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Creating business model for commercialization of university research¹

Commercialization process of research is analyzed in University-Industry-Government framework in the context of entrepreneurial university. The aim is to conceptualize the role of entrepreneurship in that process. Entrepreneurship has been identified the critical success factor in transition from mono-disciplinary to multi-disciplinary knowledge production by university.

Keywords: knowledge transfer; entrepreneurial university; entrepreneurship; University-Industry-Government linkages

Introduction

Several last years universities have been considered the source of new knowledge for building up knowledge society as pointed in the context of European Union (EU) Lisbon strategy (Raivio, 2008). This creates new goals for universities which have declared to follow thesis of academic independency from political and economic power in the late 1980s (Engwall, 2008). Somehow the declaration of academic independency and autonomy seems to be wishful thinking (ibid), as public universities are heavily depending on governments (Häyrinen-Alestalo, Peltola, 2006) dividing tax-payers money as well as creating legal environment for university. The need to reformulate and reform the role and functions of university in society in the contradicting context has caused a discussion about the crisis of the university system (Ricken, 2007; Olsen, Maassen, 2007) in Europe. Since medieval times, teaching has been considered to be the role of the university, and research became a coherent domain of the university in the late 19th and early 20th centuries. This transition process is called the first academic revolution. Now, only about 100 years later, the previous missions of universities have been complemented by a third, economic and social development mission mentioned also as serving society, innovation (Raivio, 2008) or in narrower meaning – technology transfer (TT) activity (Autio, 2007). The adoption of the third mission is referred to as the second academic revolution (Etzkowitz, 2004) and active universities in that process are called entrepreneurial universities.

The entrepreneurial university is the issue partly raising dispute, partly just passive resistance to the topic which seems somehow threatening the academic positions at the university like entrepreneurship is attracting young researchers away from the universities having problems of own academic reproduction (in some transition countries like Estonia).

Although the discussion about the role of science in society is not new (see for example, Merton, 1996; Mendelsohn, 1989) there are several different views on the role of university in that context and how this role could be fulfilled (Etzkowitz, 2004; Sörlin, 2007). Merton (see via Mendelsohn, 1989) already more than fifty years ago identified strong economic (and military) influence on modern science, and pointed

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out social role of science and scientists. The topic becomes even more complicated taking into account different models of university (Tadmor, 2006): a research institute, a teaching college and business unit. Two first models are linked into the (classical) Humboldt type of university including education and research domains as we understand that today. The third aspect means for the university being in global competition for students as well for research position on the „marketized higher mass-education“, furthermore, universities are encouraged to put their research to industrial practice. This all has led the university out of its „ivory tower“ to implementation of elements of managerialism including relevant indicators, monitoring, control and evaluation (Barry, Chandler, Clark, 2001).

The processes concur with moving from mono-disciplinary knowledge production mode 1 to trans-disciplinary knowledge production mode 2 (about mode 2 see for example, Hessels, Lente, 2008) at the university. How to manage related phenomena characterizing especially entrepreneurial university? As could be seen, academic traditions in the universities, especially in the old ones, create conservatism making them hardly manageable in the process of creating (trans-disciplinary) “knowledge for the good of society” (Van Wijk, 2008). Therefore it is easy to understand why the patterns of entrepreneurial university are more frequently represented in applied science oriented technology universities, among them for example, University of Twente (the Netherlands) and Chalmers University of Technology (Sweden) (Rasmussen, Moen, Gulbrandsen, 2006). Entrepreneurial orientation is driving university relations with the regional government as well as with industry. Entrepreneurship in these universities is not only one of study disciplines for students, it is linked via minor and major entrepreneurship programs into technology studies as well into knowledge transfer support system (Autio, 2007; Sijde, 2006). Entrepreneurship has acquired real inter- and trans-disciplinary role at the university. For several older traditional research universities, especially in (post)transition countries, that is still issue of discussion, or the discussion even has not raised yet (partly you can find evidence about that in Mets, Andrijevska, Varblane, 2008).

Mainly knowledge production and transfer processes have been studied in traditional market economy countries. The growing role of universities in creating value added for knowledge-based economic development generally in countries with post-Soviet economies has been studied less, only some papers in English could be found (for example, Grudzinski, 2005).

The paper aims to conceptualize the role of entrepreneurship in commercialization of results of university research.

The general aim causes also the need to study in following sections of the paper how intellectual property (IP) created in research by universities is transferred into industry. This means also to study how universities create value from their research for themselves – which business model they use, what they have learned from their own experience. Which are the mechanisms influencing creation and commercialization of university knowledge? The main question in building up university business model is the linkages between university’s three roles, how could the roles be balanced in the transition processes of modern university.

Evolution of university roles in production of new knowledge

Entrepreneurial university interlinks its three missions: education, research and serving society. Institutionally that has meant partly having in a university structure besides traditional education and research functions a technology transfer office

(TTO) and active patenting of own research results by the university (Baldini, 2006). That means also creating entrepreneurial competencies and mindset among university members, active position to production and implementation of university knowledge for prosperity of society and entrepreneurial environment inside and around the university supporting knowledge transfer (KT) processes in four different ways (Howard, 2005):

- *Knowledge Diffusion*, where the industry-wide adoption of the useful economic outcomes of university research is encouraged through communication, education and training, and standard-creation. Usually there are no special legal barriers to using this knowledge.
- *Knowledge Production*, which means selling licenses to exploit university 'knowledge products' in the form (mainly) of protected intellectual property (IP).
- *Knowledge relationship*, which includes ways of providing university services, collaboration and partnership in the creation and exploitation of broad IP platforms, trade secrets, know-how and tacit knowledge.
- *Knowledge engagement*, which means the universities becoming involved in order to achieve mutually beneficial outcomes (even transcending university boundaries).

As can be easily identified, active (entrepreneurial) role of universities in knowledge transfer is growing in order of listing sequence of processes above. These processes are fulfilled in the different frameworks of University-Industry-Government (UIG) linkages as examined by the number of researchers, for example, in regional development (Etzkowitz, Klofsten, 2005), learning (Matley, Mitra, 2002) and knowledge networks' (Carayannis, Alexander, 1999) context. Etzkowitz (2003) has shown evolution of UIG-relations from etatistic and laissez-faire to Triple Helix model. In post-soviet countries the process has led to laissez-fair UIG-relations' model in innovation network (Varblane, Mets, Ukrainski, 2008), which is the result of transition processes so far in economy and society generally.

In the Soviet system, the research institutes of the Academy of Sciences played the main role of knowledge production, and university R&D was of only second-rate importance in this process. The situation changed dramatically in the second half of the 1990s. For example, in Estonia after regaining national independence in 1991 research institutes had been brought from the Academy under the umbrella of the universities as research centers which very much resembled that of Finland (Glänzel, Schlemmer, 2007).

International peer-review and performance-based funding of research has been now implemented in most of European countries (Allik, 2008; Glänzel, Schlemmer, 2007; Sörlin, 2007). That means that the Universities have enjoyed governmental R&D funding based mainly on bibliometric performance indicators. By some researchers this type of science is called „curiosity driven research“ (Inzelt, 2004) strongly inclined towards basic research (Mets, 2009a) and suffering quite poor funding not only in transition countries, this is general trend in Europe if comparing with US (Dosi, Llerena, Labini, 2006). Education and Research – the two missions of the university during the last century are mainly covered by government order in most of the European countries.

Parties in UIG-relations can demonstrate different roles. Historically the relationship has been static without remarkable interactions between the actors (Figure 1a): by several researchers as well by university leaders it is supposed that fulfilling in their own region the first two missions – research and teaching,

University (Academia) performs its third mission as well (Sörlin, 2002) and there seems to be no need for any special effort from university side to be more enterprising toward the region.

Created new knowledge in the university R&D is usually considered global public good, but as knowledge feeds “new economy” has raised the question about profiting from that. This has been the topical issue for universities as well and they started to take ownership with their intellectual property (IP) in new technical solutions. Leading in that field have been American universities since accepting by Congress so called Bayh-Dole Act in 1980, allowing universities own patents arising from federal research (Siegel, Waldman, Atwater, Link, 2004).

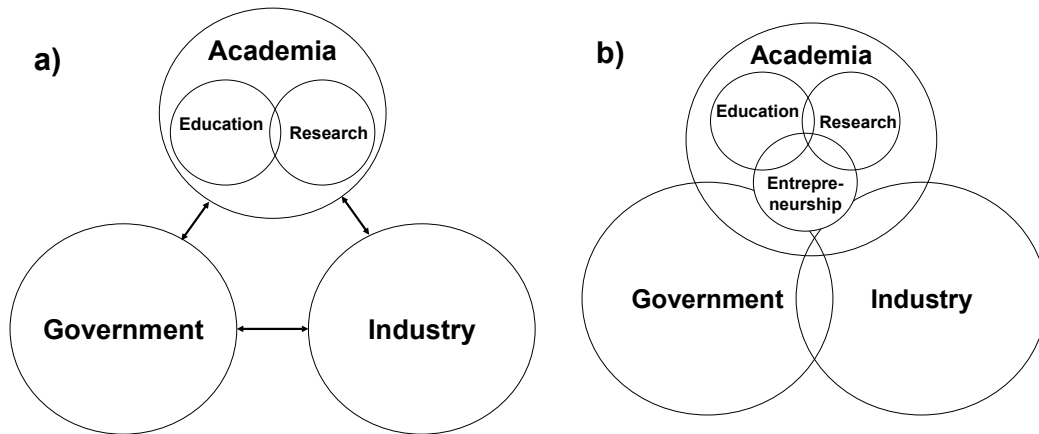


Figure 1 Shifting UIG-relations from *laissez-faire* (a) to entrepreneurial (b) model (author’s drawing)

More active position in knowledge production is taken by the universities having own TTO. Mainly, having the TTO has seen as a possibility to grow the income of the university. According to some authors US universities earn from licenses 2.7% of their R&D expenditures (Siegel et al, 2004), some of the universities are more successful in that than others (Bray, Lee, 2000). Very interesting issue comes from their practice (ibid): besides licensing out own technology universities are investing own IP as equity into spin-off start-ups. Sometimes this can be the only way to commercialize research because of no interest in IP among the industry actors. Excluding from these start-ups there are some very brilliant examples, universities were able to earn from equity deals on the equal level with license fees and royalties, but some other very brilliant examples created much more value than any IP licensing for cash. Research-based education and licensing own IP are the first two ways of university knowledge transfer into business according to Howard (2005). Founding new independent spin-off for R&D commercialization could be seen as the second-best approach besides license sales for the university (Shane, 2002). Shane (2002) argues that becoming “an entrepreneur depends more on information and opportunities than on the psychological attributes of entrepreneurs and non-entrepreneurs.” The Global Entrepreneurship Monitor (GEM) data has demonstrated positive correlation between entrepreneurship training (and education) at university and GDP per capita in high-income countries (Levie, Autio, 2008). Both aspects point

the importance of entrepreneurship training and entrepreneurial environment of university for economic development of the country generally.

Critical issue in the UIG-relations model in Figure 2b becomes the role of entrepreneurship: is enterprise integrated into all (education and not only intra-) university activities or entrepreneurship support system is targeted as function for university R&D commercialization system only? In the first case entrepreneurship becomes a part of education of the most of specialties at the university and *transdisciplinary* knowledge creation mode 2. Entrepreneurship belongs to non-business and non-economic study programs as integral part of university education. Then entrepreneurship is not only academic study and research discipline, but mainly substantial backbone of the third mission of the university.

Implementation entrepreneurship as the third domain (function) of the university means moving from *laisser-faire* UIG-relations to actively managed entrepreneurial model (Figure 1b) of serving society, having more tight links and overlaps between UIG actors as well as between the main domains characterizing entrepreneurial university and its environment. Including entrepreneurship function into the university means also implementation of more active measures for technology transfer as mentioned above. Entrepreneurship domain in University KT plays multiple roles:

- support of university spin-off processes,
- linking different disciplines into integral part of knowledge and technology transfer,
- shaping entrepreneurial attitudes among university personnel,
- via education creating entrepreneurial attitudes among students.

The first role has direct impact on TT and KT via spin-off companies. The second role creates better understanding and higher trans-disciplinary competence among academicians in different technological, legal, economic and social aspects of R&D and knowledge production (mode 2) for commercialization. The third role has indirect impact influencing on orientation and selection by researchers thematic fields and goals for R&D and implementation of new ideas in real business or other fields of society in the future. The fourth role prepares the new generation of researchers as well business and technology players of the region – that means long-term impact on the entrepreneurship environment of the region and readiness for collaboration from all sides: academia, companies (industry) and region (government). In that way entrepreneurship training and education becomes a part of the entrepreneurial university model with long-term orientation.

Creating business model for university

Suggested entrepreneurial model of UIG-linkages in the previous section is not functional enough for mapping patterns of main processes of university R&D commercialization, incl. the model how university is creating value from its own research. For that purposes the concept of business model for university is used. Business model concept has become quite popular for description the way how a company is creating value to its stakeholders – the business model is mediating technical inputs into economic output (Chesbrough, Rosenbloom, 2002; Osterwalder, 2004). Term “business model” has been already used to describe the options before the university how to fulfill high quality educational role based on research (Lombardi, 2003). Brint (2007) is using term “new university model” for comparing public and private research universities in their funding and cost aspects. Also several analyzes of technology transfer processes from a university to a firm or an

entrepreneur and relevant environment could be found (for example: Siegel et al, 2004; Hindle, Yencken, 2004; Howard, 2005). All the models are treating different facets of the entrepreneurial university, even integrating partly them, but do not link these facets together into integral model, which should contain besides already well-known teaching and research functions also commercialization of research in entrepreneurial context. Which is the role of entrepreneurship and enterprise in entrepreneurial university? How entrepreneurship is related to education, research and creation of commercial value of new knowledge? These are questions we try to answer in the current section.

Real value of new technology and knowledge created by university appears on the market, therefore the business model of the university should overcome UIG-relations framework described above in previous section. Interests of democratic society in UIG context can be represented at university in different ways: via market or/and via government. Industry is represented via concrete companies or their associations. Hereby we do not focus on analysis of these agency relations (analyzed partly in Meyer, 2001), but just take these into account as framework surrounding university with its different functional domains and instruments (Figure 2) serving as elements of the business model for commercialization of university research.

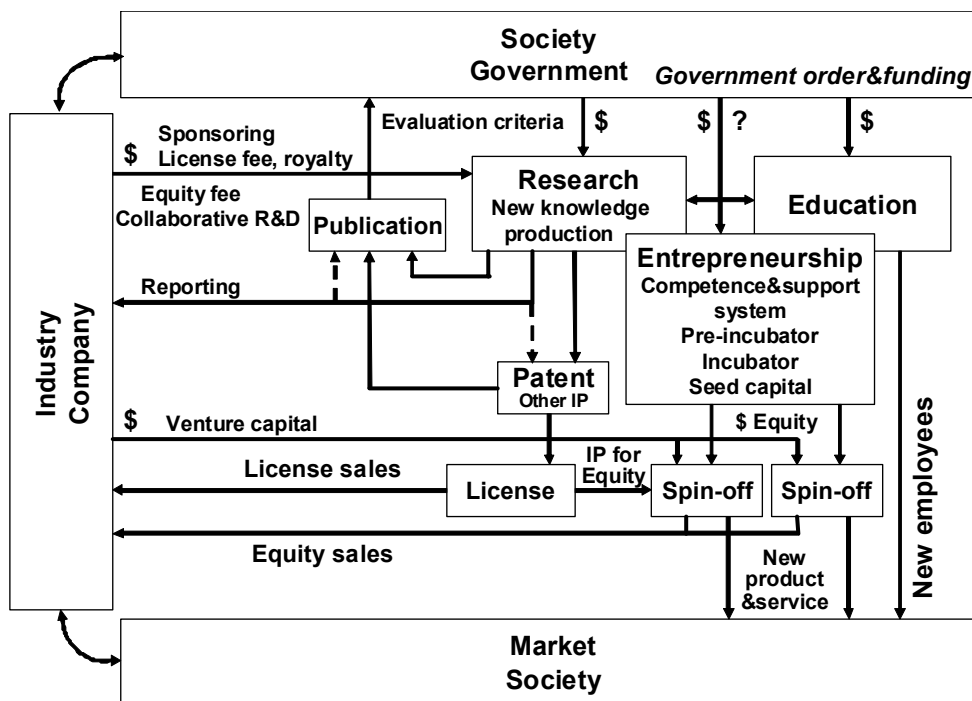


Figure 2 Business model of R&D commercialization for entrepreneurial university in the framework of University-Industry-Government (author's drawing)

General business model schema (Figure 2) does not present in details all possible IP forms (besides copyright and patent on invention) which can include some secrets, know-how, databases and others. But their location and functions in the general schema are corresponding to IP already described in the schema. There can be two different approaches to university business model:

- wider view to university as creator of intellectual and social capital for and in society,
- narrower view to university optimizing commercialization of research as fund-rising function.

Although, other solutions could be located somewhere between them, which approach to prefer depends on the agreement between society and the university. Mainly we must mention that this is the question of governmental (societal) order, evaluation criteria and funding. Therefore, building up the business model for commercialization of university research raises several strategic issues for the university necessary to take into account:

- What is the realistic vision about the roles of the university in national (European) and global context?
- Integrating national/European R&D-funding with global IP and economic context. That means the need to evaluate proportion between R&D licensing and equity investment:
 - a) What is the potential for licensing out own research?
 - b) Potential for IP equity investment;
- Attracting industrial partners into contract research and collaborative R&D;
- Attracting financial investors, incl. venture capitalists;
- Role of government policy in channeling university KT and TT;
- Integrating entrepreneurship with former domains of the university.

The Figure 2 tries to link raised topics into business model of the university, but cannot evaluate full importance of them. That can be the task of further research. Also, institutional realization of described in Figure 2 university business model with its functions depends on legal regulations of the university functions in its location.

For example: In Sweden academic personnel own their inventions and they can protect and commercialize their IP themselves (“professors’ privilege”). Swedish public universities cannot participate in commercial activities because of the requirements on publicity of information and forbidding business risks. Solution is creation of foundations, like Innovation Centre or similar, for TT purposes. Usually in European countries ownership of the university inventions is regulated by employment contract. But, which is the best solution from the public interest view point, author has not yet met in publications.

Not depending on institutional realization, knowledge transfer and entrepreneurship domain in current business model (Figure 2) have the following roles (partly used ideas from Howard (2005) and Autio (2007)):

- *Knowledge diffusion* is covered mainly by scientific and popular publications, and standards, capacity building of university graduates – new employees for private and public sector carrying new knowledge to their jobs, life-long (post-graduate) training, but partly also via other (staff) public and personal communications, and (not protected as IP) new products and services launched by university spin-offs. That means also creation of social capital and sharing of knowledge via networks. The role of entrepreneurship domain is mainly educational: training university students and facilitating entrepreneurial culture within the region.
- *Knowledge production* means patenting new technology at first, and following publications, sales of licenses on patents and other protected IP to industrial partners. Partly this function is covered with investment of own IP into spin-off companies and financial involvement of venture capital. Entrepreneurship domain (support system) is mainly targeted to spin-off processes and entrepreneurial

attitude and competencies of the academic personnel, incl. development of entrepreneurial environment, business incubation, consultancy and mentoring, seed and venture capital funding, etc.

- *Knowledge relationship* includes donation and corporate sponsoring of research projects and funding of chairs or scholarship, contracted teaching services, research and consultancy, cooperative and collaborative research, business and research partnerships, incl. industry (trans-disciplinary) research centers and institutes, joint laboratories, facilities and ventures. Because of complexity of ownership IP becomes special issue in this relationship. The roles of entrepreneurship, besides these listed above, are strategic and management support functions on industry (trans-disciplinary) level, incl. linking business and IP strategies.
- *Knowledge engagement* comes from the third mission of university and means interaction between universities, industry (business) and government to solve complex problems before society. The need for that comes from non-linearity of innovation processes which need active collaboration of UIG partners in the field of strategic issues of knowledge-based economic development, incl. R&D and knowledge transfer policies and support measures on the state level. Complex domain of entrepreneurship can be implemented as facilitator of entrepreneurial competence and culture via education and creation of entrepreneurial environment transcending university boundaries.

It seems that the TT roles described above can have intersections with each other. Here should be mentioned that not protected (as IP) technical solutions could be implemented directly (as it is) by third parties, protected technical solutions are sources of knowledge for creation of new original inventions – that means direct knowledge and indirect technology diffusion can take place. As seen from the systematization above and especially from the knowledge engagement concept, the (state) government is playing a very specific role in functioning of university entrepreneurship domain: is entrepreneurship domain a part of governmental order as education and research are/have been?

Discussion and conclusion

Analysis of concepts related to the role of university in production of new knowledge as resource for economic development is showing multi-faceted understanding about character of university position in society. There are quite orthodox views supporting so called university autonomy striving conserve “ivory tower” situation for research and education domains with their funding system, in which R&D funding is based on bibliometric performance indicators as the main evaluation criteria. Of course, peer-review based evaluation system has played important role in enhancing scientific level of research publications by universities of transition countries. The author thinks that very big share of basic research, which applicability by industry is hard to forecast, remains. Also remains the share of humanities’ research fields at classical national university.

Further development can be seen in growing share of trans-disciplinary knowledge production according to mode 2 in university R&D. But this cannot happen accidentally – the strong reliance on UIG-linkages could be expected. Because of conservatism of traditional universities the processes could take place only at the support and relevant policy of the state. Only long-term goals create the integral position for entrepreneurship domain in the university context. Discussion about the

role of entrepreneurship in university has started (see for example, Mets, 2009b). One is clear, the emerging crises situation in economy during the last year is affecting all partners in UIG framework and they cannot continue in former comfortable co-existence without radical comprehensive collaboration. Besides, after adjustment to dropped budgets of state and university, main measure is seen entrepreneurship in society as well in university creating new growth. That means entrepreneurship domain cannot be ignored by universities long time any more.

The role of entrepreneurship in university context could be seen in following:

- Linking traditional roles of university – teaching and research, in the new quality, moving from mono-disciplinary knowledge production mode 1 to trans-disciplinary mode 2;
- Shaping entrepreneurship competencies and attitudes among university members as well as in society generally;
- Support function to knowledge and technology transfer: balancing R&D toward applied research and knowledge production, incl. via collaborative research with industry, and supporting spin-off processes at university.

It could be declared that entrepreneurship is critical success factor in transition from mono-disciplinary R&D concept mode 1 to trans-disciplinary knowledge production mode 2 for society as well. It is the catalyzer for efficiency growth of technology transfer via impact on the focus of R&D as well as for fostering spin-off processes at university. Finally that leads to more balanced approach in university development and its partnership with industry and region.

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Abstract

Several last years universities have been considered the source of new knowledge for building up knowledge society as pointed in the context of European Union Lisbon strategy. This creates new goals for universities which have declared to follow thesis of academic independency from political and economic power.

Since medieval times, teaching has been considered to be the role of the university, and research became a coherent domain of the university in the late 19th and early 20th centuries. This transition process is called the first academic revolution. Now, only about 100 years later, the previous missions of universities have been complemented by a third, economic and social development. The processes concur with moving from mono-disciplinary knowledge production mode 1 to trans-disciplinary knowledge production mode 2 at the university. As could be seen, academic traditions in the universities, especially in the old and classical ones, create conservatism making them hardly manageable in the process of creating knowledge for the good of society. Therefore it is easy to understand why the patterns of entrepreneurial university are more frequently represented in applied science oriented technology universities. Entrepreneurial orientation is driving university relations with the regional government as well as with industry.

The paper aims to conceptualize the role of entrepreneurship in commercialization of results of university research.

Entrepreneurial environment inside and around the university supporting knowledge transfer (KT) processes are analyzed in the University-Industry-Government (UIG) framework. Four different methods of knowledge transfer are identified:

- Knowledge Diffusion, where the industry-wide adoption of the useful economic outcomes of university research is encouraged through communication, education and training, and standard-creation.
- Knowledge Production, which means selling licenses to exploit university 'knowledge products' in the form (mainly) of protected intellectual property (IP).
- Knowledge relationship, which includes ways of providing university services, collaboration and partnership in the creation and exploitation of broad IP platforms, trade secrets, know-how and tacit knowledge.
- Knowledge engagement, which means the universities becoming involved in order to achieve mutually beneficial outcomes (even transcending university boundaries).

From the UIG-relations model was found that entrepreneurship domain in University KT plays multiple roles:

- Linking traditional roles of university – teaching and research, in the new quality, moving from mono-disciplinary knowledge production mode 1 to trans-disciplinary mode 2;
- Shaping entrepreneurship competencies and attitudes among university members as well as in society generally;
- Support function to knowledge and technology transfer:

- c) balancing R&D toward applied research and knowledge production, incl. via collaborative research,
- d) supporting spin-off processes at university.

It is declared that entrepreneurship is critical success factor in transition from mono-disciplinary R&D concept mode 1 to trans-disciplinary knowledge production mode 2 for society as well.