-27 + Iceland, Norway and Switzerland), while the ellipse delimits the area inside standard deviations for the same countries.

It is interesting to find that if, globally, Europe stands comparison with the United States, Japan and South Korea concerning the public R&D intensity, its position is not that strong in private R&D intensity.

There are two other interesting figures in the same report. First, the number of researchers working in the private sector represents 80% of all researchers in the United States, 75% in Japan, but only 46% in Europe. Second, it appears that the R&D intensity is 36% higher in the United States than in Europe for old companies (created before 1975), but 168% higher for young companies (created after 1975). This gives an idea of the difference of entrepreneurship between Europe and the USA.

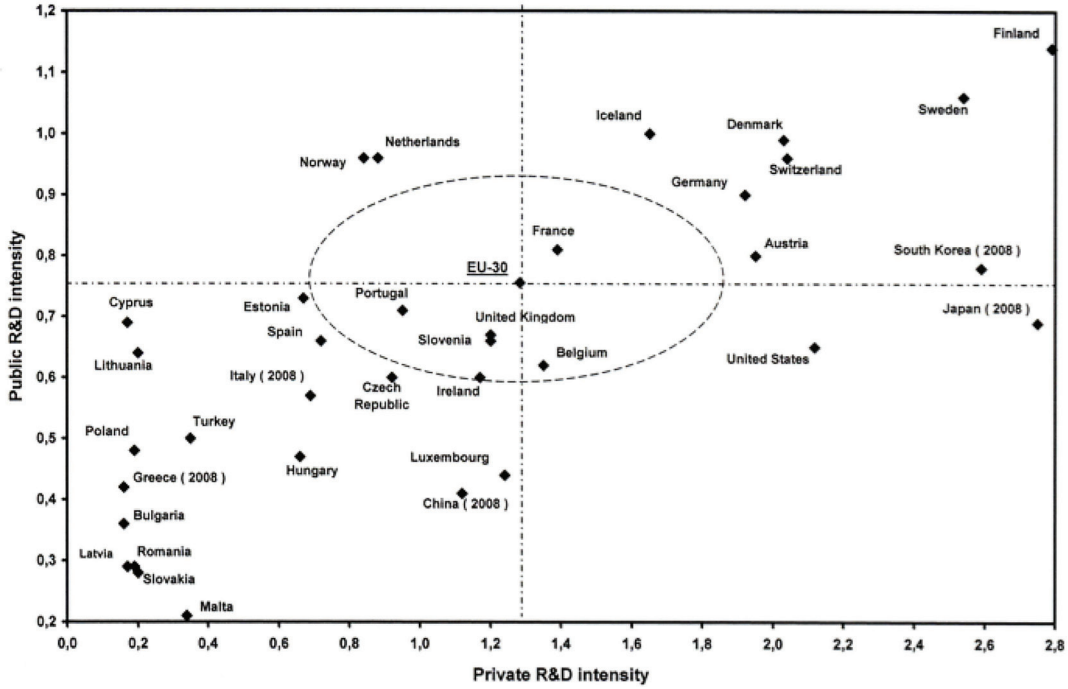

Figure 6. R&D intensity per country (2009 unless otherwise specified).

When looking for underlying causes, it could be speculated that it derives from the fact that Europe does not have many natural resources in its ground: however, this is also the case for Japan and South Korea. Another explanation could be that European salaries, particularly the social security systems, offer too high benefits: but it is in the European countries where they are the highest that the R&D intensity is also the highest. Some claim it all stems from the many successive wars in Europe, which have weakened the European economy. This work contributes to the discussion with yet another explanation: the overwhelming power that financiers and economists have, directly or indirectly, on all sectors of our society. They hold managerial positions in companies that were formerly held by engineers, and they generally insist on yielding short-term returns on investments, which trims many potential R&D projects. On the other hand, shareholders follow suit, frightened by all the commotion initiated by the rating agencies and reflected by the media as shakiness of the market.

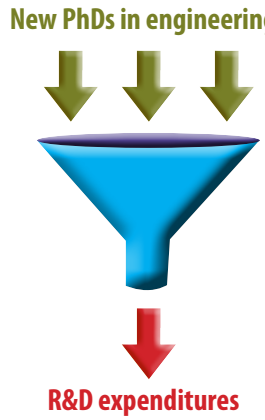

Figure 7. The Funnel effect.

4.5. Another Look at the Question

There remains one question to examine here: What could be the link between the R&D intensity and the number of PhD graduations in engineering? A survey for the European Business Summit (INSEAD, 2009) could offer some answers. It analyzed the relevant skills of graduates from European countries and from some non-European countries according to their capacity to foster growth and competitiveness; so, as shown in Figure 7, we plotted the R&D intensity as given above versus the skills (or talents) level measured by INSEAD.

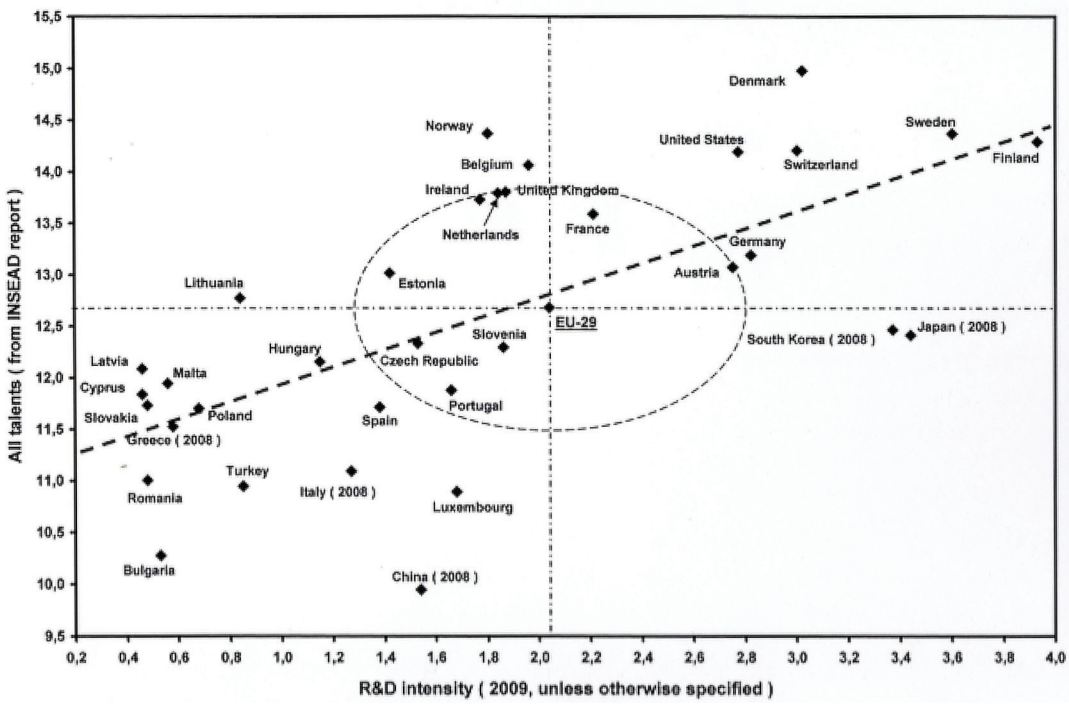

Figure 8. R&D intensity vs all talents per country.

In Figure 8, the ellipse delimits the zone within standard deviation for the 29 European countries (that is, the EU-27 plus Norway and Switzerland) and the inclined broken straight line expresses the linear correlation of both variables for all countries. It appears that there is obviously a correlation between the variables.

Consequently, it seems that the level of talents as measured by INSEAD, the number of PhD graduations in engineering and the R&D intensity are more or less linked together. Now, those three characteristics are cultural expressions, which result from a learning process. Therefore, we may conclude that the learning process – itself linked with the average mindset of people – is the main factor that explains the differences between the analyzed countries.

5. Conclusions

This article aimed to corroborate the views according to which the supply of PhDs in engineering is overcoming the demand and that many PhDs cannot find a job corresponding to their qualifications. Maybe is it true that Europe needs more researchers to enhance its competitiveness, but the comparison with the United States and Japan shows that it is essentially in industry that these researchers should be working, which is not presently the case because the European industry does not invest sufficiently in R&D.

One of the main reasons for the situation is probably the fact that many European industrial companies are managed by economists and financiers who are looking essentially for a short-term return on their investments, while R&D is a long-term investment. Engineers, on the contrary, are characterized by a proactive vision of the future, but unfortunately many of them do not pursue or reach top managerial positions. It is therefore useless – and also a waste of resources – that universities should "produce" more PhD graduates, as most of them would have to accept positions for which they are overqualified. Instead of seeking quantity, universities should improve the quality of their graduates, by developing their leadership and entrepreneurship skills.

One avenue for such development could be management-based doctorates, besides the present research-based doctorates, which would also address the management of R&D. Too many people are lacking in imagination and are resistant to change.

Engineers must take their future into their hands. Otherwise, no-one will do it for them and pave their way. As the Spanish poet Antonio Machado wrote:

Caminante, son tus huellas	Traveller, nothing but your tracks
el camino, y nada más.	are laying out your way.
Caminante, no hay camino,	Traveller, there is no road,
se hace camino al andar.	the road is made by walking.
Al andar se hace camino	By walking, you make the road
y al volver la vista atrás	and, when glancing back,
se ve la senda, que nunca	you see the track which
se ha de volver a pisar.	you will never tread again.
Caminante, no hay camino	Traveller, there is no road,
sino estelas en la mar.	only wakes upon the sea.

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About the author

Marc Goossens holds an MSC in nuclear physics. He has worked extensively in industry in applied R&D tasks, in university as an interface with industry, in insurance as a broker, and as a self-employed trainer for engineers, before retiring in 2008. He has served as Director and Executive Officer of SEII since 2005, where he works on a voluntarily basis with a focus on engineering education at the European level. He also harbors a special interest for cognitive sciences and philosophy.

Mikael Nederström
Research Manager, Psycon Corp
mikael.nederstrom@psycon.com

XI. Defining and Measuring Innovation Ability

Abstract

In pursuit of innovations, many industrial organizations today seek creativity in their workforce, without really understanding what it is. This article examines ways of defining, measuring and assessing creativity in a scientifically sustainable manner. It presents results from an empirical study of several personal assessment tests to extract the psychological core of creativity. These tests included measures of intelligence, personality and thinking styles. The results revealed the component structure behind creative thinking: innovation draws from 1) originality and fluency, 2) A tendency to think outside of the box, flexibility and self-estimated creativity, and 3) preference for complex, abstract and unsymmetrical visual stimuli over simple and symmetrical patterns.

The practical implications of these results are discussed in terms of trainability and prediction. The article also proposes a new stance for industrial organizational to address, innovation and the creative thinking process in an organizational environment.

Keywords: creativity, intelligence, thinking style, personality, personal assessment, innovation

1. Introduction

The Knowledge Triangle is fiercely driving European universities towards a fundamental change, challenging higher education institutions to question their long-time traditions and ways of working. The subsequent university reform aims to facilitate the integration of creativity into university activities, not only in actual substances but also in terms of policies and practices. Unfortunately, such an in-depth cultural shift cannot be achieved by dictating or ordering but it requires a more profound develop-

ment process where individuals and organizations themselves start, piece by piece, to shape the foundation of their operations by learning and growing together.

Policy-wise Finnish universities have taken concrete action in the right direction to promote innovation. As an example, Aalto provides platforms for its diverse operators to rehearse and exercise innovative initiative and hosts a variety of pilot ventures and daring programmes, Factories and Labs that allow individuals to experiment with the synergies between research, education and innovation. Underneath the policy level, however, lie individual capabilities that determine to what extent a university can innovate; without individuals' drive, passion and understanding of innovation processes, no creativity will materialize.

This article sets out to shed light on the dimensions of personality that support creativity and innovation. It also explains how creativity can be measured and assessed in a scientifically sustainable manner.

2. Creativity: Definition and Measurement

Most of the present concepts in psychology have received their status through a thorough operationalization process. This means that once a concept has been defined, it should be measured and studied empirically. If the concept cannot survive this process, is has been considered pseudoscience. Over the years this norm has made many theories redundant.

Typical examples in the history of psychological trash can be found in psychoanalytic, graphology and paranormal studies. As the time has passed by, one by one these unempirical entities have disappeared from the scientific research. No matter how intriguing a hypothesis is, it is not science, if it cannot stand empirical testing and measurements.

One interesting exception in this straightforward historical pattern has been the concept of creativity. In the history of psychology, creativity has traditionally been one of the most difficult concepts to define, study and measure. It is easy to say what creativity is not, or that you will recognize it when you come across it. However, it is so obvious and apparent that it cannot be judged as pseudoscience. On the other hand, its definition efforts have been limited and one-sided. Its vagueness and multifaceted nature has made it prone to fall outside various psychological disciplines.

2.1 Is Creativity Real?

Some researchers, prone to mysticism, have intentionally confused the concept of creativity. They have aimed to keep it as an unexplained, esoteric and theoretical construct without any commonsense or measurable consequences. This type of an armchair definition has been maintained to secure creativity's esoteric and unique position in the field of psychology.

On the other hand, some reductionist skeptics have devaluated and deconstructed the entire concept, because it is not empirical enough. They have not had patience to study whether there are, nevertheless, some measurable candidates as building

blocks of creativity. The truth lies somewhere between these two extreme poles, as usual. The following sections demonstrate ways in which it is possible to define, measure and study creativity empirically, while maintaining its unique and unreductionistic character.

2.2 Various Expressions of Creativity

One reason for the allegedly confused definitions lies in the word "creativity" itself. If this same term is used for the neurotic, obsessive-compulsive composer and the sleek R&D engineer, it raises questions about the meaningfulness of such a generalization. After all, the two characters differ vastly in terms of appearance and mental end products. Both the composer and the engineer are obviously creating something new and original, sometimes even highly appreciated. But is there really any reason to believe that the creative process behind these two completely different types stems from the same psychological origin?

Supposedly there is. The basic building blocks of human personality, thinking styles and mental abilities are the same for all people. It is rather the relative strength of these blocks which varies between individuals; a certain combination can give a significant boost for creative thinking. This unique combination can be used to understand the creative process behind the composer as well as the engineer.

If a researcher has just a hammer as a tool, all the problems look like nails. However, focusing only on one mental tool narrows one's ability to think creatively of creativity itself. That is why we need more than just one construct to understand the colorful concept of creativity.

3. Thinking Styles and Personality

Maybe the most popular proxy for creativity has been so called divergent thinking (DT), and several studies on creativity have relied on DT tests (cf. Furnham et Nederström, 2010). DT is a skill which helps to produce novel, unstructured, original and associative ideas. Hence, it can be seen as an opposite force to convergent, rational, analytical and logical reasoning. The tests on DT require people to produce several ideas in response to a specific prompt in a specific time period. Most commonly, DT tests are quantitatively scored for the number of responses (fluency) provided by the participant. They may also be scored for statistical infrequency of response (originality) and flexibility.

The cognitive style (or thinking style) framework is a less-known classification system in personality psychology. This classification falls somewhere between cognitive abilities, the DT and personality. Within this framework, especially the intuitive, experimenting, and innovative thinking style has been associated with creativity. Furthermore, the openness to experiences, when considered as a personality trait, comes close to this type of thinking styles. People with an open mind and no mental constraints are more prone to produce new ideas. Hence, this trait has a strong potential as a predictor of creative thinking.

If all this sounds complicated and confusing, the reader is well on track. The vast conceptual richness of theories and classifications in differential psychology is exceptionally present in studies of creativity.

4. Information Processing Skills

In addition to thinking styles and personality, the general mental ability (or intelligence) has sometimes been regarded as a part of creative thinking. The general mental ability is strongly associated with work and life success and various other outcomes in several studies (Gottfredson, 2004). This ability is related to some extent to almost all cognitive skills – hence it is no wonder it has also been associated with creativity. This connection between intelligence and creativity is in line with the commonsense assumptions. It makes one wonder whether there is any real opportunity for a person to be creative, if he/she does not have the mental ability to process ideas.

This hypothesis is well justified, if one remembers that intelligence is a general processing skill which enables us to understand, connect and handle complex information from our environment. And, after all, the information from our environment is raw material for new and creative ideas.

5. An Empirical Study of the Constructs

To study the relative contribution of these different building blocks, an empirical study was conducted on all ingredients of creativity. These results have been reported in detail in a master's thesis of psychology at the University of Helsinki (Pekkonen, 2010).

The participants in the study were assessed at Psycon Corporation in a psychological personnel assessment center in Finland. The sample of 121 job-seeking candidates contained various age groups (ranging from 20–60 years, mean 38 years) and different educational backgrounds. Most of the job seekers were seeking manager level and expert positions. These candidates completed a series of tests which all have been suggested to be measures of the creative potential. These measures included tests of divergent thinking, general mental ability, cognitive styles, visual preferences, various personality questionnaires, and tests for out-of-the-box problem solving. In addition to these tests, each candidate gave a subjective self-estimate of his/her potential for creative thinking.

This exceptionally wide test pattern was used to cover all the possible aspects and theories of creative thinking. Biases related to different kind of measures were controlled by using both objective and subjective measures.

6. Ingredients of Creativity

The study revealed, as hypothesized, that DT was a significant predictor of performance in various creativity tests. All three aspects (fluency, originality and flexibil-

ity) of DT were connected to other types of creativity, personality and mental ability measures. When all the test results were factor-analyzed together, a certain pattern was obtained which revealed the internal structure of creativity. In other words, this analysis yielded the common core for different creativity tests.

After a thorough analysis, it seemed that creativity contains three different aspects of mental processing:

1) Originality and fluency
2) A tendency to think outside of the box, flexibility and self-estimated creativity
3) Preference for complex, abstract and unsymmetrical visual stimuli over simple and symmetrical patterns.

All these main components were somehow connected, but yet independent enough to be treated as separate psychological constructs. In addition, the three components were positively connected to general mental ability, openness to experience and intuitive-experiential thinking style, as hypothesized. In practical terms: when these three main components meet high intelligence, open mind and use of intuition, the person's behavior is probably creative. These associations invite interest: despite the constructs in question being measured with different tests, their results nevertheless correlated strongly. This is in alignment with predictions from theories on creative personality.

7. Theory and Training

All in all, these findings are well in line with previous studies and hypotheses on creative thinking. This study aimed to combine various psychological tests to form a bigger picture of creativity and to analyze it empirically. The findings demonstrate that even though creativity is a rich and multifaceted concept, it is possible to define and measure it.

The next step would be to investigate whether is it possible to teach or develop these building blocks to increase a person's creative potential. So far, too many development programs have been finished with undefined and poorly measured results. The main achievement of these programs has been a happy participant, who has not, however, grown any more creative or innovative in real life. All the developing efforts will be in vain, if they do not take into account the reality of all these psychological components. Thus, the results presented here offer an essential point of departure for creativity trainings in the future. Training drawing from a scientific basis could yield enormous impacts on industry and society at large, when properly implemented.

8. Adaptation and Innovation

When discussing creativity as a resource, one tends to move to a world of clichés and sales talk. But there seems to be a grain of truth in the clichés. The ways of thinking

behind creativity appear to be exactly the same as those stressed and pursued in today's organizations.

In rapidly changing environments, the ability to adapt to the unpredictable, intellectual openness and flexible problem-solving are definitely important on a practical level. In personal assessments, a proper definition and measuring tool for these properties are practical means of increasing the predictive value of the assessments.

How does creativity relate to innovation, then? An innovation can be a symphony, a painting, a new technical solution or merely a new, efficient way of accomplishing tasks. They all constitute extremely divergent by-products of a certain type of a thinking process. However, they all have something in common, namely creative thinking.

The creative thinking process is always a necessary (but not, of course, a sufficient) condition for innovation. And every now and then, the need for creativity results in something original, useful and appreciated, which then leads to a real innovation. When examining the results of the creativity study against these backgrounds, they no longer feel so theoretical. Creativity is not just a scientific-historical curiosity but an increasingly important part of everyday organizational behavior.

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About the author

Mikael Nederström has an M.A in cognitive science and is currently finishing his PhD on personality psychology. His research interests centre on industrial and organizational psychology, particularly on personal assessment, personality judgments, and psychological/psychometric testing. As a research manager at Psycon Corp., he develops assessment tests and leadership development tools and teaches end-users in interpreting and implementing these measures.

Pia Lappalainen
Lecturer, Aalto University
pia.lappalainen@aalto.fi

XII. Promoting Innovation in the Classroom

Abstract

University curriculum design serves as a pertinent avenue for Knowledge Triangle principles. Topical and relevant higher education draws from recent research findings and bolsters industrial innovativeness. Resultatively, pedagogic emphases in engineering education have shifted from calculation to problem-solving skills and innovation abilities. Vitality in human thought is presently recognized as a source of industrial, national and global competitiveness, inviting curriculum design to elevate such thinking abilities as imagining and creativity to leverage industrial brainpower.

This article views innovation as an ability that is teachable and learnable in the classroom, contributing to industrial competence development in two ways. First, it examines the make-up of innovation capability through a collection of organizational factors, on the one hand, and through individual qualities, on the other. Its findings suggest that such organizational assets as trust and safety and such individual characteristics as optimism and affective functioning promote creative processes in professional communities. Second, the writing urges universities to revise their curricula to respond to competence development needs in these areas. As pedagogy, it proposes such classroom management strategies as student empowerment, self-management tactics, collaborative learning and problem-based learning as methodologies worth experimenting with in any classroom hoping to serve as a venue of innovation skills development.

Keywords: innovation ability, organizational factors, individual characteristics, university pedagogy

1. Background

Currently, industries are facing mounting demands that challenge their traditional capabilities. These demands embrace such societal trends as globalization, the rise of the service sector, emergence of the digital economy, fragmentation of work communities, and transfer from modern values of economic wealth to postmodern values celebrating e.g. self-fulfilment and social relations. The accelerating technological advancement is pressuring engineering organizations to be first-to-market with new ideas and products, with innovation emerging as the foundation for companies' efforts to outperform their competitors. (Arhio, 2007) As a result, organizations are expected to raise not only their level of productivity but also creativity to survive in the fiercely competitive and aggressively changing operating environment.

In the larger set-up, postmodern industries are witnessing a paradigm shift from pure cognition-based models of organizational behavior towards ones combining cognition and affect. This is resultative of the understanding that faculties outside cognition may prove to bring competitive advantage by serving as key psychological drivers of thinking, motivation, and behavior. Conclusively, it is recognized that the success of sustainable technological development depends, in addition to technical factors, on soft socio-economic, social-emotional, and socio-cultural ones. (Niitamo, 1999)

This article examines innovation ability as an organizational asset. It is a key driver of economic development, determining companies' life cycles and technological breakthroughs, and realizing commercialization and industrialization in pursuit of higher profits. Innovation is also a tool for entrepreneurship and therefore entails societal impact and significance. As innovation no longer just happens, it needs to be driven, managed and encouraged, which necessitates a more in-depth understanding of organizational innovation ability. Previous literature has identified such influencing factors as an organization's technical and industrial conditions, as well as its management concepts and financial strength as factors contributing to innovation ability. (Lu, 2008) Based on a literature review, the present text complements earlier findings by addressing capacity stemming from human capital, including organizational safety and individual employees' personality dispositions. This writing also argues that innovation ability is comprised of skills that can be taught and developed, urging universities and corporate training providers to revise their curricula in a way that unleashes the creative talent of the young. (ur Rahman, 2009)

2. Organizational Characteristics Promoting Innovation

A healthy and supportive socio-cultural environment is likely to foster innovation. On the organizational level, innovations rest on education and lifelong learning that allow people to live up to their full potential, and on networks which provide the social capital necessary for research and development. Networks present themselves as organizational structures but also as resources promoting communication, trust

and understanding, thereby facilitating innovation activities. Networks also serve as a means to learn, individually and organizationally, by offering forums for sharing information, exchanging best practices, and learning from one another. (Arhio, 2007)

Therefore, in order to optimize creativity, agility and efficiency, organizations are to sustain and foster the intellectual and mental capacity of their personnel to encourage them to constantly give their utmost best. Unfortunately, it is too often ignored that the build-up of organizational capability calls for trust and communality, and employee autonomy. Instead, the prevailing instability and lack of predictability cause growing employee insecurity and frustration, subsequently undermining organizational performance. (Kultanen, 2009)

Organizational safety draws from individuals who are trustworthy, on the one hand, and who can trust others, on the other, necessitating physical and mental vulnerability among other individuals and emotional honesty. Trust manifests itself in the ability to tolerate mistakes, which is an important stepping stone in securing organizational growth, renewal, and innovation. A climate that does not accept errors and imperfection cannot be creative. The essential attribute is to learn from the past mistakes, and not to make the same mistake twice. (Åhman, 2004)

Innovativeness in work communities builds largely on group diversity where the members are highly oriented towards common goals. Appreciation of diversity and criticism are instrumental in reducing unnecessary group conformity or groupthink and in giving a boost to group performance and especially creative thinking. (Korhonen-Yrjänheikki, 2011)

At times organizations unintentionally jeopardize or hinder creativity by allowing or setting barriers to innovation activity. These barriers stem from excessive control, too frequent or inappropriately targeted assessment, a patronizing atmosphere, or constant rush. Too much control and monitoring tends to restrain new-creating activities by instigating fear of failure or mistakes. Anticipation of negative outcomes paralyzes productive action, whereas feelings of safety unleash potential. (Goleman, 1998)

3. Individuals' Characteristics Promoting Innovation

Creative intelligence is pivotal for the formulation of extraordinary ideas and problem-solving. On the employee level, innovation necessitates a myriad of skills and personality traits. It also calls for individuals who can take risks, cross the boundaries between disciplines and visualize the broader context, that of society. Innovative workers delve not only into specialized technical content, but also into its broader implications, while harbouring an interest in developing their communication skills and ability to adapt, change, and work in teams. (Akay, 2008)

Innovative individuals are known to take a liking to creative problem solving and appreciate originality. They search for new angles and sources of information to invent new ideas. They integrate both cognitive and affective processes in new-creating activities; creative thinking is cognitive activity but on the affective level they possess the self-confidence, persistence and persuasiveness required in understanding and nurturing innovative endeavors. Innovative individuals willingly take initiative and

demonstrate entrepreneurial and extraordinary attitude and thereby achieve more than what is expected and inspire others to follow suit. (Goleman, 1998)

Optimism has also been recognized as a critical factor in new-creating activities. It has traditionally been linked with such positive outcomes as good mood, morale, perseverance, popularity and occupational success. In contrast, pessimism is known to lead to passivity, failure, social estrangement, even depression. Where it was earlier viewed as a mood or an attitude, it is today treated as an individual difference, a dispositional and rather fixed trait-like component. Variance in optimism-pessimism impacts an individual's explanatory style: optimists attribute problems and failures to external, unstable or situational causes. Pessimists, then, would associate problems with internal, permanent and global causes. Ideally, organizational members harness realistic optimism, enabling opportunity-seeking behavioural patterns. Some argue for learned optimism, though, as there is evidence of pessimists and neutrals learning to become optimists through self-reflection and diagnosis of self-defeating beliefs. (Luthans et al., 2001)

On the interaction side, individuals who are high on agreeableness help remove barriers to open dialogue and communication by reducing the interlocutors' fear of being judged. Approachability is particularly crucial when encouraging unconventional or innovative ideas and de-inhibiting others from fear or expression. (Byrge & Hansen.:2009)

Conclusively, organizational innovation capability rests more and more on individuals' multidisciplinary competence and systems thinking, on the type of personality traits as optimism and openness, and on such skills as communication. (Silva et al., 2009)

4. Pedagogy for Promoting Innovation

This section presents pedagogic platforms that serve as enablers in the build-up of competences supporting innovation in organizations. These platforms deviate from the transfer of mastery in subject contents and emphasizes, instead, critical thinking, communication, teamwork, risk-taking, foresights, change management and entrepreneurial skills, which are recognized as facilitators of innovation. (ur Rahman, 2009) To secure these capabilities and the heterogeneity of industrial work teams, modern skilling practices need to foster diversity and differentiation. The institutional culture should therefore be upgraded by questioning the traditional role of the teacher, the formality of the classroom, and the teacher-centred lecturing style. (Lu, 1997)

Instead, student rights of personal autonomy and choice should be promoted by providing students with independence, freedom, self-reliance, and self-actualization. Unfortunately, such individualistic ideals seem at least ostensibly to contradict with today's demands for collectivism, cooperation and in-group interdependence. Individualistic student needs cannot be ignored, though, as student characteristics and learner orientations account for unique variance in learner empowerment and subsequently in learning outcomes. Individualism could be promoted by taking into account the diverse, individual learning styles. However, in pursuit of effective peda-

gogy, current university education relies heavily on the tradition of homogeneous classroom compliance. (Lee et al., 1997) Moving away from compliance-driven towards diversity-oriented teaching necessitates an enlargement of teacher repertoires of classroom management techniques. This cannot be achieved by authoritarian or modelling teacher roles but instead the student should be placed at the centre to facilitate self-directed, student-centred learning (Lu, 1997), promoting active rather than reactive learning. (Brodie & Porter, 2008)

4.1 Integrated Courses

Recent research signals that teaching within the context of a subject area and using case studies drawing from real-world phenomena is the most effective way of enhancing critical thinking, insight, and creativity through experience-based learning. In addition, analyses of such authentic cases that mirror reality encourage students to apply their knowledge of theory to practice. (Kreps & Lederman, 1985) Application of real-life cases is also a means of securing the relevance of the study material in a way that meets a student's personal and career needs and goals, which is known to be a factor increasing student motivation and empowerment. (Frymier et al., 1996) Finally, students require practice in the real world in order to be prepared for a real-world work environment. Case studies, in addition to offering models of situations students are likely to face in their professional lives, also help them develop both short-range strategies for solving organizational problems and long-range strategies for preventing such problems from reoccurring. (Kreps & Lederman, 1985)

Integrated courses offer a wider spectrum of assignment potential and thereby also opportunities for student freedom in being creative. Traditionally, creative people are rarely rewarded for demonstrating their abilities. Therefore, course assignments in the researcher's experiment were rated not merely for their language proficiency and communicational value but also for novelty, creative integration of disparate elements, and perceived effort. Aesthetic value cannot be overlooked, either, the assignment allowing such an element. (Sternberg, 1997)

The emerging methodology requirements place heavy demands on the teacher, in addition to substantive expertise. More specifically, lecturers are expected to develop tolerance for ambiguity, and ability to formulate relevant questions to force students to probe their thinking and stimulate them to articulate their own understanding. The teacher must also be sensitive to student learning styles to know who need pushing and who need more indirect postures. Finally, teachers are to demonstrate a sense of timing and judgement to know when and how to guide, allow multiple interpretations, and direct student thinking towards preferred outcomes. To sum up, the teacher acts more as a facilitator, resource and discussion leader than as a judge. (Kreps & Lederman, 1985)

4.2 Problem-Based Learning (PBL)

University education is instrumental in helping students acquire not only contents but also meaningful, deep and elaborative learning strategies. As learning results from

a combination of social factors materializing in student's communicative interaction, problem-solving offers a natural avenue for learning in technical education. Besides expanding conceptual understanding and the ability to apply meta-cognitive and reasoning strategies, PBL enhances teamwork skills. It also offers a way of visualizing how theory relates to problem solving, bridging the gap between knowledge and skills. (Kreps & Lederman, 1985) Similarly, it facilitates adaptation and participation in change, creative and critical thought, appreciation of competing viewpoints, identification of learning weaknesses and strengths, self-directed learning, leadership skills and utilization of relevant and varied sources, all critical for innovation activity (de Graaff et al, 2007).

Problem solving poses a challenge even before the actual solving process begins – the solvers need to be able to define the problem. Problem definition is important in industry and therefore it should be taught at the university level. In its entirety, the problem solving process serves as a knowledge acquisition method resulting in selective comparison ability, allowing the individual to build on past experience to solve problems in the present. A dimension of PBL to be stressed is the harmful effect of overusing or misusing selective comparison, which helps form insights through a connection between acquired knowledge and experience: when contexts differ, a solution that proved helpful in one environment may not be successful at all in another. (Sternberg, 1997)

As a teamwork experience, PBL emulates authentic working life situations. Such collaborative exercises offer a way of bridging the disconnection between real-world industrial life and university education. In sum, research indicates that learning, retention of knowledge and appreciation of problem solving increase through PBL. Furthermore, it is argued that PBL also promotes creative thinking. (Borges et al., 2009)

4.3 Cooperative Learning

Verbal interaction and overt discussion in groups are effective methods of acquiring and creating new knowledge through elaboration, rehearsal, restructuring and personalization of information. Interactive learning also improves verbal and written communicative ability, which serve as pertinent working-life skills as participation in groups is increasingly prevalent among today's professionals. As an example, the absence of critical thinking in the group decision-making process will result in inferior and regrettable decisions or groupthink (Korhonen-Yrjänheikki, 2011).

Shared and cooperative learning allows students to develop their line of thought and to respond to those developed by others in the group. Discussion in groups activates prior knowledge, mobilizes existing knowledge and helps create new relations between concepts, and allows students to become aware of their own beliefs and perspectives. Verbalizing an idea helps to fix it in the memory and integrate it into existing knowledge, and repeating and explaining it will promote longer-term retention of the information. (Lamont et al., 2010)

One form of verbal interaction, arguing, in particular, sets a challenge to innovation activities in groups. University education should therefore allow graduates to assume new approaches to argumentation and controversial situations which they easily find

awkward and uncomfortable. Social pressure to conform to general politeness standards and to meet expectations on collaborative image discourages students from advocating positions in debate. However, in industry arguing is known to generate such favourable outcomes as evolution of ideas, greater creativity, and problem solving. This necessitates students to adopt strategies motivating them for stronger positioning and to respect dissent and preparing them for arguments and for responding positively to the argumentative behavior of their interlocutors. Unfortunately, beliefs colouring argument as anti-social communication inhibit performance in situations requiring communication. As a remedy, educators could dedicate part of the lecturing time to address different student beliefs about arguing. Students could be helped to understand the benefits of argument by depicting arguing merely as a mode of social interaction, as a means of establishing and enforcing power, as an element impacting participant self-concept, as a way of conveying information, and, naturally, as a indicant of one's verbal and rhetorical skills. (Rancer et al., 1985)

4.4 Self-Management Techniques

Self-theories impact largely how students view their intelligence, bearing a subsequent effect on their motivation, performance, and ability to cope with innovation challenges. Self-theories draw from self-beliefs which determine whether the individual is inclined to operate toward a fixed mindset or a growth one. In the former the student is strongly outcome-oriented in his pursuit of appearing smart, seeing errors as a defeat reflecting his ability and performance. He therefore avoids challenges, rejects criticism and finds other people's success a threat. Students with a growth mindset, on the contrary, see errors as a challenge, accepting mistakes as an integral part of the learning process, which as such provides the ultimate motive. They willingly accept feedback and find inspiration in the accomplishments of others. (Simon et al., 2008)

Since fixed mindsets are harmful in terms of learning, university pedagogy ought to deploy attitude change techniques. Simon et al. (2008) propose intervention techniques such as 'saying is believing' where students internalize their intelligence development capacity through written pep talks they engage in, targeted to junior students as encouragement. They also advocate the reduction of stereotype threat where negative self-perceptions result in underperformance, by intervention coaching students to believe that intelligence is expandable and that, e.g., it is possible to learn innovation ability.

Furthermore, self-awareness can be raised through self- and peer assessments, which are known to assist students in developing pertinent professional skills such as reflection and critical thinking. The reflective practice can be encouraged by requesting students to engage in a reflective portfolio or journal writing to follow up their learning. Leveraged self-awareness, then, supports mood regulation and helps turn the individual into a more balanced, optimistic, extroverted and confident personality that finds it easier to engage in group innovation activities. (Brodie & Porter, 2008)

4.5 Student Empowerment

Regardless of which of the above-mentioned approaches are applied, they must be built on the platform of empowerment in order to foster a learning environment that kindles the desire to learn. The shift from the conventional depowering education that essentially allowed the student merely to receive, file and store teacher deposits for memorization and repetition does not support intrinsic motivation to learn and perform. (Frymier et al., 1996) As a solution, empowering educational strategies enhance individuals' ownership and control, and increase personal responsibility and accountability for outcomes. An empowering classroom culture promotes self-knowledge by liberating students to explore themselves as learners. (Brunson & Vogt, 1996)

Empowerment pedagogies also promote the alignment and adoption of common values in the classroom, reducing feelings of powerlessness and intimidation while fostering feelings of qualification, meaningfulness and self-confidence. These serve as important preconditions in education subjecting students to vulnerability through public expression of their own ideas and oral delivery of their own products. (Frymier et al., 1996)

The cornerstones of empowering educational philosophies constitute trust, communication and participation, which elicit commitment. More concretely, verbal persuasion serves as the means of communicating to students the teacher's faith in their ability and competence to perform the given tasks. Such interaction not solely redistributes power in the classroom but allows students to actively create their power. This type of verbal communication is multileveled, honest, constructive, and places emphasis on active listening and reception of student feedback. A permissive or free environment also rids students of fear of judgment and rejection, allowing them to feel free to put forth ideas and questions, knowing that the lecturer will not react through rejection, derision, blame or authoritarian injunctions. It is of the essence that the teacher models behavior that is non-judgemental, cooperative, empathetic, and spontaneous, thereby reducing communication apprehension and making students feel more competent and motivated to perform classroom tasks. (Kreps & Lederman, 1985)

Further, empowered students are granted the privilege of choice. Instead of following the syllabus precisely, students should be provided with freedom to exercise choice in applying assignment specifications and operational classroom rules. Such freedom allows students to exercise the rights and responsibilities granted to them in working life and in innovation projects, in particular. (Frymier et al., 1996)

A final immediacy-derived solution nurturing a safe atmosphere allowing students to move away from self-protection, research proposes perceived caring on the part of the lecturer. The construct of perceived caring draws from three factors in teacher behavior: empathy, understanding, and responsiveness. Empathy manifests itself as concern for student well-being; understanding implies the teacher's ability to comprehend and respect student views, and responsiveness refers to the teacher being attentive and listening to the students and reacting to student needs and problems promptly.

5. Conclusion

This article sought to identify industrial sources of competitive edge by examining factors impacting organizational innovation ability. This contribution shifts emphasis in organizational competence development towards individuals' capabilities, personality traits and learnable skills, resorting to findings signalling that even personality dispositions can be taught, learned and developed in universities.

To allow students to move from passivity to participation and emotional engagement, teachers need to move away from didactic modes to more discursive and argumentative modes of teaching. This will encourage students to elaborate, defend and extend their positions and opinions, thereby fostering critical thinking and purposeful learning, not just mere memorization. For this to materialize, the pedagogue needs to create a nonthreatening climate, emphasize genuine communication, and associate learning with actual, productive uses. This way the students will feel free to risk, challenge and question – all essential elements of organizational innovation activity.

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About the author

Pia Lappalainen has a Ph.D in Science (Technology) and an M.A in English, French, communications, and Pedagogics. Her research interests centre on industrial organizations, leadership, and engineers' competence development. As university lecturer at Aalto University in Finland, she pursues ways of integrating social competence into university curriculum in order to help engineering graduates better meet industrial needs. In 2009 she won a prize and funding in an Aalto University Pedagogical Innovations competition, which allowed her to experiment with new pedagogies with her students.

XIII. Experiences in Implementing the Knowledge Triangle – Cases

Universities, companies, as well as public-sector bodies are facing rapid changes: phenomena are coalescing, sectoral boundaries have become blurred, the volume of new knowledge is growing exponentially, and complexity has increased significantly. Thus, the importance of responsiveness, scientific relevance and innovation has grown huge over the past few years.

Pioneers and potential trend-setters are more and more often those who succeed, because they pave the way and set the ground rules for action. It is not necessary to be a leader in every sphere; what matters is the courage for taking action and platforms for igniting knowledge potential and the creative state of mind. It is usually enough to build sufficiently confidently on top scientific knowledge and co-design related innovation practices together with the key stakeholders from different areas of society.

Societal challenges cannot be addressed through conventional management methods. Boosting renewal capital is critical to success: creativity, innovation and the confidence to innovate also serve as keys to success.

This article presents three cases in which Aalto University has applied the Knowledge Triangle as a principle for deepening synergies between research, innovation and learning.

Case 1: ACSI – Knowledge Triangle in Action

Mika Pirttivaara
Team Leader, Aalto University
mika.pirttivaara@aalto.fi

It is widely acknowledged that the gap between novel research knowledge and practical applications is huge. In order to bridge this gap, the innovation divide, there is a need to design pioneering competences, sophisticated instruments and agile methodologies for bridging research systemically to innovation and higher education.

The most important source of innovation emerges on micro-level processes and creative flows between people. In innovation systems, the micro level processes are quintessential, not only for the individuals involved but also for the results and impact. In the current complex and hectic world, short-term and ad hoc group settings are of a specific interest; however, innovative work in short term informal groups has hardly at all been studied.

Aalto Camp for Societal Innovation ACSI is an innovation camp and a related innovation process, aiming at creating solutions to diverse and real-life societal concerns and challenges. Cases to the camp are provided by the local, regional or global societal stakeholders including companies, public-sector bodies and NGOs.

In the core of the process is an 8-day innovation camp. It operates in a multi-disciplinary, communal and dialogue-oriented way allowing the participants collaborate in mixed multicultural teams. The teams are supported by multiform and timely facilitation.

For example, in ACSI 2012, seven cases were chosen (see Table 1 for all ACSI cases 2010–2012). The cases were processed in the teams to which the camp participants – totally 70 from 30 different countries – were allocated. The teams of approximately 10 people represented field experts, researchers, students and practitioners from linking fields. They received preparatory material on their case, visited the respective case sites, and created new approaches and solutions. The outcomes were demonstrated and presented in the ACSIbition, on the last day of the camp.

Conceptually ACSI operates on the Knowledge Triangle (KT), i.e. it combines research, education and innovation to enhance renewal capabilities and efficiency of each area. The goal is to break the borders between traditional university practices and to create synergy by integrating students, teachers, researchers, artists and working life experts from various disciplines to study and work together. Thus, ACSI acts as a

- contributor of innovation methodologies: learning, research and enriching societal interaction;
- content contributor: ACSI produces knowledge, solutions and innovation based on real-life needs and complex societal challenges;
- driver of systemic change: whole ACSI concept as an operational mode is a driving force;
- booster for innovation culture and policies.

ACSI 2010	
Case	**Case Client(s)**
1. New role of school in lifelong learning and e-learning	WsoyPRO Ltd.
2. Lifelong learning & professional development of the Aalto alumni	Academic Engineers and Architects in Finland – TEK and SEFE – The Finnish Association of Business School Graduates
3. Developing and branding new living area	City of Espoo
4. Kotka Culture Harbour	City of Kotka
5. Active Life Village	Laurea University of Applied Sciences
6. Versatile suite of services for elderly people	City of Helsinki

ACSI 2011	
Case	**Case Client(s)**
1. Enriching Negotiations for Common Ground	Crisis Management Initiative (CMI)
2. New Model for Work-based Learning	Academic Engineers and Architects in Finland – TEK and SEFE – The Finnish Association of Business School Graduates
3. Development of a New City Environment	City of Kotka
4. International Collaboration Development of Structural Funds	The Ministry of Employment and the Economy
5. Improving Project Administration in ESF projects	Aalto University
6. Local Digital Agenda and Digital Campus	Aalto University
7. Increasing the Societal Impact of Arts	Aalto University
8. Increasing Innovation Practice in City Environment	City of Espoo
9. Knowledge Triangle	Aalto University
10. Silver Potential	Unlimited Potential Ltd and Laurea University of Applied Sciences

Table 1. ACSI cases 2010–2011.

In its simplest form, ACSI's KT-based concept consists of three basic elements (Figure 1):

1. ACSI 2.0 research project, which investigates ACSI's innovation process and its impact;
2. Aalto Societal Innovation Studies course for both undergraduate and graduate students, and
3. ACSI innovation camp (process).

ACSI 2012	
Case	**Case Client(s)**
1. Opportunities in the New Socio-Economic Wave	Finland Futures Research Centre (University of Turku)
2. New Models for Regional Competitiveness and Collaboration	City of Kotka
3. Innovativeness	Region Skåne and the City of Malmö
4. New Kinds of Collaboration	The City of Amsterdam
5. T3 as the Societal Innovation Test Bed	The City of Espoo
6. T3 Innovation Demonstrations in Real Life & Virtual Reality	The City of Espoo
7. ICT Cluster Revolution as an Accelerator for Job Creation	The Cities of Espoo and Oulu and Culminatum Innovation Ltd

Table 2. ACSI cases 2012

Micro-level dynamics is the fundamental basis of ACSI, and these processes are under continuous research concerning (a) the patterns and dynamics of self-renewing systems, and (b) methods for accelerating innovation ecosystem evolution. A group-level micro perspective is essential for innovation, i.e. knowledge exchange and collaboration within a group is tightly linked to the outcomes and results. Performing on

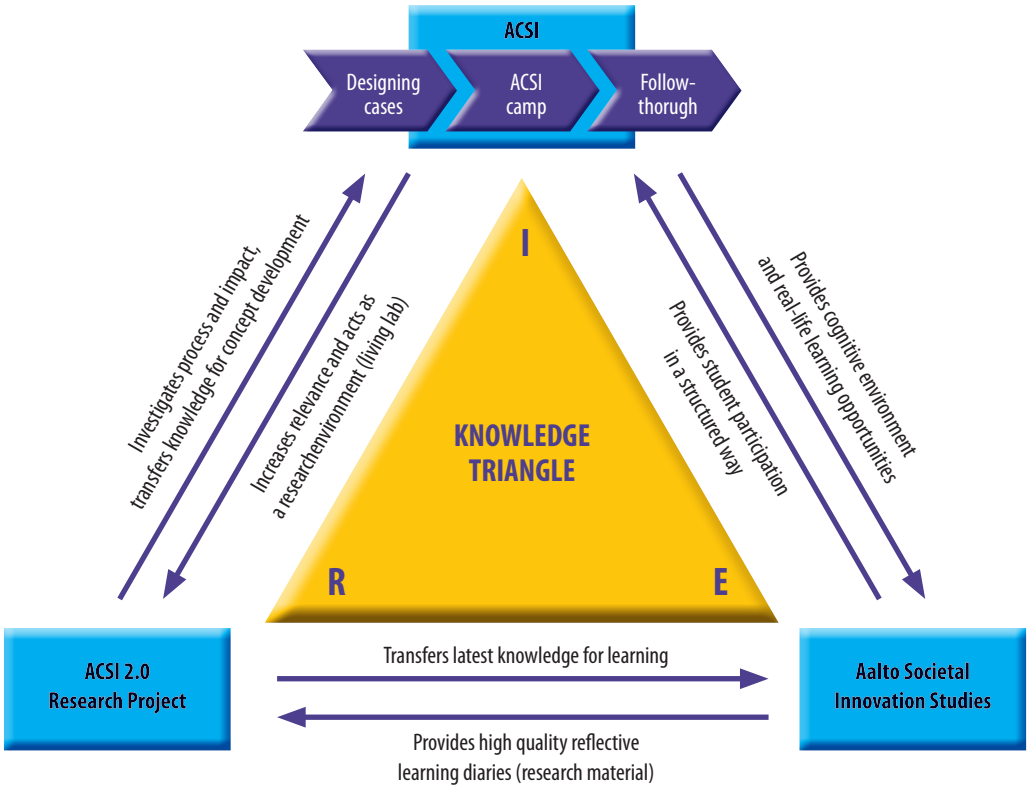

Figure 1. ACSI's KT-based concept example (R=research, E=education, I=innovation).

the Knowledge Triangle principle ensures that research findings are easily translated into improved ACSI's concept elements, updated Aalto Societal Innovation Studies' core content and new learning methodologies.

Learning outcomes are strengthened by collective, reflective and introspective learning processes. Students and other camp participants benefit from the highly inspiring cognitive elements of the energetic innovation process. Real-life societal challenges and the overall working mode strengthen motivation and deepen emotional connections (e.g. joy, trust, respect). All educational activities are adjusted to produce focused results, such as high-quality reflective learning diaries, which can also be used in scientific purposes.

In the context illustrated above, ACSI acts as a platform for learning, producing new scientific knowledge, and co-creating actionable ideas for solving complex societal challenges. Orchestration and facilitation support collaborative sense making and the generation of common purposes over the entire process. This makes ACSI a thought leadership process and an accelerator for both societal and cultural transition.

About the author

Mika Pirttivaara is the Team Leader of the Aalto Societal Innovation Initiative at the Center of Knowledge and Innovation Research (CKIR), Aalto University School of Business. During the recent years he has been working with societal innovation and conceptualization of emerging innovation intstruments located at university-industry-society boundaries. He is also the Club Conductor of the Aalto Future Club (http://ckir.aalto.fi/en/about/aalto_future_club/). http://www.linkedin.com/profile/view?id=2776867

Case 2: Experiences in Implementing the Knowledge Triangle Principles at Aalto University

Pasi Laitala
Manager of Economic and Business Development, City of Espoo
pasi.laitala@espoo.fi

Lars Miikki
Senior Consultant, Järvelin Design Ltd, Aalto University
lars.miikki@jarvelin.fi, lars.miikki@aalto.fi

This section describes some major practical experiences in implementing the Knowledge Triangle (KT) principles at Aalto University in 2010–2011. The KT method is a significant new path of development for Aalto University. The aim is to have education, research and innovation interacting in such a way that each actor gains significant added value through this conceptualized way of operations. The goal of KT is to enhance the quality of education, to create new research of national and international significance, and to encourage innovativeness and create favorable conditions for innovations. In order to reach this target, open and natural dialogue between different actors is needed. At Aalto University, the development of the KT model has been enabled by a close collaboration with the Aalto Camp for Societal Innovation ACSI, an international prototype of new generation innovation agenda. This section describes how the KT model will be applied in the activities of one Aalto department during the next few years.

Piloting KT in the Energizing Urban Ecosystems Research Program

The KT emphasizes multidisciplinary research and the piloting of practical applications. The KT has been developed at Aalto University since the beginning of 2010. It has focused on the theme area of built environment, challenged by e.g. climate change, energy-related impacts of city planning, renovation needs, multiculturalism and continuing scattering of community structure. These require significant new measures and open-minded solutions based on research.

According to the pilot plan, the KT will be tested and further developed in 2012–2015, within the Energizing Urban Ecosystems research program of RYM Ltd. RYM is the Strategic Centre for Science, Technology and Innovation of the built environment in Finland (www.rym.fi). The KT will be piloted by the Department of Surveying in collaboration with other departments. The strong role and commitment of the City of Espoo in the program, together with the participation of relevant businesses and universities, creates the basis for research targeted at entire urban areas and the development of applications utilizing KT. The collaboration model ensures a wider scientific significance of the results. The research program framework enables developing a practical application of the KT. In the long run, this supports the development of the entire field of built environments.

The pilot aims to create a new, multi-level and multidisciplinary method. It will be documented and conceptualized in a way that facilitates the participation of the partners. The research program aims at a deliberate construction of interface collisions. This way new research questions can be found. An open interaction network for the KT will be organized. Within the network, different actors develop topics and content to be processed for education, research and innovation activities. The collaboration concentrates especially on such problems related to urban structure as eco-efficiency and creating regional success from the points of view of climate change, life cycle economy, internationality and innovativeness.

Education

1. Themes of the work package will be integrated into courses.
2. Practical work and assignments will be targeted at the research questions and the results will be distributed to the benefit of businesses, the city and research.
3. Thesis topics will focus on the themes of the work package and will be integrated as a part of the research.
4. Researchers will participate in the supervision of practical work and theses.
5. Practical work and theses will support the research throughout the entire duration of the program. Recognition of research questions as well as creating and applying relevant results will also be developed.
6. Students' practical training in projects relevant to the program will be supported.
7. The creation of researcher careers will be supported.

Aims: In 2011, the KT will be applied in four different courses, in other words, approximately 150–200 students will contribute to the results of the research program with their practical work. The practical work will serve as bases for theses. In 2011, approximately 10 students completed their Bachelor's and five their Master's Theses related to the research program. The volume will be increased, and the target is to have 500–800 students annually involved in the research program through their studies.

Research

1. Students' work and previous research will be utilized.
2. Research will be conducted in research groups. This speeds up the application of the results.
3. The research will be scheduled relative to the needs and other KT activities in an efficient way.
4. A part of the research will be conducted in the facilities of the partners to enable quicker and more efficient utilization of the results in city planning.
5. A model will be created where partnership is integrated as a part of the research activities, also with regard to resources.

Aims: The research themes and the internal coordination of the research within the EUE research program will be defined in 2012. Research activities will include an estimated 10 doctoral dissertations altogether. Moreover, research will be conducted as post doc research.

Innovation Activities

1. A basis for innovation activities will be created through multilateral collaboration.
2. A solution will be implemented to channel research results to societal demonstrations and practical applications at a fast pace.
3. The results of innovation activities will be measured and the development of the method will be ongoing.
4. Internal communications and evaluation will be carried out.

Aims: In 2011 the focus was on building the network. During the program period 2012–2015, the results of the innovation activities will include new business concept ideas and implementations, demonstrations, studies, patents, new businesses, new ways of collaboration, and national and international networking methods for systematic action. The volume of the network will also be measured by the number of the organizations and individuals collaborating through the initiative.

Benefits for the Parties

As for education, the most central benefit is the utilization of current, actual topics and methods. With the help of the model, students can increase their professional skills markedly compared to their accustomed ways of studying (lectures and exams). Increased professional competence also supports the creation of career paths. Moreover, doctoral studies and research will appear more inviting a choice for career. This encourages gifted students to choose the career of a researcher.

As for research, the KT supports the creation of relevant research, as well as accelerates and boosts research. Students can be seen as an important resource for research. Collaborating with partners increases research potential and creates more career opportunities for researchers. The career exchange of researchers diversifies the career and enhances the relevance of research challenges and their applicability in societal innovations. This enables and partly even requires international research, simultaneously opening possibilities for research work as a part of the international scientific community. ACSI has a significant role in promoting the global networking by bringing a conceptualized real-life and real-case culture to the research.

Innovation activities create for the partners a working method where they can participate through education and research in solving research problems essential for their own operations. The speedy application increases the significance and impact of the research. The model improves the competitiveness of research activities. Partners can be genuinely involved in research, which enables the quick utilization of the results. The types of research that require quick solutions can in the future be conducted with the help of this model.

Collaboration with the Espoo City

In January 2012, Aalto University and the City of Espoo drew a strategic framework agreement to strengthen large-scale collaboration between the City and the University. The collaboration aims to foster societal innovations, open up possibilities for new business, support the development of entrepreneurship, and enable multidisciplinary research. The City and the University together with industry will increase their collaboration in the development of the larger campus area (the so-called T3 area) into an attractive environment for start-ups and as well as for international students and researchers.

Several joint projects and activities have been started with the aim of developing the area to as innovative, desired and attractive urban area, where new ways of working and work-life balance is supported in a modern way with the built environment. Especially the built environment and the service infrastructure are thematic areas for many joint research projects and educational activities which will upgrade the entire area to an energizing platform for enriching interaction between the most varied types of users.

The goal of these actions conducted in the T3 area, as the European pioneer of an innovation ecosystem test-bed, is to demonstrate how the key enabling success factors and application elements of EU2020 Strategy can effectively be implemented in the area, and how to modernize the Triple Helix model by enhancing the required collaboration based on the Knowledge Triangle approach between the city, universities, research institutes and enterprises. This will be accomplished in close collaboration with national and international partners and other pioneering regions as well. The experiences and the results will be widely shared.

About the authors

Pasi Laitala, M.Sc. (Tech.) works as Manager of Economic and Business Development at the City of Espoo. Recent tasks include acting as Land Use Expert at Fortum Corporation (energy industry), Lecturer and Developer in Aalto University (Department of Surveying), CEO in Wireless Media Finland Ltd. He has also gained experience from working in the third sector in professional and student organizations.

Lars Miikki, Senior Consultant M.Sc. (Tech.) at Järvelin Design Oy operates in several regional research and development projects and initiatives promoting the T3 area in the City of Espoo as one of the leading innovation hubs. Recent and ongoing positions include Task Coordinator in the Energizing Urban Ecosystem program, work package Regional Innovation Ecosystem T3 Ba & Flow 2012–2016, Project manager at Culminatum Innovation Ltd in the EKA Forerunner area Helsinki Region project work package B 2012–2014, Project Researcher at the Department of Real Estate, Planning and Geoinformatics, Aalto University 2012–, Urban Miller at the Urban Mill startup 2012–.

Case 3: T3 as Societal Innovation Test Bed (ACSI 2012 Case 5)

Aniko Kalman
Associate Professor, Budapest University of Technology and Economics
drkalmananiko@gmail.com

Challenge and background

The City of Espoo harbors an interest to develop the T3 area (Otaniemi-Keilaniemi-Tapiola) into both an effective operating environment that energizes people, and a globally unique and orchestrated innovation ecosystem based on mutual interaction between the university, companies, the public sector and the third sector. Espoo wants to be a pioneer in the municipal sector and a good place to live, learn and work and encourage entrepreneurship.

The primary challenge is how to empower and encourage people; inhabitants, workers, students and visitors to co-create new ways to make their daily life better. Next, it must be established how these innovations could be spread out and extended to other regions – even throughout Europe

Concrete steps

This process requires a multifaceted approach involving various steps. These steps can be implemented consecutively or sometimes even in parallel with each other. Firstly, a system / systems must be developed for harvesting, channeling and realizing values and ideas that emerge from the processes. This will allow the collection of ideas, i.e. sparks. Next, the ongoing projects throughout the T3 area need to be brought together in the forums on different levels so that ideas and knowledge can be benefited from by all stakeholders and actors in the T3 area. This will create the basis for cooperation and networks inside the T3. Then, prototypes should be modeled and made scalable to other regions (for example the other ACSI 2012 regions; Kotka in Finland, Skåne in Sweden and Amsterdam in the Netherlands). This would allow benchmarking, sharing experiences and evaluation between the regions. This step provides for cooperation and networks on a wider scale. In addition, a contract between the city and the university was suggested at ACSI 2011. This signals the appearance of strengthened collaboration between the City and the University.

Concrete results and impacts

When people in the T3 area and outside will be able and willing to find new means to enhance their lives, they will co-create new user-centric innovations that benefit their daily lives, which then will also have a wider impact on society. To accomplish this, there will be places where people with common interests come together and develop their ideas further through rapid prototyping in the initiated micro-level programs.

This, in turn, will have an impact on the local economy and well-being through job-creation and the development of new user-centric products and services.

Desired outcomes in January 2014

Open and inviting meeting places are functioning in the area. ACSI 2013 has further developed systems for harvesting, channeling and realizing values and ideas. First, micro-level programs have been implemented and the group of regional facilitators has been engaged. The T3 area has gained both economical and societal benefits through the proposed procedures, e.g. in the form of increased employment rate, new investments and businesses. "Talent attracts talent" has materialized through an increasing amount of start-ups and new inhabitants in the region.

Central questions to be addressed

The success of the proposed concept in practice in the next years will redefine its key challenges. However, currently the main issues to tackle include the following:

- How to ensure that the steps of the proposed system model allow opportunities?
- How to efficiently engage with what is already happening and link with other innovation actions?
- What systemic changes are needed for this to happen?
- How to truly commit the different actors; e.g. is the city ready for radical decisions?
- Who should be the facilitator for these changes?
- How do societal innovations in this area impact other areas and the whole world?
- How to ensure the creation of societal innovations in practice versus, for example, the creation of technological innovations?
- How to ensure the development and continuation of the ideas developed in ACSI 2012?

Societal innovation

The changing global environment, its challenges and economic pressure will result in rapidly growing demand for societal innovations. Meanwhile, stimuli and push from government and other actors is needed, and the reinforcement of the Triple Helix model.

By connecting the innovative players of the T3 area, posing stimulating topics and spaces to them, combining their diverse skills, and lowering the barriers of bureaucratic funding procedures, we can release the untapped potential of the T3 innovation ecosystem to produce user-centric innovations that can be applied across Europe.

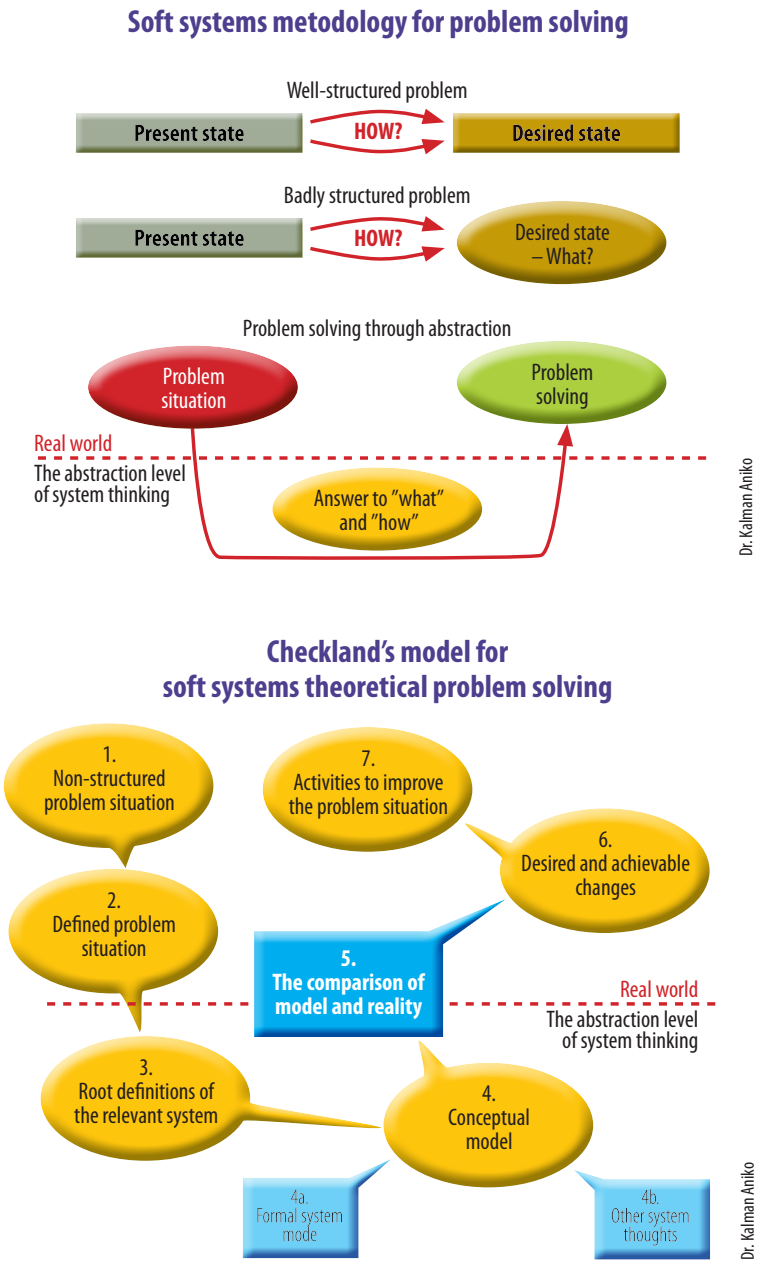

Figure 1. Peter Checkland's Soft Systems Methodology can be applied to non-systemic situations.

Feedback on the task

The participants of the workshop received some information only a few days before the ACSI events week, which meant little time for getting familiar with the task and for preparation. It would have been useful to have an effective, informative website on ACSI which could make it easier for the target group to gather information and to understand the focus and significance of this model. This is how we could have realised

why we were invited and what our task was. Good, well-structured and well-prepared background information is imperative for initiating a new innovative process. Some exact points of reference are necessary for creative work, if we pursue effective work and concrete outcomes.

Societal innovation

This is a complex societal task based often on intuition without a clearly articulated spoken and written agenda; so everybody has their own subjective, individual opinion on this topic. The first problem, however, is how to make homogeneous the feelings from the meaning into reality.

For the selected target group/actors it would be advisable to give the opportunity for some research into the topic beforehand, and offer online support in order to obtain more information in advance.

The problem is complex: how to make the individual motivated and involved in their community? How to find the common interest, common and shared knowledge? One of the results could be the realization of how this target group can get information on their own. It is important to get to know what kind of problem learning style (Kolb) the members of the target group prefer.

Group work difficulties

The main question is what is most important in this situation: the group work dynamics or making something new and creative; or to solve the problem. The different types of tasks require different approches. From this aspect, it is important to know the most important ctiteria for selecting the group members. In this case the different background, experiences of the different target group /actors are important.

The structure should perhaps be made more clear, for example, by using the Peter Checkland SSM model (Soft Systems Methodology in Action 1999): how to transform a non-structured situation into a well-structured situation? See Figure 1.

Working in a group on the problem according to the Checkland problem-based method, Soft Systems Mehtodology (SSM) may yield results. For this, the description of the case-study is important. It offers clear, exact information about the non-structured situation – allowing the group members to ask as many and as comprehensive questions as they want and feel necessary. This will enable the indentification of their different approaches (diagrammes, figures, numbers, lifestyle) are important in this case. As for shaping, forming the group: is it good to know what kind of skills they have, what contribution they can make, what motivates them?

Our experience from ACSI 2012 showed that creating groups from participants of different ages was desirable: it provided an invisible working hierarchy from the first moment. The different character of the individuals exceedingly influenced the work. In the beginning, the information collection process shaped the group matrix: the way participants listened to each other, respect for the others proved that heterogeneity can be an advantage.This level is the form of the knowledge transfer: using the learnt method in the similar way and trying to share the information in a new format,

and in new situation. As for the implementation of the same methods in the societal project, intergenerational cooperation is useful and necessary from the viewpoint of societal collaboration. It is important that collaborative, motivated young persons are selected who can work on the realization of the project for credit points in the framework of their university studies.

In sum, the lessons learnt from ACSI 2012 are as follows: The most effective way of cooperation is allowing the personal impact to evolve; personal motivation/interest in solving the problems is of key importance. However, for maximum efficacy it is useful to give an opportunity for online information gathering in advance. Another fact to remember is that the professional aspect is the most important when creating a working group, as the differences in personality and character could influence the overall performance. A good introduction is always important. In our case, the warm-up requiring some kinesthetic-artistic rendering of a given idea was met with somewhat mixed feelings: I think it helped the group dynamic but the participants should only be involved voluntarily as some may find it disturbing. The active teamwork involvement of the local (Finnish) experts was of great help, and the presence of the international experts of different fields was also helpful in liberating thoughts. Given the nature of the task, it is expedient to involve experts, such as urban designers, architects, sociologists and HR experts, who are directly connected to the topic.

Motivating participants can be achieved in two ways: 1) the task itself – which in this case was more than worthwhile – can attract contributors; 2) a final acknowledgement of participation is awarded in the form of a certificate.

If the participants invest their time in such activities, they also learn a great deal, which then can be transcribed in the form of a certificate, which should identify the competences that participants improved in the course of the training/workshop. All in all, ACSI 2012 was an enriching experience both personally and professionally.

About the author

Anikó Kálmán is recognized as one of the few experts in Hungary in the field of Andragogy. She has a PhD in Educational Science and the Habilitated Doctor qualification in 2007 in management and organizational sciences. She is currently: associate professor in adult education and lifelong learning and deputy head of the department of Technical Education at the Budapest University of Technology and Economics (BME), academic staff member at the Doctoral School of the Faculty of Education and Psychology at the Eotvos Lorand University, Budapest (www.elte.hu), executive president of the MELLearN Hungarian National University Lifelong Learning Network (www.mellern.hu), adult education expert at the Hungarian National Ministry of Social Affairs and Labour and at the Hungarian National Ministry of Education and Culture, expert to the Andragogy Committee of the Hungarian Ministry of Education, expert of the Tempus Public Foundation in the fields of vocational training, higher education and R&D. Fort the past decade, she has served as an international working group leader of projects and networks in more than 30 countries.

Epilogue
Open Letter to the Readers

Dear readers,

Some of you might wonder what the importance of the different subjects tackled in this book is. So, let me embrace a broader perspective.

A long time ago, our forefathers, the mammoth hunters, were slaughtering their preys in a rash way, by pushing entire herds towards precipices at the bottom of which they were crashing, not imagining that one day mammoths would run short. In the year 474 AD – two years before the last Roman Emperor's destitution by the Germanic invaders – Sidonius Apollinaris, Gallo-Roman writer, bishop and politician, wrote that he hoped his son would become consul of Rome, also unable to imagine that the Roman Empire could disappear one day, even though all the signs of its impending disappearance were available.

And, in the last century, the British historian Arnold Toynbee, in his monumental Study of History in 12 volumes, analyzed the origin and fate of 23 civilizations, among which 22 died by suicide, due to the progressive transition from the Promethean vision of their founders – as he expresses it – to the congenital blindness of their last representatives. The 23rd civilization is our Western Civilization: why should it be an exception to the rule?

Our world, where one billion people lack of drinking water and of electricity, is now confronted with many serious problems such as poverty, diseases, violence, fundamentalism... The most important of them is not climate change – we are not even sure that it is due to human activities – but energy. During the last 12,000 years – since the time just preceding the apparition of agriculture and breeding – the mean energy consumed per inhabitant of the Earth has been multiplied by nearly 80 (namely, in round figures, from 1 GJ/year in 10000 BC to 80 GJ/year in 2000 AC); during the same period, the world population has been multiplied by 1,500 (more or less from 4 million to 6 billion individuals); and, therefore, the total yearly consumption of energy has passed from 4.1015 to 480.1018 J/year, which translated into a multiplicative factor of 120,000! In terms of power, our present capacity corresponds to 13 TW; in comparison, the total geothermal power of the Earth is of 16 TW and the power of the tides due to the moon and the sun is of 3.5 TW.

Another perspective is given by the famous logistic curve: the last two centuries have witnessed a tremendous explosion of our technological means (the most sloping part of the curve), but some signs of slowing down are perceptible. In this overall picture, Europe's position is far from comfortable, not because Europeans are less intelligent, but because Europe's structures and ways of working are mainly old-fashioned and many of us are struggling and losing energy in attempt to preserve our advantageous position, instead of contributing to our common interests. And this is a particularly serious handicap, as Europe has only little natural resources and has to rely on its human capacities.

This is why this book about lifelong learning and the Knowledge Triangle is important: it does not bring forward solutions on a plate – that would be too simple – but it proposes some lines of action so that we could, all together, find the solutions. It is quite a big challenge, of course, but our future is at stake: "Live or die", that has always been the implacable law of nature; there is no reason why it should not apply anymore because we are human! We must not be "overpessimistic" of course, but not bury our head in the sand, either.

Marc Goossens
retired engineer (M.Ph.Sc.)
European Society for Engineers and Industrialists

SEFI is the largest network of higher engineering education institutions (HEIs) and educators in Europe.

It is an international NGO created in 1973 to contribute to the development and improvement of HEE in Europe, to reinforce the position of the engineering professionals in society, to promote information about HEE and improve communication between teachers, researchers and students, to reinforce the university-business cooperation and to encourage the European dimension in higher engineering education.

SEFI is an international Forum composed of HEIs, academic staff and teachers, students, related associations and companies in 47 countries.

Our activities: Annual Conferences, Ad hoc seminars/workshops organised by our working groups and Task forces, organisation of the European Engineering Deans Conventions, Scientific publications (incl. the European Journal of Engineering Education), European projects, Position papers, cooperation with other major European associations and international bodies such as the European Commission, the UNESCO, the Council of Europe or the OECD.

SEFI is very much in involved in international cooperation, in European projects and also actively participated in the creation of ENAEE, IFEES, EuroPace, IACEE and of the European Engineering Deans Council, EEDC.

For further information
SEFI Head Office
119, rue de Stassart
B-1050 Brussels
Tel. + 32 2 5023609
Fax: + 32 2 5029611
info@sefi.be - www.sefi.be
VAT BE0413.286.613

The Knowledge Triangle

This book is a story about re-connection. It reunites research and learning to promote the creation of the new. Through policy descriptions and strategy statements, this publication reveals what is happening behind the scenes on the EU, as well as national and institutional levels. The many practical cases presented manifest the concrete efforts put to materializing the Knowledge Triangle: creating more synergy between research, education and innovation. And the recent research findings shared open the curtain to what innovativeness means, how it could be fostered, and why it is imperative in advancing the sustainable Knowledge Society.

"The Knowledge Triangle should primarily be seen as a large-scale societal innovation through which Europe can strengthen its research potential, increase its capacity to educate talents and to promote and create demand-driven open innovation platforms for wide societal use." CESAER

"High-level learning outcomes cannot be reached by traditional teaching methods. The new learning environment is based on a culture which is characterized by learning and working together, and by research, development and innovation. Students need to be motivated to think outside the box and take initiative for collaborative learning. New ways to learn call for new approaches to pedagogical development and assessment that truly encourage learning by doing and motivate the learners. Bringing together theory and practice is essential in implementing the Knowledge Triangle." EUGENE

SEFI European Society for Engineering Education
Europäische Gesellschaft für Ingenieur-Ausbildung
Société Européenne pour la Formation des Ingénieurs

Aalto University

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