Anikó Kálmán
Associate Professor, PhD.Habil.
Department of Technical Pedagogy, Deputy Head of Department
Budapest University of Technology and Economics, Hungary
kalman.a@eik.bme.hu

László Farkas
Associate Professor, PhD, MSc.E.E.
Student Innovation Centre
Budapest University of Technology and Economics, Hungary
farkas.laszlo@hik.bme.hu

Donát Dékány
Director, MSc.E.E.
Student Innovation Centre
Budapest University of Technology and Economics, Hungary
dekany.donat@hik.bme.hu

18. Budapest BME: Developing a Student Innovation Ecosystem

Abstract

Building on the Knowledge Triangle model of innovation, higher education is required to respond more directly to social and economic needs. New boundary-crossing organizations and structures are being developed to help negotiate the pathways, the new cultural and innovation tradition necessitating a different approach.

During the research university project presented here, the vision and frames of a new university structure and eco-system were developed at Budapest University of Technology and Economics.

The main aim of developing the student innovation eco-system is to form and propagate an innovation culture among university commoners. The set-up of the student innovation eco-system followed a more network-like, bottom-up approach, where attitude and mindset constitute the most important building blocks. The eco-system consists of new elective subjects, training of trainers, networking, new idea generation activities and competitions, university-student-industry partnership, and forming of an innovation society. This step-by-step, bottom-up approach, where small activities are launched and connected to each other, can serve as a good example for regions with a less accentuated innovation culture and tradition.

KEYWORDS: Innovation at university, the Knowledge Triangle, Forming attitude

1. Introduction

In the case of traditional universities, the mission and role of higher education and academic research is distinct from commercial activity. Presently the idea of university is changing due to several factors. Higher education institutions traditionally reflected a simplistic understanding of knowledge creation, different social classes and labour market requirements. Today traditional universities are unable to meet all the demands and requirements of the global knowledge society. Therefore there is a real need for a new model of higher education, which requires that traditional universities be reshaped (Kálmán, 2013).

Building on the Knowledge Triangle model of innovation, higher education is required to respond more directly to social and economic needs. Different programmatic models and initiatives are emerging that bring together actors from civil society, the state and state agencies, and higher education to mobilize and harness knowledge, talent and investment in order to address a diverse range of problems and need through coordinated action. New boundary-crossing organizations and structures are being developed to help negotiate the pathways and different cultures.

Budapest University of Technology and Economics (BME) is a research university in Hungary. BME is a partner of Aalto University that started to build a research-development-innovation (RDI) eco-system in the past years. However, the different culture and innovation tradition requires a culture different from Aalto's approach— a more network-like, bottom-up approach, where attitude and mindset constitute the most important building blocks.

2. Implementing the Knowledge Triangle in Hungary

The National Research and Development and Innovation Strategy (National Innovation Office, 2013) defines the following specific objectives for 2013–2020:

A. Developing knowledge bases
    A1. Education and talent management
    A2. Strengthening of research organizations (especially at the HAS and in higher education)
    A3. Internationally competitive R&D infrastructure
    A4. Modern research management

B. Knowledge flow
    B1. Efficient central public innovation services
    B2. Introduction of decentralized innovation services
    B3. Strong traditional innovation co-operations
    B4. Support for open, pre-competitive and social innovation co-operations

B5. Efficient participation in the EU and international calls for proposals and initiatives

C. Knowledge utilization
C1. The creation of a start-up ecosystem
C2. Awareness raising, law enforcement and relaxation of intellectual property protection
C3. Demand creation for R&D of medium-sized enterprises
C4. Efficient support for foreign market entry
C5. Deliberate public demand for innovation
C6. Large-company workplaces of high knowledge content with intensive local knowledge connections
C7. Increasingly innovative and diversifying SMEs
C8. The enhancement of the spread of adaptive innovation solutions primarily based on informationand communication technologies
C9. The most competitive R&D tax incentive system in Europe
Higher education has an important role in the objectives, especially in A1–A4.

The education strategy of Hungary, called Shift gear in education (Palkovics, 2014, underway) identifies the following main strategic aims of higher education institutes in Hungary:
- educational system based on performance
- world-class research
- leadership in regional and urban growth
- (smart) specialisation
- new institutional system
- educational innovation
- effective leadership and new market models
- The most important instruments (actions) to reach the aims include:
- setting up of centres for close cooperation between university and industry (especially SMEs)
- new financing instruments, long-term strategy for RDI resources (human and infrastructure)
- strengthening international cooperation
- developing incubator and technology transfer services
- taking part in implementing the smart city concept
- increasing activity in societal innovation
- strengthening services towards students and society
- including new and innovative ways and topics into curricula (project work, entrepreneurship)
- training of trainers
- increasing attitude-shaping activities

The innovation and start-up strategy of the Budapest region is described in Budapest Runway 2.0.2.0 (Korányi, 2014). This roadmap has a very ambitious vision: by 2020 Budapest will be the start-up capital of the region. The strategy states that "It is undeniable that good (higher) education, particularly in the STEM areas (Science, Technology, Engineering, and Mathematics)—where Hungarian excellence is traditionally strong—together with competition are necessary prerequisites for innovative enterprises. [… but] these necessary prerequisites alone are not sufficient. In fact, it is increasingly clear from the leading start-up and innovation centres around the world, that with only these two prerequisites in place, ideas and innovations will not result in new products and will not provide the basis for successful start-ups, as the innovations will die in the early stages of development. This is a waste of talent, energy, and ambition. What is needed is a certain environment, an ecosystem, which enables ideas and innovations to reach the market as products and services, and where consumers engage with the ideas as part of the innovation process, transforming the economy and seeding new industries."

The main components of the start-up ecosystem are:
• education and training,
• access to funds,
• taxation and regulation, and
• enabling environment.

In education and training, a new driver and support for university spin-off enterprises and start-up business academies are needed. To create an enabling environment, we must ensure personal knowledge transfer, social networking and awareness raising, as well as strengthen bottom-up (grassroots) actions.

The aims, activities and instruments at national and regional level are in good relation to European strategies like Triple Helix and Smart Specialisation (Markkula, 2013a) and the Knowledge Triangle (Markkula, 2013b).

As a summary, we can conclude that the main roles of universities in implementing the Knowledge Triangle in Hungary are:
• strengthening the R&D resources (infrastructure, human resources etc.)
• identifying strategic priority areas and research focuses
• strengthening the interdisciplinary approach and networking
• supporting the institutional technology transfer infrastructure, management and processes
• setting up a synergy between enterprises and researchers
• strengthening open innovation services and taking part in start-up ecosystems
• developing innovative trainings and educational materials
• identifying and developing talent
• strengthening creativity and entrepreneurial attitude in the entire education sector

3. Developing the Frames of University RDI Eco-System

Budapest University of Technology and Economics has a more than 200-year history and is traditionally good at education and research—it received the Hungarian government award research university in 2010. Until then, innovation was performed in parallel at innovation parks, like Innotech founded by BME (Pálmai, 2004).

During the research university project, the frames of a new university structure were developed as summarized in the report Research university milestones (Péceli et al., 2012), in parallel to the traditional educational structure. The Federated Innovation and Knowledge Centre was formed to join research and innovation activities. The most important results of the project include (Figure 1):

- Priority research areas were identified (sustainable energy, vehicle technology and transport, biotechnology, nanotechnology, intelligent environment)
- R&D infrastructure (equipment, places, resources) was invested and aligned across the university
- horizontal working groups were established
- institutional relations widened
- undergraduates, postgraduates and doctoral candidates were involved in the research work
- talent management was set up
- foreign language training was enhanced and training of trainers courses were started
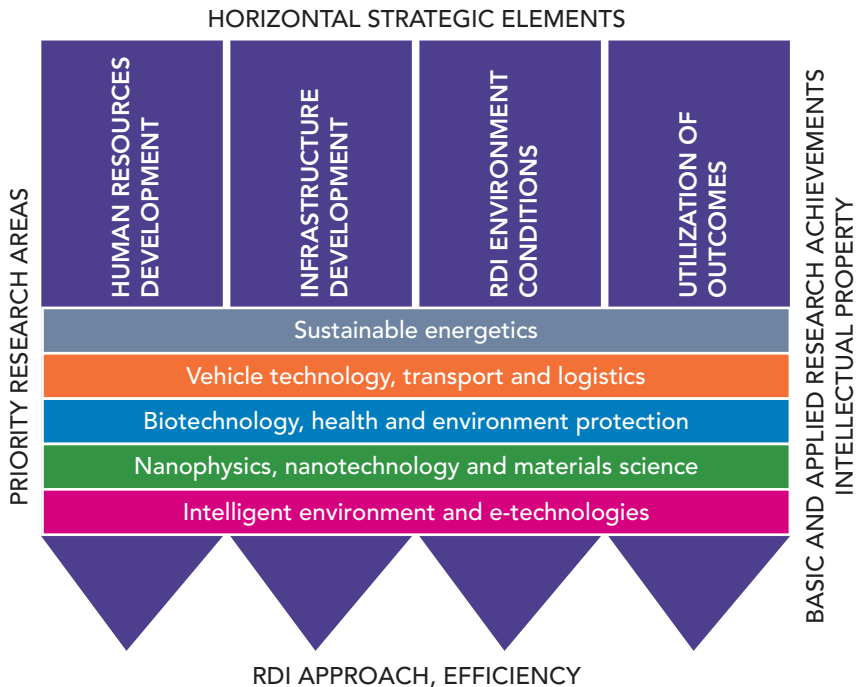

Figure 1. Results of the "Research University" project.

The vision of the research university is to create an RDI eco-system based on three main "legs".

The first leg, the concept of SME programme is based on the fact that R&D activities are relatively low in Hungarian SMEs. BME, as a university, has the sufficient knowledge to conduct R&D activities for SMEs with the help of state funding.

The second leg is Industrial campus, a place where large international research institutes and companies can use university resources. The funding is based on equal shares of the company, university and state.

The third leg is Student, university and industry programme, often called the student innovation eco-system, which is described in the following chapters.

The vision and activities of the research university project fulfils the requirements and recommendations of the Technical University of Tomorrow outlined by Ulab (Ulab, 2013).

4. Developing the Frames for the Student Innovation Eco-System

The Research university milestones (Péceli et al., 2012, 46–47.) report states that "Participation in the various technology transfer events requires a change of attitude from the stakeholders. [… Our aim is] to involve as many university students in the process as possible and to provide assistance for the utilization of the intellectual products created by students."

The main aim of developing the student innovation eco-system is to form and propagate an innovation culture and attitude at BME. Our vision is that an innovative society must be rooted at universities where the three legs of knowledge triangle can exist: education, research—and innovation.

In the last years, the organizational and administrative frames were developed at the university along with the establishment of the Technology and Knowledge Transfer Office (as part of the Federated Innovation and Knowledge Centre) and internal knowledge-handling regulations. But shaping a culture and an attitude requires long and hard work involving all university commoners—lecturers, researchers and, most importantly, students.

To shape the attitude, several formal and non-formal units and networks were established, in parallel to the traditional university organization, were commoners can work actively. The Student Innovation Centre (as part of the Federated Innovation and Knowledge Centre) helps students create and develop new ideas and products. The Technology and Knowledge Transfer Network gathers together researchers and lecturers interested in applying research results to develop new products and solutions.

The best way to shape the attitude is to show people new possibilities and futures, and involve them in these activities. Based on this idea, a local innovation eco-system was developed with the following collaborative elements: education (new subject sand training), networking, idea generation, partnerships and dissemination.

5. Elements of the Eco-System

5.1 Education

New elective subjects

An innovation attitude can be inspired with new, elective subjects. The Starting and Managing Innovative Businesses elective subject started four years ago, allowing students to become acquainted with the basics of an entrepreneurial mindset via case studies and invited talks, so practice is in focus (with very little theory). As homework, students have to start an (imaginative or real) new business.

The curriculum of the subject includes generating a business idea, developing a business concept, forming the core group, developing a business model, managing product development with the lean start-up, planning financing, stepping into the related market, and writing one-page pitch. The invited talks are held by start-up leaders, financial investors, company managers and lawyers.

The course runs with 200–300 students/semester.

5.2 Training of teachers

The training sessions organized within the frames of the project Training of Trainers at the University of Technology and Economics (Kálmán, 2012) provide significant contributions to the reduction of missing trainer competences that are necessary for the implementation of the requirements of the Knowledge Triangle. These sessions were based on the institutional demands and requirements of BME that were measured in the previous years within the themes addressed in a survey. The training is suitable for flexibly following the internal training demands and also for training participants to fulfil the competency requirements of the teaching profession, to be prepared for the challenges raised by the teaching-learning process, to learn how to learn.

The free training of a limited number of participants, organized within the framework of the project, provides the participants with knowledge and competences needed in competence-based curriculum development, in applying adequate teaching methods and in employing systems that provide individual, open learning ways. The professional content of the project is connected to the following programs: Methodological training, Training for tutorial tasks, Digital competences in the teaching activities, E-curriculum development, English professional language, and Health and security.

The training started in 2010. Until now, altogether 358 lecturers, researchers and PhD students attended the training.

5.3 Networking

Technology and Knowledge Transfer Network

Networking can enhance boundary-crossing cooperation and knowledge sharing between lecturers and researchers from different fields. The Technology and Knowledge Transfer Network (often called the Club) was formed at BME in 2011. Three to four lecturers and researchers from one faculty were involved, who could also interact with the faculty staff. The network is self-organized and its meetings held every month to set up and discuss new ideas, project possibilities, and calls for proposals. Our experience is that the network can help initialize cross-faculty cooperation and project work, as well as disseminate innovation-related information among the lecturers and researchers.

Starting and Managing Innovative Businesses 2.0

The most talented students from Starting and Managing Innovative Businesses elective subject are invited to take part in a facultative course (with no credit points at the moment) called Starting and Managing Innovative Businesses 2.0, where they can work on their businesses. Meetings are held weekly during the semester. At the beginning, students start working together, and later they work in groups with corporate mentors. At the end of the course they have a more detailed business plan.

SMIB 2.0 runs with 18–20 student projects/year.

5.4 New idea generation

Our experience shows that students at BME have many ideas but little knowledge of how to innovate and start a business. This mindset cannot be taught in a traditional, lecture-like way—they have to experience it.

Idea Competition

The Idea Competition is planned to be held annually (it started a year ago). During the competition, students can present their new solutions and to-be products. The competition has three rounds. At first, the interested students fill in an application with some basic information: a short description, demands and benefits, status of the development, and future plans. In the second round, additional questions have to be answered during an interview about: the novelty of the solution, competitors, market, time needed for the first prototype, and the team members. The aim of such a personal interview is to force the competitors to think about these questions. The applicants also receive training in presentation techniques, what investors look for, and case studies of start-ups.

Based on the second round, 15–20 applications are selected for the third round. They present their solutions for a committee in 10 minutes with 5-minute interaction. The committee consists of representatives of financial investors, innovation associations, and university experts. The prize of the competition is the award of Leading Innovative Project of the Year with a symbolic grant of 1000 Euros.

Figure 2. Creative groupwork in the Idea Hall.

The main aim of the competition is not to hand out the prize. During the competition, talented and determined students can interact with mentors and start their business. Both investors and university experts offer their help to the selected projects, and students interested in groupwork are also welcome. Every competitor receives positive feedback. This feedback is essential to form the targeted attitude.

In 2013, 31 applications were submitted. This year (2014), the number of applications increased to 63. In 2013, 19 applications were selected for the third round (competition in 2014 is still under way). Out of these 19 projects, three are mentored by investors, another three are running with the help of university experts and getting ready for the first prototypes, and one is under patent application.

Student Innovation Centre

The Student Innovation Centre (SIC) helps students create and develop new ideas and products. Experts in SIC support determined student teams from SMIB 2.0 and Idea Competition, as well as teams developing new ideas on their own. SIC helps students find resources, experts, consultants, laboratory and workshop capacity, new student members—anything that a student team needs.

Idea Hall—working and thinking together

An old machinery hall (laboratory) was renovated and transformed into a public hall, where student teams and start-ups can work on their own business. Our experience shows that these teams are willing to support each other because they can think together, gather other opinions, borrow and lend team members—work as an innovation society (Figure 2). To support the interaction, several social events and meetings are organized, for example Monday Breakfasts held every two weeks.

At the moment, two years after opening the hall, 11 teams are working in the Idea Hall (often referred to as Demola Hall).

5.5 University-student-industry partnership

Demola Budapest co-creation

Demola (www.demola.net) is an open innovation platform, working in eight European cities so far, where companies, universities and students co-create a solution concept for problems important for the companies. It is based on a fusion of ideas, skills, and perspectives of students from various backgrounds. They work together as a team, with the help of company and university experts. Getting started with Demola is free of charge for the companies. After the work is complete, the project team will present the results. If, and only if, the company finds the results useful and valuable, they have the option to either license or purchase the rights from the team.

Participating in a student team means approximately four months of self-organized teamwork and co-creation with the project partner. Each team has a Demola facilitator appointed to them to support their process and give them team management tools, contacts and links to professionals. Most of the students can match the Demola project with a subject or a subject project and receive credits for the work.

Demola Budapest (www.demola.hu) started with three pilot projects in 2013. In 2014, during the two semesters, we started 11 projects with 38 student participants, out of which 11 are outside BME and three are foreign students. The closing and final presentations of the projects are still under way. At the moment three project results are accepted by the company and none rejected.

5.6 Hosting events

The Idea Hall is also a place for innovation events. Several national and international start-up challenges, meetings and workshops are organized in the Hall, such as:

- Hackathon-in-a-Box—a two-day start-up competition for university students in Hungary
- Entrepreneurs in Focus—a training held by the American Chamber of Commerce in Hungary
- First Monday—Monthly gathering of the Budapest start-up community
- How to start a start-up—a free online course held by Stanford University is discussed together
- Startup Sauna—a closed coaching event for the most promising start-ups
- Appcampus—funding and coaching for mobile developers
- Mentoring innovative start-up companies—organized by Hungarian National Innovation Office

These events are good opportunities for BME student teams to present their start-up ideas, acquire feedback and mentoring from experts and build social capital. On

the other side, the innovation activities of BME become more and more known by the stakeholders.

5.7. Dissemination

Innovation activities and the eco-system must be advertised and disseminated among students and lecturers to involve more and more university commoners. Besides traditional communication ways, like news and articles in university media, new ways are also adopted to reach our target group, like Facebook notifications and Youtube virus videos. Every semester, SIC and Demola staff gives short introductions at university courses and organizes kick-off and social events which those interested can attend and interact in freely.

We believe that the best dissemination channel is the positive feedback from students who have already participated in the activities.
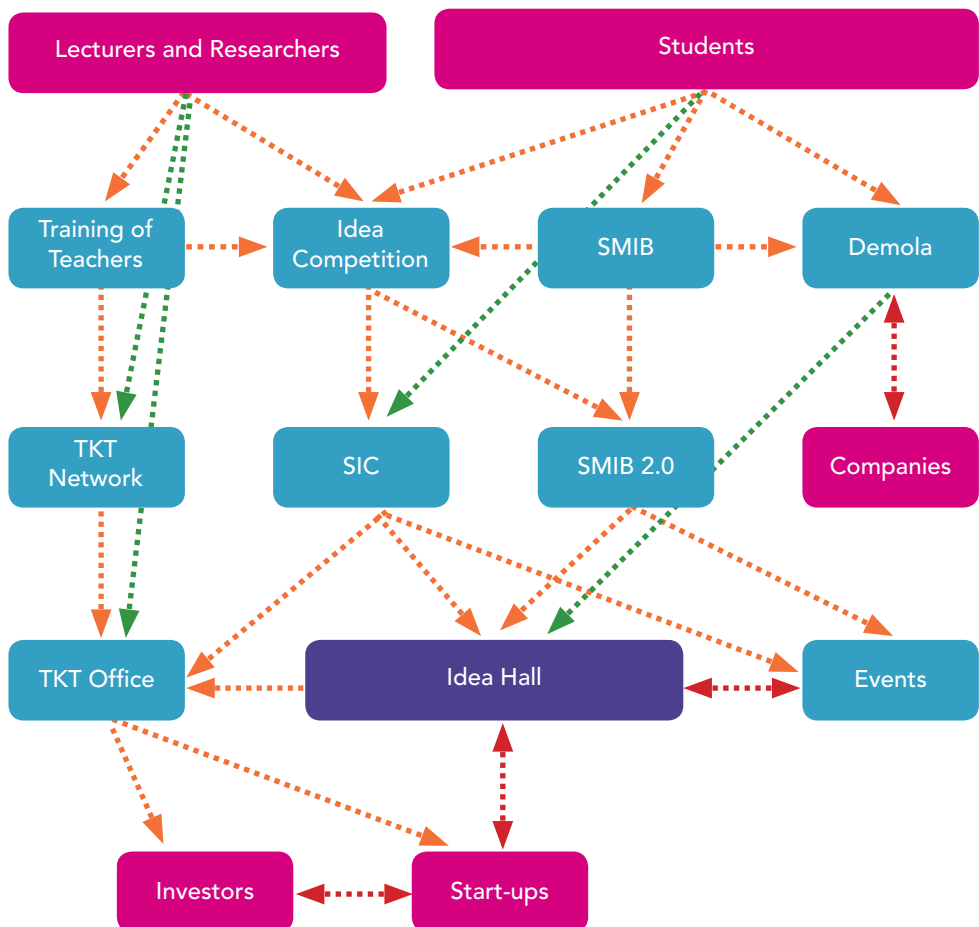
Interaction of the Elements

Figure 3. Interaction of the eco-system elements.

The interaction and connection of the elements in the mini eco-system is shown in Figure 3. Lecturers and researchers can attend the Training of Trainers and get in touch with the innovation culture. If they are interested, they can take part in the Technology and Knowledge Transfer Network. If a research and development project becomes a business idea, they can continue with the Technology and Knowledge Transfer Office. The role of the TKT Office is to find resources (investors) and to establish start-up companies—mostly shared by the researchers with a small share of the university.

The interested students can attend the Starting and Managing Innovative Businesses subject and shape the basic innovative mindset. Students with solution ideas can attend the Idea Competition, while those interested in corporate work can attend the Demola projects. In the next step, talented and committed students can start innovative work at the Student Innovation Centre and plan their business in Starting and Managing Innovative Businesses 2.0.

The central place of innovative work is the Idea Hall, where all innovative projects can find a place and support for their work.

Cooperation of students and lecturers is very important when forming a culture and an attitude. This collaboration is encouraging both for students and lecturers (and researchers). Our aim is to strengthen this cooperation. For example, lecturers supporting a winning team at the Idea Competition can also receive a prize. Student teams often need expert assistance to step forward. In this case, the Technology and Knowledge Transfer Network can e.g. help them find experts inside and outside the university, organize work with university laboratories and workshops.

The organization of the mini eco-system is parallel to university organization, only two of them being university divisions.

5.8 Extending the eco-system

The BME student innovation eco-system has many similar activities to other university innovation eco-systems, like, for example, Aalto University in the Helsinki Smart Region (Miikki, 2014). However, BME has to walk a more groundbreaking path to set up and operate the innovation eco-system—and change the mindsets of university commoners.

To widen our activities and reach our long-term aims, the following activities are planned in the near future:

- open the student innovation eco-system towards urban and regional innovation activities and networks (e.g. competitions, incubator and accelerator centres)

- create close cooperation with community innovation centres (workshops and living labs)

- include other Hungarian universities in the system (e.g. widen the Demola Network)

- strengthen international network activities (e.g. launch cross-border projects at international level)
- promote and disseminate the results and possibilities towards students and industry
- include incubator, pre-seed and seed funds, based on the results achieved

The method that we can employ to reach our aims is based on the ACSI (Aalto Camp For Societal Innovation) method, modified to meet local specialities and best practices. ACSI is an instrument created at Aalto University for answering real-life challenges with the help of quick prototypes, pilots and demonstrations. ACSI re-inforces the role of the university as an important developer of innovation systems by connecting global expertise, high-quality research and university-level continuing education in collaboration with the public and private sectors (Triple Helix). It can also be adopted in developing applications for bridging the gaps between the university and other educational levels, as well as in supporting the different paths of lifelong learning.

6. Summary

The student innovation eco-system started its operations two years ago. This time is not enough to yield long-standing impacts, but the feedback and the increasing number of participants shows that the direction is good, and, step by step, a new culture and attitude can form among university commoners—lecturers, researchers and students. This step-by-step, bottom-up approach, where small activities are launched and connected to each other, can be a good example for regions with a less accentuated innovation culture and tradition.

References

Kálmán, A. (2012). Training of Trainers—Paradigm Shift in Qualitative Higher Education. In: IACEE 2012 World Conference on Continuing Engineering Education, 17–19 May 2012, Valencia, Spain. ISBN: 978-84-8363-858-3 (CD).

Kálmán A. (2013). Developments in Hungarian Lifelong Learning Policies as Means of Implementing the Knowledge Triangle. In: The Knowledge Triangle—Reinventing the Future, 85–100. Lappalainen, P. & Markkula, M. (Eds.). ISBN 978-2-87352-006-9, SEFI—Aalto University—Universitat Politècnica de València and VLC/Campus.

Korányi, L. (Ed.) (2014). Budapest Runway 2.0.2.0. Accessed from http://www.nih.gov.hu/strategy/publications/budapest-2-0-2-0-runway.

Markkula, M. (2013). Special Report of the Triple Helix 11 Conference on 8–10 July 2013, http://www.triplehelixassociation.org/helice/volume-2-2013/helice-issue-8.

Markkula, M. (2013). The Knowledge Triangle Renewing the University Culture. In: The Knowledge Triangle—Reinventing the Future, pp. 85–100. Eds: Pia Lappalainen, Markku Markkula, ISBN 978-2-87352-006-9, SEFI—Aalto University—Universitat Politècnica de València and VLC/Campus.

Miikki, L., Markkula, M., Schaffers, H. (Eds.) (2014). Helsinki Smart Region: Pioneering for Europe 2020. Accessed from http://www.uudenmaanliitto.fi/en/helsinki-uusimaa_region/helsinki-uusimaa_region_facts.

National Innovation Office (2013). Investment in the future. National Research and Development and Innovation Strategy (2013–2020), from http://www.nih.gov.hu/strategy/national-rdi-strategy/hungarian-rdi-strategy.

Palkovics, L. (Ed.) (2014). Shift gear in education. Accessed from http://www.kormany.hu/download/5/65/20000/Fels%C5%91oktat%C3%A1si%20strat%C3%A9gia_2014_10_21.pdf (in Hungarian).

Pálmai, Z. (2004). An innovation park in Hungary: INNOTECH of the Budapest University of Technology and Economics. In Technovation, 24 (5), 421–432.

Péceli, G., Kovács, K., Tömösközi, S. (Eds.) (2012). Research university milestones 2012. Accessed from https://kutatas.bme.hu/portal/system/files/M%C3%A9rf%C3%B6ldk%C3%B6_2012_EN_20121123.pdf.

Ulab (2013). White Paper: How to build the Technical University of Tomorrow. ISBN 978-84-695-7624-3.

About the authors

Dr. **Anikó Kálmán** received her PhD in the field of higher education-lifelong learning in 1999. She is Habilitated Doctor in Management and Organizational Sciences and Deputy Head of Department of Technical Pedagogy. She is president of Hungarian University Lifelong Learning Network, was leader of international working groups in five European Adult Education and Lifelong Learning projects, and organized numerous national and international conferences and workshops. She is the elected member of the SEFI Administrative Council; from September 2012 the appointed ambassador for the Budapest University of Technology and Economics by the Rector, responsible for the EU projects (fostering the promotion of the Horizon 2020 program and the implementation of the Knowledge Triangle); tasks: ensuring that these projects and relations work for the benefit and the development of BME.

Dr. **László Farkas,** Director of Science at Student Innovation Centre, received his PhD in 2003. He participated in several Hungarian and international development projects, was responsible for two EC projects, and organized several scientific workshops, exhibitions and summer schools. He developed and teaches BSc and MSc courses titled Engineering problem solving and Development of new products, and he is consultant of 5–8 student project works/year.

Mr. **Donát Dékány** graduated as an electrical engineer at the MSc level at the BME Faculty of Electrical Engineering and Informatics. He was the head of the student organization of the Faculty and member of the board at the university level. He founded the Alumni organization of the Faculty and has a specific relation to the graduated students of BME. Currently he is the director of Student Innovation Centre and member of the project management team responsible for the development of supporting framework conditions and tools for technology transfer at the university.