

Entrepreneurial Business Model for Classical Research University¹

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Commercialization process of research is analyzed in University-Industry-Government (UIG) framework in the context of entrepreneurial university business model. Critical issue in the UIG-relations model is the role of entrepreneurship: is enterprise integrated into all (education and not only intra-) university activities or is entrepreneurship support system targeted as a function for university R&D commercialization system only? From the literature it is known that the patterns of entrepreneurial university as a knowledge creator for society are more frequently represented in applied science oriented technology universities. The main aspects in entrepreneurial pattern of university are creation and implementation of transferable new knowledge and behaviour of actors in that process. All these aspects contain topics related to R&D funding, inventorship and ownership of patents. Patenting alone is not the evidence of entrepreneurial behaviour of the university, but this is one of the first steps targeted to implement created new knowledge into real business.

The aim of the paper is to explore knowledge creation, especially patented intellectual property (IP) created by university staff targeted on commercialization of university research. Entrepreneurship and entrepreneurial environment in UIG network have been identified as critical success factor in knowledge production by university. Based on previous publications university business model in the University-Industry-Government framework has been described. The author's position is that the (state) government is playing a very specific role in university entrepreneurship domain via governmental order as it has been in the fields of education and research. Empirical survey of knowledge production is based on the sample of five European universities from Sweden, Finland, Estonia and the Netherlands. The main research questions are general data about sample universities, like number of researchers, funding of R&D, creation of IP as well as indicators of efficiency of knowledge production. Results demonstrate growth in a number of publications abstracted in ISI Web between 1.2 and 2.0 times in the period 2000-2008. Productivity of publication per researcher differs maximum 1.9 times between universities and productivity of patenting figure differs approximately 13.5 times, partly as a result of Swedish "professors' privilege" IP regime. That points on the need to learn

more non-university patenting by academic personnel of other countries, but it obviously raises the question related to employment and patent ownership regulation in European countries generally. This regulation seems to be absolutely inefficient to protect new knowledge produced for national public R&D funding.

Keywords: *knowledge production; entrepreneurial university; intellectual property (IP); publication; patenting; University-Industry-Government linkages.*

Introduction

Writing of the current paper was inspired by the meetings of innovation specialists from five European universities initiated by the head of Uppsala University Innovation AB dr. Lars Jonsson in December 2007. So called *Uppsala Round-table* includes four old classical universities: Uppsala (Sweden, founded in 1477), Groningen (the Netherlands, 1614), Helsinki (Finland, 1640) and Tartu (Estonia, 1632), and one much younger University of Linköping (Sweden, 1975). Three of them (Groningen, Uppsala and Tartu) belong to Coimbra Group of European multidisciplinary universities of high international standard (<http://www.coimbragroup.be/index.html>). Common to these universities is origin from small countries. The main topic of the *Uppsala Round-table* is enhancing commercialization system of universities' research.

Already nearly last ten 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 of innovation in Europe (Raivio, 2008). That means that the previous missions of universities – education and research, have been complemented by a third, economic and social development mission mentioned also as serving society, innovation (Raivio, 2008; Strauf, Scherer, 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.

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

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role of university in that context and how this role could be fulfilled (Etzkowitz, 2004; Sorlin, 2007). Merton (see via Mendelsohn, 1989) already more than fifty years ago identified strong economic (and military) influence on modern science, and pointed 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.

Besides, especially in a small national state specific aspect of the third mission is very important for the comprehensive (classical) national university – teaching and research in national culture (University of Tartu, 2009). This is the topic of survival for national culture, and universities have carried that mission far before conceptualizing entrepreneurial university.

The processes mentioned above 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 as a knowledge creator for society 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 its knowledge users: with the regional government as well as with industry. What should be the users’ initiative and share in the structure of new knowledge created by university?

Gulbrandsen and Slipersæter (2007) distinguish three categories of indicators which reflect both kinds of university research commercialization: a) user-directed; b) user- and science-directed; and c) science-directed. That categorization can be treated in the context of patterns of knowledge transfer (KT) according to Howard (2005) including knowledge (1) diffusion; (2) production; (3) relationship; and (4) engagement.

Although the list of indicators for any of three categories is quite comprehensive and these are partly overlapping these four KT methods, the main aspects in entrepreneurial pattern of university are creation and implementation of transferable new knowledge and behavior of actors in that process. All these contain topics related to R&D funding, inventorship and ownership of patents. Patenting alone is not the evidence of entrepreneurial behavior of the academia, but this is one of

the first steps targeted to implement created new knowledge in real business.

The **scientific problem** studied with in the article is new knowledge production and performance evaluation of classical research university.

The **aim** of the research is to explore knowledge creation, especially protected intellectual property created by university staff and targeted on commercialization of university research.

The **object** of the article is entrepreneurial university in the knowledge production and transfer context.

Research methods are critical analysis of scientific literature and comparative empirical survey of knowledge production by universities of different small country origin.

The general aim causes the need to study the environment of knowledge production and its transfer by universities: how universities create value from their research for themselves and society – which business model they use. That means to determine universities’ productivity of knowledge creation generally and protected intellectual property (IP) specifically. That means also searching if it is possible to identify universities that are more entrepreneurial in knowledge production than others? The main outcome from evaluating the functions of university business model is the linkages between university’s three roles which could be balanced in the transition processes of modern university.

University business model for production and commercialization of new knowledge

Entrepreneurial university interlinks its three missions: education, research and serving society. Institutionally that has meant 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. Knowledge production and commercialization related 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), knowledge networks’ (Carayannis, Alexander, 1999) and IP system (Kelli, Pisuke, 2008) 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.

Parties in UIG-relations (Figure 1) can demonstrate different roles. Historically the relationship has been static without remarkable interactions between the actors: 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. 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. International peer-review and performance-based funding of research has been 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.

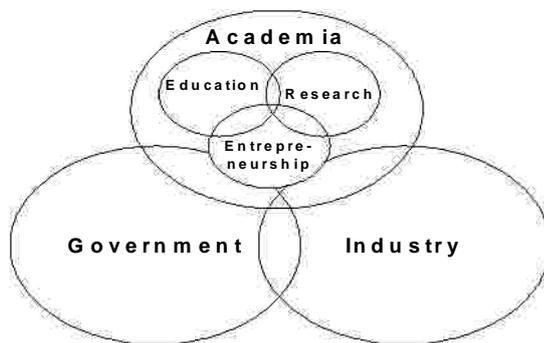


Figure 1. Main actors and domains of entrepreneurial university (Mets, 2009)

Creation of new knowledge in the university R&D feeding “new economy” has raised the question about profiting from that. This has become 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).

More active position in knowledge production is taken by the universities having own TTO. Mainly, having the TTO has been 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 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).

Critical issue in the UIG-relations model in Figure 1 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 trans-disciplinary 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 of entrepreneurship as the third domain (function) of the university means moving from laissez-faire UIG-relations to actively managed entrepreneurial model (Figure 1.) 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 (partly based on Autio, 2007):

- 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.

In that way entrepreneurship training and education becomes a part of the entrepreneurial university model with long-term orientation.

Several analyses of technology transfer processes from a university to a firm or an entrepreneur and relevant environment are treating different facets of the entrepreneurial university, even integrating partly them (see for example: Lanskoronskis, Ramoniene, Barsauskas, 2009; Staskeviciute, Neverauskas, 2008; Howard, 2005; Siegel et al, 2004; Hindle, Yencken, 2004), 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. Suggested entrepreneurial model of UIG-linkages in Figure 1 is not functional enough for mapping patterns of the 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 has been implemented before in companies’ framework (Chesbrough, Rosenbloom, 2002; Osterwalder, 2004), hereby for university is used (Figure 2).

General business model schema (Figure 2) does not present in details all possible IP forms (besides copyright and patent on invention) which can include business 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 a 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. We must mention that this is the question of governmental (societal) order, evaluation criteria and funding. 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.

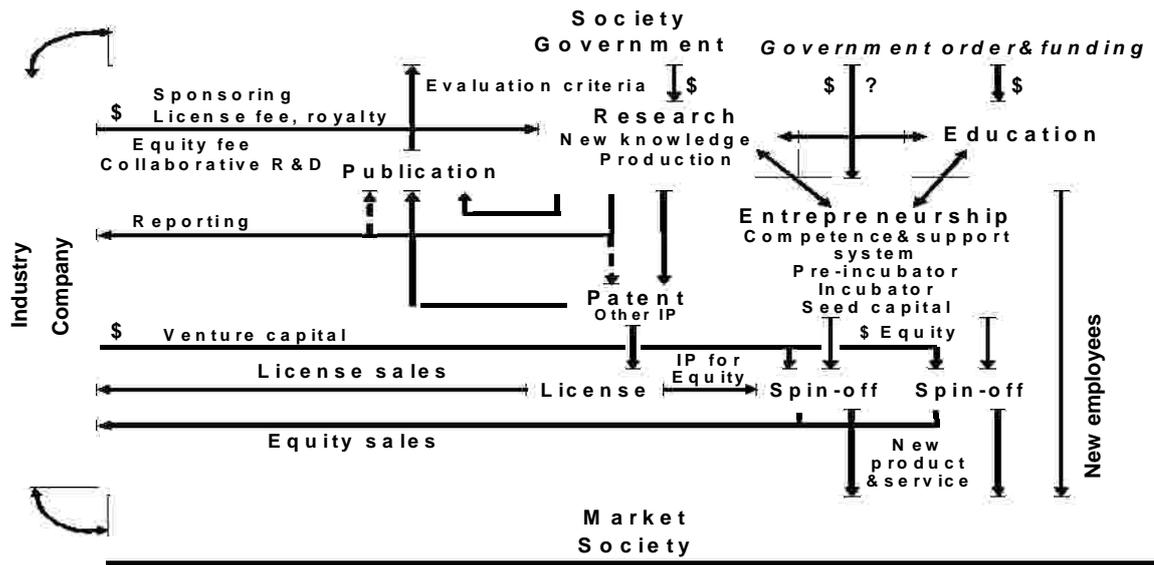


Figure 2. University business model in the University-Industry-Government framework (author's drawing improved from Mets, 2009)

Not depending on institutional realization, knowledge transfer and entrepreneurship domain in current business model (Figure 2) have the following roles (Mets, 2009; 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 centres 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 in solving 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 a facilitator of entrepreneurial competence and culture via education and creation of entrepreneurial environment transcending university boundaries.

It seems that the KT 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 the 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 it can be 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?

Attributes of new knowledge created at university

Fulfilling the third mission – creating new knowledge – means also the need to measure knowledge created by university. Most popular and easiest way is searching and counting papers in ISI databases, which is covering about

80 % of publications in science and technology (the same cannot be mentioned about social sciences).

It is used that knowledge production of academic person as well as university research generally are evaluated according his/her/its publications – quantity measured with the number of papers and quality – how highly the journals publishing his/her/its papers are ranked, and frequency of citation. Usually publications in the journals listed in ISI Web of Science are more valuable, although among them also exists ranking depending on value of impact factor, but also some other rankings of journals by authority institutions. These are the most popular criteria at seeking academic positions and funding grants by researchers. Knowledge production is related partly to metrics for ranking of universities including complexity of global competitiveness of higher education. Examples of such ranking are of Financial Times and recently created by Shanghai Jiao Tong University (for example see Academic Ranking of World Universities (ARWU) published annually by the Shanghai Jiao Tong University: <http://www.arwu.org/>), etc. (McKelvey, Holmen, 2009). (Of course the highest recognition is the Noble Prize, which hereby is not discussed.) According to ARWU (2008) members of Uppsala Roundtable are positioned in the following sequence: 68. Helsinki; 71. Uppsala; 101.-150. Groningen; 402.-503. Linköping; and Tartu University has not placed among first 503.

Only in the last ten years patents and knowledge transfer are also among academic evaluation criteria, although somehow in a hesitant way and frequently believed that patenting is disturbing research quality and publication productivity as well is opposing academic freedom (Van Zeebroeck, Van Pottelsberghe, Guellec, 2008). This opinion is disclaimed by several researchers. From the research of Breschi, Lissoni, and Montabbio (2007) comes that academic inventors exhibit superior productivity in publishing as well, even in basic-science-oriented journals, and benefit from financial or cognitive resources of technology-oriented projects.

For measuring knowledge transfer by TTOs specialists of American and European universities generally use quite similar systems of indicators, acknowledging that some issues decrease the comparability of two different samples (Gardner, Fong, Huang, 2007). General metrics can be divided into two types (ibid):

- Primary metrics: (1) number of invention disclosures; (2) number of US patent applications; (3) number of licenses executed; (4) total income from licenses; (5) number of start-up companies formed;
- Secondary metrics: (1) value of sponsored research expenditures; (2) number of US patents issued; (3) number of active licenses; (4) total income from royalties; (5) number of full-time professionals in TTOs; (6) legal expenditures on protection of IP.

Analyzing the indicators, it becomes clearer in which conditions these can be implemented. Because the time lag between patent application filing and publication the databases cannot give relevant information about last period and in some cases if comparability needed data of patents issued can be more relevant. Comparing European and US universities, researchers have found that European

academic patenting differs from US practice with dominance of business ownership on academic patents reaching more than 60 per cent of total number of academic patents (Lissoni, Llerena, McKelvey, Sanditov, 2009). But there are also differences between countries related to professors' privilege, like in Sweden (ibid). That means patent ownership in European universities becomes specific topic for evaluation.

Empirical research and methodology

Empirical research focuses on mapping main patterns of knowledge and IP creation functions of the sample group of research universities belonging to *Uppsala Roundtable*. This gives us data for identifying entrepreneurial pattern of knowledge production in these universities and among their personnel as well. Besides, carrying empirical research on the sample of *Uppsala Roundtable* helps better lead the joint development processes for common benefit of all parties.

For mapping situation general data about partners in association was collected, like number of students, teachers and researchers, funding of R&D, etc. This data gives better understanding also about relations between UIG partners. First of all, search for research publications about the main topic and case universities were carried out using Google Scholar®. That gave possibility to learn the aspects researchers already covered about the sample. Then historical facts and general overviews were collected from previous researches. After that web-pages and annual reports of the universities were studied to collect information about their history, structure and size characteristics, R&D funding and innovation activity.

Unfortunately, at preliminary survey it was not possible to identify all indicators and aspects of financing research fields related to creation of new technologies. From ISI Web of Knowledge was searched information about scientific articles, and proceeding papers as well because of peculiarities of ICT and informatics: researchers of the field are publishing mainly in conference proceedings. If in ISI web the publications from science and technology could be differentiated from social sciences and art and humanities, then the same division of research funding is not available on the webs of universities. Therefore general statistics identified (Table 1) includes mainly the total number of researchers and total funding of research (incl. humanities and social sciences, which usually are not producing patent-protected IP). A number of researchers in some cases can include doctoral students in some cases not. According to the experience of Tartu, it seems to depend on the practical aspect – has the doctoral student research role at and for the university or he/she is treated just as the student. In Estonia, because of different status of doctoral students (stipend is budgeted by state order only for part of doctoral students, not all) their contribution to research is remarkable and they are included into the statistics if also hired as researcher. In personnel statistics full time equivalent if available was found out. The publications and researchers of university medical centres are included into statistics.

Patent family information was mapped using search engine esp@cenet, worldwide databases of the European Patent Office (2009) and the web Patent Genius. First, the

patent documents according to the university as applicant, and after that the documents related to involved persons were searched. Especially person search was necessary for Swedish universities because “professor’s privilege” – that means university members are the owners of their inventions and have freedom to decide the way of own IP protection. Patent families were analyzed to explain the geographical range of IP protection. Here the question arises which type of patent document(s) – application(s) or issued patent(s) – characterize(s) better knowledge creation processes at universities. As it is known, patent application publication period can be even longer than that of papers in some peer-reviewed journals. Besides, because the lag between application filing and its publication by patent office the numbers of the last periods could not reflect real knowledge creation by university members. Therefore it was decided to use data of patents issued. If a university member was in the list of inventors, the patent was counted for his/her university. There the question has been raised how to differentiate the namesakes among the Swedish inventors. Here the analysis of academic profile and residence (partly using the site Patent Genius: <http://www.patentgenius.com/> if patented in USA) of the Swedish inventor was used. Of course, the patent data

gathered in that way cannot pretend on absolute accuracy. We were not ready to carry out similar phone calls to check persons’ identity matching as done by creators of KEINS database for similar purposes for whole Sweden (Lissoni, Llerena, McKelvey, Sanditov, 2009) covering only partly the sample and period of current research. Hereby only general overview, not creation of database, was expected. The facts collected during the previous studies as well as current research were evaluated in the context of research questions. The aspects not covered before and newer trends were mapped, also some interpretations were checked in interviews and partly checked with the TT managers of case universities.

Findings

Hereby it should be mentioned that the findings described below are preliminary and in the final process of validation and critical analysis can partly change and add the context as well specify the data and conclusions. Partly the findings of the current research are already given in general data Table 1.

Table 1

General data and indicators of knowledge creation by some European research universities in 2008 (the author’s compilation and calculations)

University \ indicator	Founded, year	Students, No.	Teachers & researchers, No.	R&D funding 2008, M€	ISI publ. No.	Patents per year (2000-2008)	Expenses per ISI publication, 1000 € publ	ISI publ per person	R&D expenses per patent, M€/pat	Patents per 100 publ.	Patents per 1000 persons
University of Tartu	1632	17100	1412	41,9	630	1,4	66,5	0,45	29,9	0,22	0,99
University of Helsinki	1640/1828	35200	3845	193	3183	8,7	60,6	0,83	22,2	0,27	2,26
Uppsala University	1477	19900	4000	290	2610	24	111,1	0,65	12,1	0,92	6,00
Linköping University	1975	16900	1964	132	1134	37,7	116,4	0,58	3,5	3,32	19,20
University of Groningen	1614	25167	2057		2506	9,1	0,0	1,22	0,0	0,36	4,42

* For Swedish universities and the University of Tartu all academic patents counted, for others – only if university is applicant.

“ Uppsala University – interim data of patenting, ongoing search has not covered all departments yet.

* R&D funding for University of Groningen – evaluation from the total budget.

Even the simple data about the sample universities is not absolutely explicit, for example founding date: university activities interrupted for some period or university moved from one location to another or university has some kind of predecessor. But also some data can have different interpretation on the web-pages of universities. Some sources (even in different parts of the same document) give R&D funding together with funding for research infra-structure, some of them – without, number of researchers include PhD students, in some cases – not, number of academic personnel is presented in full-time equivalent, sometimes number of persons, etc. In analysis author tried to reduce differences in size and finances of universities. For that purposes relative indicators are used.

As for the period 2000-2008 besides publication and patenting other information was not available for most of the sample members, additional data for the last year was fixed. As indicator of patents received was quite small and unstable for some universities in annual measure, average value of the period is used. Table 1 gives general

understanding about academic productivity of university members. We can see the highest efficiency in publication by University of Helsinki in two means: number of publications per researcher and expenses per publication. The figures about production and productivity of patented IP by members of Swedish universities are much higher than by others. Academic inventing is extremely effective in the Linköping University, even if considering that data for some other sample universities (Helsinki and Groningen) is related only to university-owned (or university as applicant for) patents. General data about patenting in Table 2 confirms intensity of IP production and patenting by Swedish academic personnel.

Quite interesting are trends of scientific publication in ISI Web of Knowledge by universities as shown by the results of the survey of the first type of knowledge production (Figure 3).

Table 2

Number of patents by patent families received in the period 2000-2008 (the author's compilation and calculations)

University \ Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	TOTAL
University of Tartu	0	1	1	0	2	1	4	4	0	13
University of Helsinki	2	9	9	8	16	9	12	7	6	78
Uppsala University	17	27	28	29	19	17	28	22	29	216
Linköping University	9	39	38	62	42	45	31	36	37	339
University of Groningen	5	9	8	11	9	12	10	10	8	82

* For Swedish universities and the University of Tartu all academic patents counted, for others – only if university is applicant.

** Uppsala University – interim data of patenting, ongoing search has not covered all departments yet.

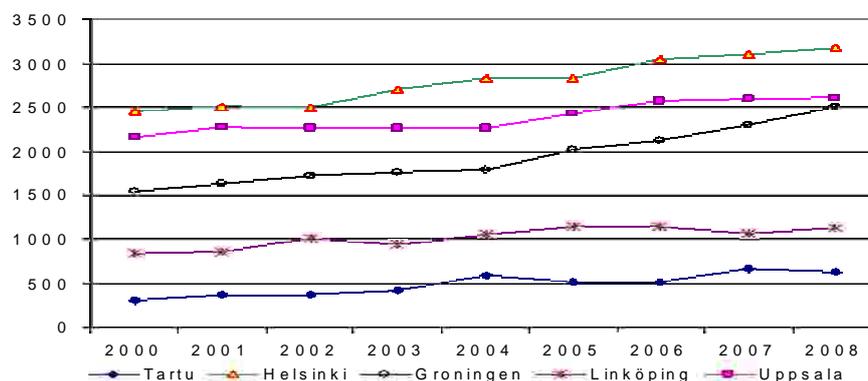


Figure 3. Number of articles and proceeding papers in ISI Web of Knowledge by universities in 2000-2008 (the author's compilation and calculations)

University of Tartu demonstrates the highest rate of growth and has doubled its absolute number of publications in 9-year period, but efficiency per researcher (Table 1) is still until 1.9 times lower from leaders' (Groningen and Helsinki) result. Interpreting that indicator could be concluded lower level of research as well lower resources for support personnel, or peculiarities of research fields, and that the topic needs further elaboration. Growth has been more intensive also in University of Groningen (1.6 X) than in Helsinki (1.3 X), Linköping (1.36) or Uppsala (1.2 X) universities.

As absolute numbers of publication and patenting by universities differ quite drastically between each other, it should be useful to reduce these indicators to some kind of

relative value. For that purpose the ratio of patents to 100 ISI Web publications is used as presented in Figure 4.

The share of patent-protected IP among research results is highest in Swedish universities, but particularly outstanding is the result of academic personnel of Linköping University being 3.2-13.5 times more productive than others. Here it should be mentioned that the data for Swedish academic personnel of the sample was collected as the result of person-based search, but for others – search for university as patent applicant. A quick search for academic personnel of Tartu University with the search engine esp@cenet gave only five patents which applicant was other than university.

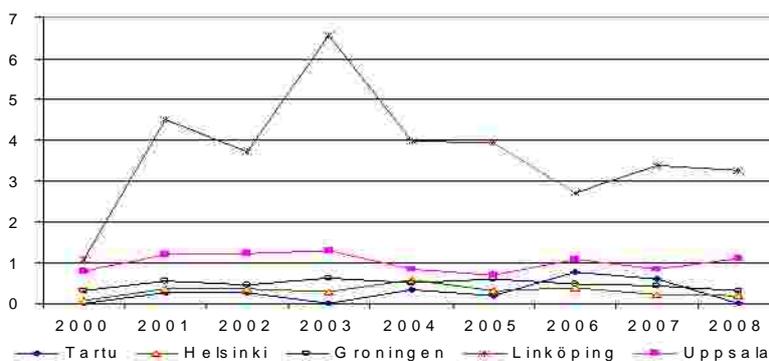


Figure 4. Number of patents per 100 ISI Web of Knowledge publications received by universities in 2000-2008 (the author's compilation and calculations)

From Figure 4 should be mentioned that relative productivity of patented IP production by non-Swedish universities has more smooth distribution than absolute indicator of publications in Figure 3.

Discussion and conclusion

Implementation of business model concept for knowledge production and commercialization demonstrates wide complex of linkages between education, research and

entrepreneurship domains at modern classical university. Entrepreneurship could be seen as leading domain in shaping research orientation and intention for knowledge production and transfer at modern research university. There can be identified different patterns of knowledge production at universities from different countries, even differences between universities of the same country.

Data of the survey about production of knowledge as public good (ISI Web publications) in sample universities demonstrates quite intensive growth, especially Tartu University, which started from the lowest level in 2000. Comparing patented IP production, it seems that more technology oriented younger Linköping University is more active and entrepreneurial than old traditional ones as it could be supposed from literature review on the topic. But here arises also another conclusion that Swedish professor's privilege IP regime supports strongly academic inventing and patenting as could be seen also on the example of Uppsala University. As a result, the patenting activity demonstrates the highest entrepreneurial behaviour

among Linköping University personnel. Although patenting statistics for non-Swedish universities besides University of Tartu do not include non-university patents, the difference between academic patenting is drastically big. When productivity of publications per researcher differs maximum 1.9 times between universities, then productivity of patenting by academic personnel differs approximately 13.5 times. That can point on the need to learn more non-university patenting by academic personnel of other countries. It obviously raises the question about employment and patent ownership regulation in these countries, may-be also in European countries generally. This regulation seems to be absolutely inefficient to protect new knowledge produced for national public R&D funding in some countries. That means that great share of patentable IP in many cases can be published and dispersed worldwide as public good. Finally, this is the question about efficiency of a university business model and innovation system generally, how entrepreneurially it is exploited.

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Fundamentaliųjų tyrimų universitetui pritaikytas entrapreneriško verslo modelis

Santrauka

Komercinio proceso tyrimas yra analizuojamas Universiteto –Pramones – Valdžios (toliau – UPV) sistemoje taikant universiteto entrapreneriško verslo modelį.

Pagrindinė UPV problema – neišskus entrapreneriškumo vaidmuo: ar imone integruojama į visas universiteto mokymosi (ir ne tik vidinio) veiklas ar verslumo paramos sistema skirta tam, kad veiktų universiteto mokslinių tyrimų komercinio sistema.

Iš literatūros žinoma, kad entraprenerišku universitetu kaip žinių visuomenei kureju sistemos yra dažniau pritaikomos taikomiesiems mokslams skirtuose technologiniuose universitetuose. Pagrindiniai universiteto verslumo modelio aspektai yra perduodamu žinių ir elgesio veiksmu tame procese sukūrimas ir įgyvendinimas. Visos šios temos yra susijusios su mokslinių tyrimų finansavimu, investavimu ir patentu nuosavybės teisėmis. Vien patentavimas nėra universiteto versliniškumo elgesio irodymas, tačiau tai yra vienas iš pirmųjų veiksmų įgyvendinti sukurtas naujas žinias realiaje versle.

Straipsnio tikslas – iširti žinių kurimo procesą, ypač saugomos intelektualinės nuosavybės (toliau – IN), sukurtos universiteto darbuotoju, atsakingu už universiteto tyrimų komercinimą. Pagrindinis tyrimo tikslas salygoja poreikį išnagrinėti žinių gamybos ir jos perdavimo universitetuose aplinką: kaip universitetai kuria savo mokslinių tyrimų pridėtinę vertę sau ir visuomenei – kuriuos verslo modelius jie taiko. Tai reiškia, kad siekiama nustatyti universiteto produktyvumą, kuriant žinias apskritai ir apsaugojant IN konkrečiai.

Verslumas ir verslumo aplinka UPV sistemoje buvo įvardyti kaip svarbus sėkmes faktoriai žinioms kuriti ir technologijoms perduoti universitete. Remiantis ankstesnėmis publikacijomis, buvo aprašytas UPV sistemoje. Nepriklausomai nuo institucinio įgyvendinimo, žinių perdavimo ir universiteto verslumo srityje veikiantis verslo modelis atlieka šias funkcijas:

- Žinios daugiausia skleidžiamos moksliniais ir populiariausias leidiniais, standartais, stiprinant universiteto absolventų gebėjimus – perduodant nauju privaciojo ir viešojo sektoriaus darbuotoju naujas žinias savo darbe, mokantis visa gyvenimą (baigus universitetą), taip pat, iš dalies žinios skleidžiamos naudojantis kitais (personalo) viešaisiais ir asmeniniais ryšiais, naudojant naujus produktus ir paslaugas (nesaugomus kaip IN), i rinka pateiktus per universiteto papildoma nauda (angl. *spin off*). Tai reiškia, kad kuriami ir socialinio kapitalo bei dalijimosi žiniomis tinklai. Verslumo srities pagrindu vaidmuo daugiausia yra švietėjiškas – mokomi universiteto studentai ir skatinama verslumo kultūra regione.
- Žinių kurimo savoka – pirmiausia patentuojama nauja technologija, vėliau pateikiamos publikacijos, licencijos patentams, parduodami kiti saugomi IN pramonės partneriams. Iš dalies ši funkcija atliekama investuojant savo IN į atsiskyrusias nuo universiteto bendroves ir rizikos kapitala imones kapitale. Verslumo srities pagrindas (paramos sistema) labiausiai yra skirtas papildomos naudos (angl. *spin-off*) procesams ir mokslo darbuotoju versliniškam požiūriui bei kompetencijai, iskaitant verslo aplinkos pletojimąsi, verslo inkubavimą, konsultavimą ir mentorystę, finansavimą pradinio ir rizikos kapitalu ir t. t.
- Žinių ryšiai apima dotacijas ir bendra mokslinių tyrimų projektu remimą bei postu ir stipendiju finansavimą, mokymo paslaugas, tyrimus ir konsultacijas pagal sutartis, bendradarbiavimą moksliniuose tyrimuose, verslo ir mokslinių tyrimų partnerystes, iskaitant pramonės (transdisciplininių) mokslinių tyrimų centrus ir institutus, bendras laboratorijas, įrangą. Del kompleksiško IN savininko nustatymas tampa atskira problema šiuose ryšiuose. Verslumo vaidmuo (be išvardytu) – vykdyti strategines ir paramos valdymo funkcijas pramonės lygmeniu, iskaitant verslo ir IN strategijų susiejimą.
- Žinių „idarbinimas“ yra kiles iš trečiosios universiteto misijos ir reiškia saveika tarp universiteto, pramonės (verslo) ir vyriausybės sprendžiant sudėtingas visuomenes problemas. Poreikis kyla iš inovacijų proceso netiesiškumo, kuriam reikalinga UPV partneriams aktyviai bendradarbiauti sprendžiant strateginius žinių ekonomikos pletros klausimus, iskaitant ir MTTP ir žinių perdavimo politika ir paramos priemoniu įgyvendinimą valstybes lygiu. Kompleksiškai verslumas gali buti įgyvendintas kaip paprastesnes versliniškumo kompetencijos ir kultūra per švietimą ir kuriant verslumo aplinką, peržengiancia universiteto sienas.

Autorius laikosi pozicijos, kad (valstybe) valdžia valstybiniais pavedimais atlieka labai specifini vaidmeni universiteto verslumo srityje, kaip tai atliekama mokslo ir tyrimu srityse.

Žinių pletra universitetuose yra vertinama taikant publikavimo ir patentu rodiklius. Empiriniai žinių generavimo tyrimai yra pagristi penkiu Europos universitetu, priklausanciu vadinamuju Upsalos *apskritajam stalui*, patirtimi, iš Upsalos (Švedija, ikurtas 1477 m.), Groningeno (Nyderlandai, ikurtas 1614 m.), Helsinkio (Suomija, ikurtas 1640 m.), Tartu (Estija, ikurtas 1632 m.) ir gerokai jaunesnio universiteto – Lincio (Švedija, ikurtas 1975 m.). Empiriniu tyrimu demesys ypac skiriamas pagrindiniu žinių modeliams planuoti, taip pat intelektualines nuosavybes sukūrimo funkcijoms atrinktuose mokslinių tyrimu universitetu grupese. Žinių kurimo empirinio tyrimo pavyzdys yra paremtas penkiu Europos universitetu (Švedijos, Suomijos, Estijos ir Nyderlandu) patirtimi. Pagrindiniai tyrimo klausimai buvo susije su bendra informacija apie pasirinktus universitetus: tyreju skaiciumi, moksliniu tyrimu finansavimu, IN sukūrimu taip pat žinių kurimo efektyvumo rodikliais. ISI žinių tinklalapyje buvo ieškoma informacijos apie mokslinius straipsnius ir dokumentus, taip pat informacijos apie IT ir informatikos institutus: tarp mokslininku publikuojamu straipsniu daugiausia straipsniu, pristatytu ivairiose konferencijose. Informacija apie patentu šeima buvo rasta prisijungus prie paieškos *esp@cenet*, Europos patentu biuro (2009) pasaulio duomenu bazes ir internetinio „Patentu genijaus“. Pirmiausia buvo ieškoma patentu dokumentu pagal universitetus kaip pareiškejus, vėliau – dokumentu, susijusiu su patentavimo procese dalyvaujanciais asmenimis. Ypac buvo reikalinga paieška pagal asmenis tiriant Švedijos universitetu pateiktus patentus del „profesoriaus privilegijos“, – universitetu nariai ir savo išradimu savininkai laisvai sprendžia, kaip apsaugoti savo nuosavybe. Remiantis 2000–2008 metu rezultatais publikaciju pateiktu ISI tinkle, padaugejo 1,2 – 2,0 karto. Tartu universiteto patirtis rodo, kad labiausiai padaugejo publikaciju – ju per 9 metus padvigubejo. Tačiau vieno mokslo darbuotoju efektyvumo rodiklis vis dar yra iki 1,9 karto mažesnis už šio rodiklio lyderiu (Groningeno ir Helsinkio universitetu) rodikli. Tokie rezultatai galejo buti del to, kad universitete vykdoma mažiau moksliniu tyrimu, taip pat sumažinti ištekliai, skirti darbuotojams remti. Taip pat del moksliniu tyrimu srities ypatumu ir del to, kad šia tema reikia tirti toliau. Rodiklio Groningeno universitete buvo didesnis (1,6 karto) negu Helsinkio (1,3 karto), Linköpingo (1.36) arba Uppsalos (1.2 karto) universitetuose.

Absolutus publikaciju ir patentu pagal universitetus skaiciai gana smarkiai skiriasi tarpusavyje, todėl tikslinga sumažinti šiuos rodiklius iki kažkokios santykines vertes. Tam tikslui ir yra naudojamas santykis patentu rodiklis, pateiktas interneto 100 ISI Internetiniu publikaciju puslapyje. Didžiausia publikaciju efektyvuma pagal universitetus galime pamatyti Helsinkio universitete dviem budais: publikaciju skaiciumi tenkanciu vienam mokslo darbuotoju (0,83, maždaug toks pats kaip ir Groningeno universitete) ir išlaidomis už viena publikacija (~ 61 euras tukstanciu ISI publikaciju). Švedijos universitetu nariu patentuotos IN gamybos ir produktyvumo rodikliai yra daug didesni nei kitu. Patentu santykis 100-ai ISI internetiniu publikaciju ne Švedijos universitetuose buvo tarp 0,27 ir 0,36, o Švedijos universitetuose šis rodiklis sieke 3,32 (Linköpingo universitetas).

Vieno tyreju publikavimo produktyvumas tarp universitetu skiriasi daugiausia 1,9 karto, o patentavimo skaicius skiriasi 13,5 karto iš dalies del Švedijos „privilegiju profesoriams“ IN režimo. Tai rodo, kad akademiniams darbuotojams iš kitu šaliu reikia pasimokyti daugiau neuniversitetinio patentavimo. Tačiau tai akivaizdžiai rodo, kad reikia pasirupinti idarbinimu ir patento savininko reglamentavimu bendrai Europos šalyse. Šis reglamentavimas atrodo visiškai neveiksmingas saugant naujas žinias, sukurtas pagal nacionalini moksliniu tyrimu kai kuriose šalyse finansavima. Tai reiškia, kad daugeliu atveju didžioji dalis patentabilios IN gali buti skelbiama visame pasaulyje kaip visuomenes nuosavybe. Galu gale kaip tai panaudoti imonems, yra universiteto verslo modelio ir inovaciju diegimo sistemos apskritai efektyvumo klausimas.

Raktažodžiai: *Žinių kurimas; entrapreneriškas universitetas, intelektine nuosavybe (IN), publikavimas, patentavimas, Universiteto – Pramones – Valdžios ryšiai*

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