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Innovation, product development and patents at universities

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Abstract. In the present article actual matters of technological innovations are dealt with in the context of research universities, mainly taking into account the circumstances in Estonia. For the description of a process of technological innovation one of the cognitive models has been used. Patents are an integral part of technological innovation, notably in the case of development of new products. The patent statistics given in the article shows that despite wishes, the business sector and universities are not enough oriented internationally. Besides that, there is a lack of enterprises and R&D performing firms, who might play a considerable role in the economy of Estonia, in these key sectors. Amendments to the Utility Models Act would enable to increase the legal certainty of the protection of utility models and to make it more attractive for the universities and SME-s.

Key words: knowledge-based economy, license of rights, patents statistics, product development, technological innovation, utility model.

1. INTRODUCTION

Innovation, information technology and knowledge-based economy are nowadays in all political, science and economic forums high sounding key words. Explosive development of information technology during the recent decades has significantly influenced the development of innovative products and their use in practice. Information products are playing more important role in economy. Bringing innovations to market has not been the main historical role of university researchers. Instead, university researchers quite appropriately concentrate on basic science. There is an eternal dilemma whether it is more important to publish scientific papers or to file patent applications. As technologies have grown more sophisticated and emerging industries have become more high-tech, universities

have become more important players in the processes of invention, innovation, and commercialization [1]. Undoubtedly, patents are an indicator showing the competitiveness of the products and technological processes created as a result of R&D activities in the universities. In Estonia, first and foremost the Tallinn University of Technology and the University of Tartu have the researchers, material means and facilities for working out innovative products the Estonian economy requires in order to ensure Estonia's transfer to knowledge-based economy. According to the Estonian Research and Development and Innovation Strategy 2007–2013 "Knowledge-Based Estonia" the key technologies, supporting innovation, are information technologies, material technologies, communication- and biotechnologies. National research and development programmes were launched on the basis of the strategy for developing these key technologies [2]. The term of innovation will be explained and a general overview of the activity of patenting as an essential innovation indicator at the mentioned two Estonian universities will be provided.

2. MEANING AND MODELS OF INNOVATION

Innovation is a concept that can be interpreted in different ways. Innovation means different things to different people depending on whether they are politicians, scientists, entrepreneurs, media or just common people. In the context of "Green Paper on Innovation" of the European Commission, innovation is considered as being a synonym for successful production, assimilation and exploitation of novelty in economic and social spheres. It offers new solutions to problems and thus makes it possible to meet the needs of both the individual and society [3]. Generally, innovation is divided into technological innovations and non-technological innovations.

Technological innovations comprise new products and processes and significant technological changes in products and processes. An innovation has been implemented if it has been introduced on the market (product innovation) [4]. Technological innovations may be classified also as product vs. process, radical (basic or fundamental) vs. incremental (improvement), and disruptive vs. sustaining (sequential and/or complementary). Important types of non-technological innovations that do not result from scientific and/or technological R&D, but are often crucial for profitably marketing the products and services resulting from the investment made in R&D are marketing innovation, institutional innovation, and complementary innovation [5].

In order to harmonize the understandings of the nature of innovation and to compare the countries on the macro level as well as the enterprises and other institutions on micro level, nowadays the OECD methodology, based on three manuals, is used. The Frascati Manual [6] contains standard practice for surveys on research and experimental development. The Oslo Manual [7] gives guidelines for collecting and interpreting technological innovation data, and Patent Manual [8] is intended to give guidance on the measurement of scientific and

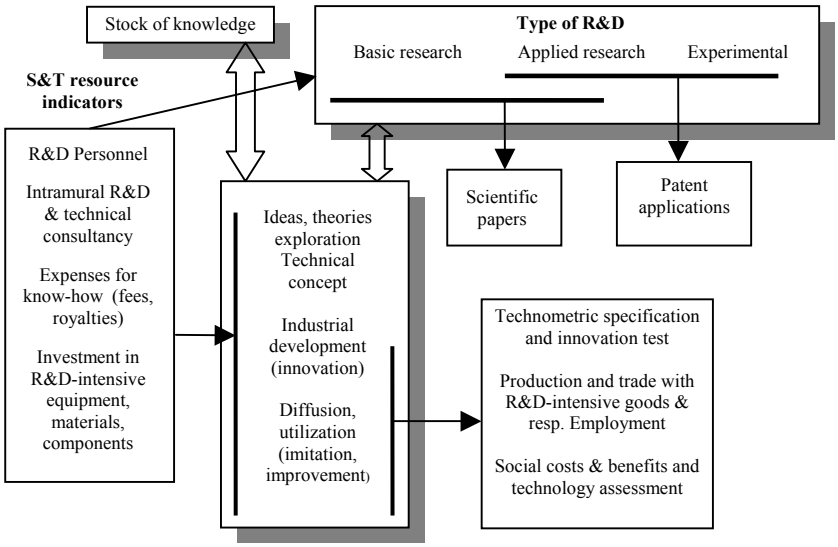

Fig. 1. Models of the process of technological innovation [8].

technological activities using patent data as science and technology indicators. According to the Oslo Manual (point 59), the knowledge-based economy is an expression coined to describe trends in the most advanced economies towards greater dependence on knowledge, information and high skill levels, and an increasing need for access to all of these. R&D and innovation are key elements in the knowledge-based economy.

In Fig. 1, one of the cognitive models of the process of technological innovation is shown for better understanding of the nature of the innovation[1].

3. TECHNOLOGICAL INNOVATION AND PATENTS

Nowadays, development of technological innovations is based mainly on the system of intellectual property, especially on industrial property. However, legal protection of the subjects of industrial property, first of all inventions, plays an important role in the industrial and innovation policy of industrially developed countries.

Patent systems are designed with the main objectives of promoting innovation, development and commercialization of inventions, inducing disclosure of an invention and enabling orderly development of broad prospects [9]. As it is known,

[1] According European Commission information 2006/C 323/01 "Community framework for state aid for research and development and innovation", research categories are defined as follows: fundamental research, industrial research, experimental development.

the laws of industrial property protection are the sole laws enabling to create market monopoly. Patent system and exclusive rights, given via this system, would not exist without social agreement. Patent system is an agreement between the inventor and the society, according to which the society gives the inventor an exclusive right for the use of the invention for up to 20 years in return for making the subject matter of the invention public [10]. Patent is a good measure of accumulation of national intellectual capital. It represents one aspect of country's R&D effort. It is a good approximation for technological sophistication [11].

Before 1990-ies many high-tech companies, mainly in the field of information technology (IT), did not pay much attention to patenting their developments. Globalization of the world economy and emerging markets led to the need for protection of new products from the competitors on both internal and external markets. The amount of ideas due to the use of IT on a large scale by the modernization of existing products and working out new products, which exceeded the possibilities to develop them into products at once, led fast to the growth of the numbers of patent applications in industrially developed countries [12]. Besides protection of the products, launched on the market, also defensive use of patents has spread, even to that extent that a new term "patent arms race" has been taken into use. It may be stated that part of patents has the nature of the technology and part of them is for "crafty lawyering".

The term "patent trolls" is also widely used. These are firms, which do not deal with product development themselves to a great extent, but exist mainly to buy other inventor's patents and enforce licenses.

Despite the aforementioned drawbacks, patents as indicators of technological innovation have certain advantages. Excluding trivial patents and patents used purely for lawyering, those inventions, which are expected to have a commercial value, are the clear outcome of innovation process. Nowadays, the value of the patents lies in the fact that they form a large number of public documents, on the basis of which it is possible to make extensive statistical research to bring out, for example, inventive activity in different technical fields, directions of development, leading firms, research institutions, researchers and other key persons in the universities or most prominent figures in the field. Disadvantages of the patents as indicators are that patents measure inventions rather than innovations. Not all inventions are patentable. This is the case of software, which is protected only by copyright, except in the USA. Not all inventions are patented. Firms prefer in many cases to protect their innovations with other methods, such as technological complexity (know-how) or other industrial secrecy.

Despite the fact that patents can be treated as an indication of the efficiency of innovation process in different ways, nowadays their existence is extremely important let alone that a patent portfolio of sufficient size is required for a successful "patent arms race".

4. PRODUCT DEVELOPMENT AND UNIVERSITY INVENTIONS

In case of university research, there is an eternal dilemma whether it is more important to publish scientific papers or to file patent applications in the innovation process from basic research until experimental development [13]. International publications are without doubt essential for the universities, because these are the main indicators by accreditation. But a large number of references and interest in scientific articles do not mean that the results of the scientific researchers have novelty to the extent that they can be protectable. Undoubtedly, patents are an indicator showing the competitiveness of the products and technological processes created as a result of R&D activities at the universities. Neither development of new products nor sustainable cooperation with industry is possible without patents. Moreover, competitive products have to be protected as a basis for the establishment of start-up and spin-off firms. Although patenting activity of the universities of the EU has increased, the universities of the USA and Japan are still on the leading position. According to the WIPO, top university applicants by the number of published PCT international applications in 2010 were the following [14,15]: 1) University of California – 306 (2011 – 277); 2) Massachusetts Institute of Technology – 145 (2011 – 179); 3) University of Texas System – 130 (2011 – 127); 4) University of Florida – 107; 5) University of Tokyo – 105; 6) Columbia University in the City of New York – 91; 7) Harvard College – 91; 8) Johns Hopkins University – 89; 9) Seoul National University – 86; 10) Arizona Board of Regents (governing body of Arizona's public university system) – 80.

5. PATENTING ACTIVITIES IN ESTONIA

As it was mentioned before, information and communication technologies, biotechnologies and material technologies are technologies considered key technologies for the economy of Estonia to which much attention has been paid. These fields of technologies have been the most important fields of technologies in the world for a long time from the standpoint of innovation. In 2010, according to the WIPO, number of PCT international applications, published in the field of digital communication, saw the fastest growth – 17.3%, (10 581 published applications). This technical field accounted for the largest share of total PCT applications, published in 2010. Almost every other field of technology experienced a decline or modest growth. The sharpest decline in patenting was seen in the field of telecommunications [16].

Scientific research has been carried out in the aforementioned key areas in Estonia for the last 30–40 years. Therefore there are highly qualified scientists in these areas and nowadays they have assembled into two main research universities – Tallinn University of Technology (TUT) and the University of Tartu (UT). Before the 1990-ies, the universities had for their basic research and

applied research an output either in the Estonia or former Soviet Union industry as experimental solution. It should be mentioned that, unfortunately, in Estonia there is no industry for implementing key technologies to the extent to have an essential impact on the economy. However, especially biotechnology and material technology are areas, which require big investments for the implementation of production and highly qualified work force, which are nowadays clearly too demanding for the economy of Estonia. Taking that into account, the universities prefer international cooperation to the internal one in Estonia in the field of high technology.

Proceeding from the evaluation on the basis of the research on innovation in the Baltic region, made by Technopolis Group to the EU Commission in April 2011 [17], the small absolute number of patents and the absence of patents in some fields suggests, firstly, that the business sector in all three Baltic States is not internationally oriented and, secondly, there is an absence of industries, or of R&D performing firms, in some key fields. The low number of patents makes it not possible to identify a technological specialization for these three countries.

In Fig. 2, the number of Estonian patent applications and granted patents, filed with the Estonian Patent Office in the years 2005–2011, and in Fig. 3 the number of utility model applications and registrations are shown [18].

In Fig. 4, European patents, enforced in Estonia, are shown. It should be mentioned that the numbers shown are too low to call Estonia a technologically developed country.

In Fig. 5, it can be seen to which fields of technology the patents, enforced in Estonia in 2011, belong. It should be mentioned that in class C enforced patents concern mainly pharmaceutical industry. The rate of the enforced patents, belonging to the areas of key technologies, is small, which may mean that there is little interest in making investments in these fields.

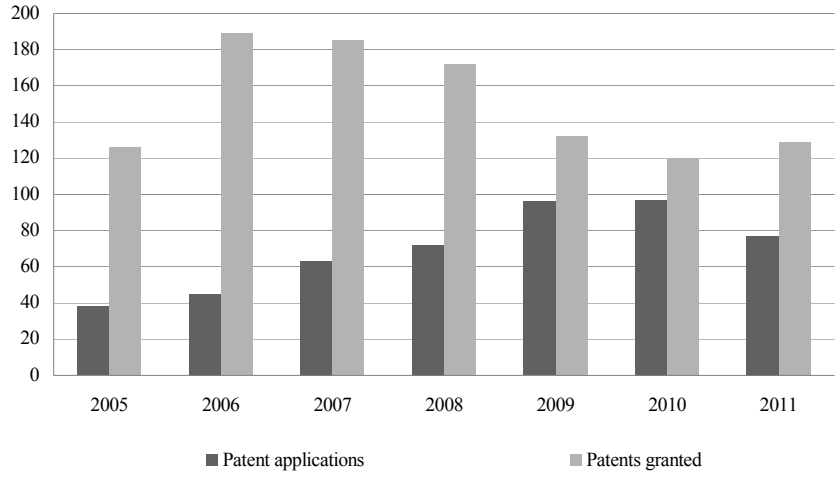

Fig. 2. Patent applications and granted patents.

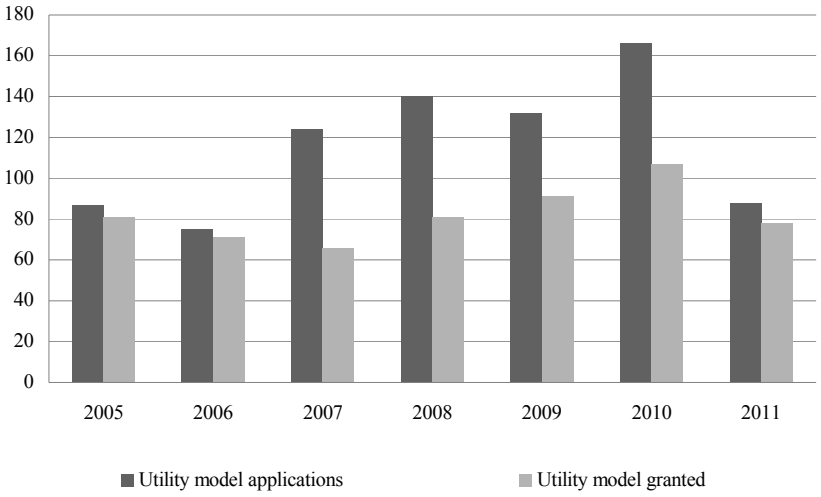

Fig. 3. Utility model applications and registrations.

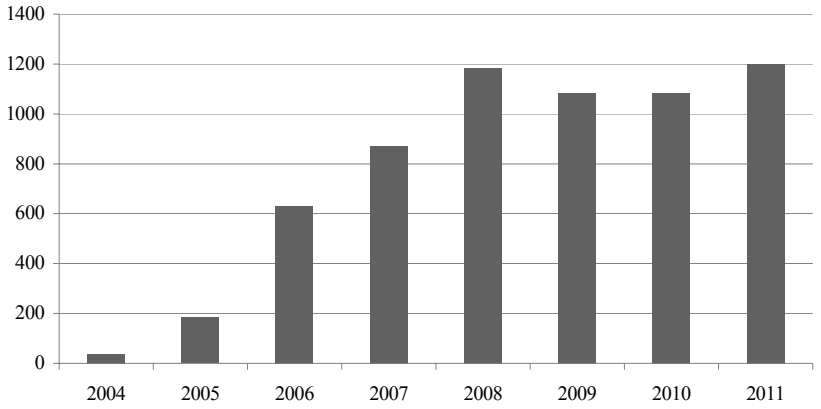

Fig. 4. European patents enforced in Estonia.

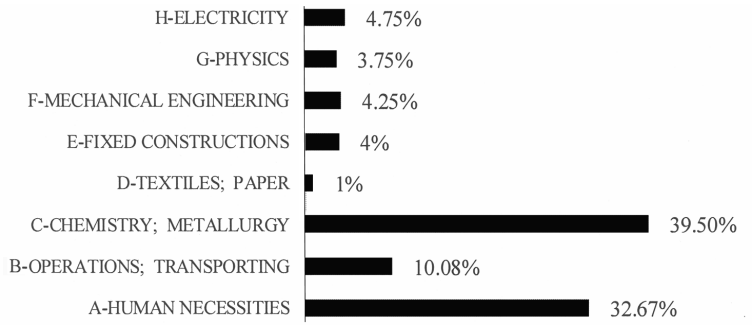

Fig. 5. European patents by IPC enforced in 2011.

In Figs 6 and 7, the number of patent applications, utility model applications and PCT international applications, filed with the Estonian Patent Office by TUT and UT during the period from 1996 until 2011, are given. It can be seen that the absolute number of applications for legal protection of inventions has been very low at both universities during the whole period.

On the whole, from the patents granted on the basis of the total number of 44 patent applications, filed with the Estonian Patent Office by the TUT (17 patents) were still in force at the end of 2011. In case of the UT, 12 patents were in force from the 36 filed patent applications. The small number of patents in force reveals that it is impossible to make use of the inventions or their long-term legal protection in Estonia.

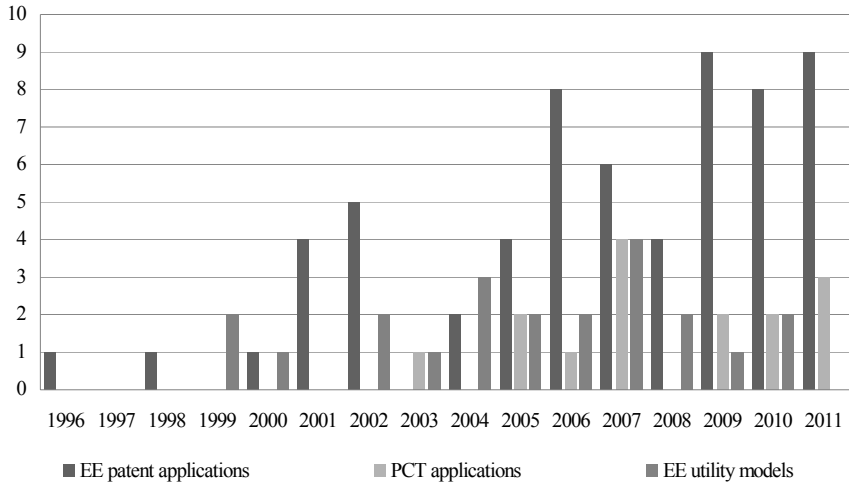

Fig. 6. Patent and utility model applications of the Tallinn University of Technology.

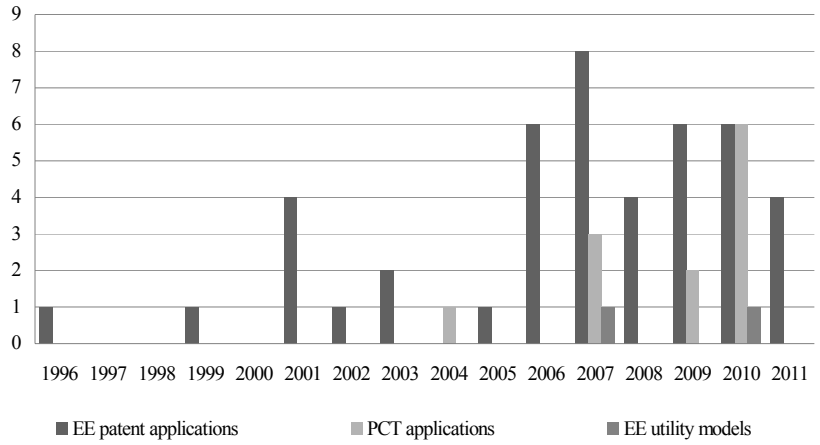

Fig. 7. Patent and utility model applications of the University of Tartu.

In Fig. 8, the number of published PCT applications of the TUT and in Fig. 9 of the UT are shown. The data of the WIPO contain also the patent applications that were not filed via the Estonian Patent Office or were filed with a patent applicant from some other country. In Figs 10 and 11 it can be seen that at both universities the largest number of patent applications have been filed in the fields of microbiology and gene technology (patent classes C12N and C12Q). EP applications of both universities are shown in Figs 12 and 13.

The number of European patents filed by Tallinn University of Technology has been provided in Fig. 10 and the number of patents filed by the University of Tartu has been shown in Fig. 13. It can be noticed that the number of the European patent applications is low.

In case of the afore-given data it should be stated that these are public data. Therefore it should be taken into account that due to long backlogs, especially in the EPO and the USPTO, it is impossible to evaluate whether the activity of patenting of the universities has remarkably changed in recent couple of years.

Neither has the present research brought out the impact of the inventions, the authors of which are scientists of the universities, but in which the universities have not been mentioned as applicants or co-applicants. The main inventions

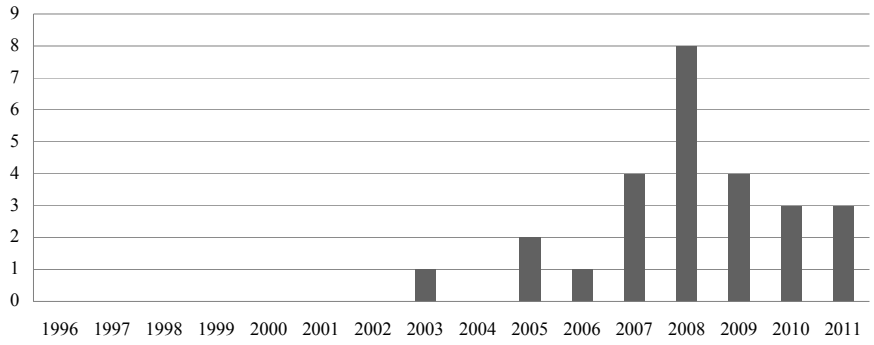

Fig. 8. PCT applications of the Tallinn University of Technology.

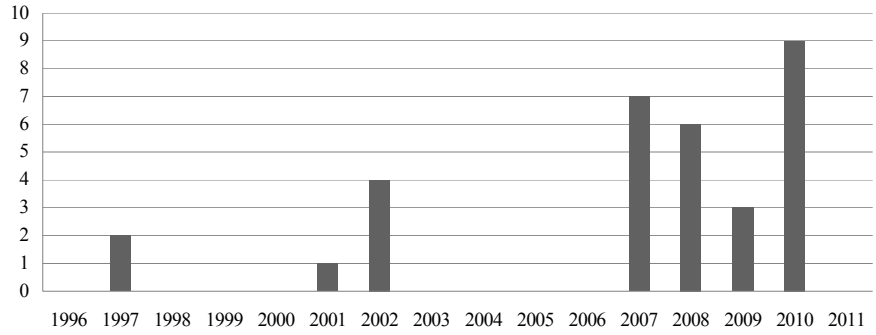

Fig. 9. PCT applications of the Tartu University.

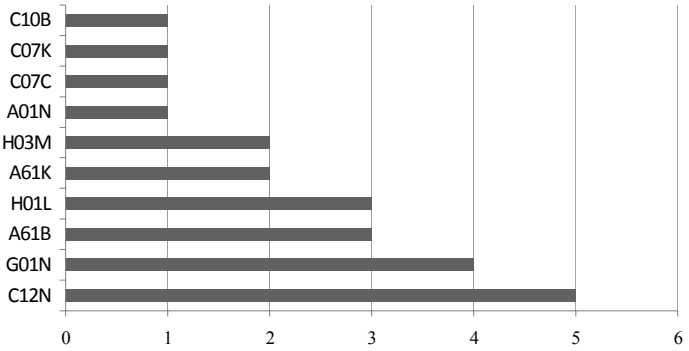

Fig. 10. PCT applications of the Tallinn University of Technology classified by International Patent Classification (IPC).

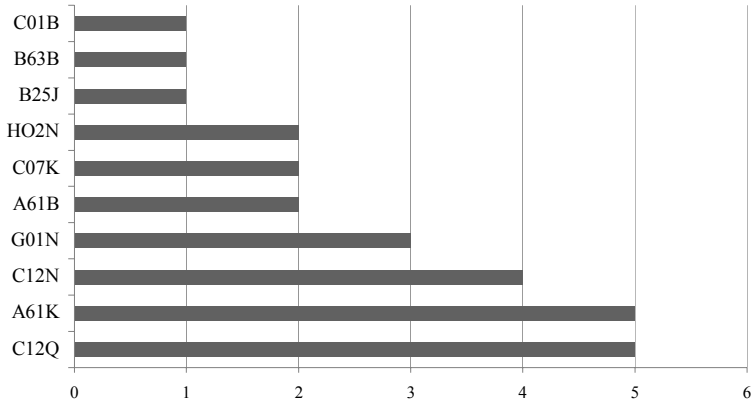

Fig. 11. PCT applications of the University of Tartu classified by International Patent Classification (IPC).

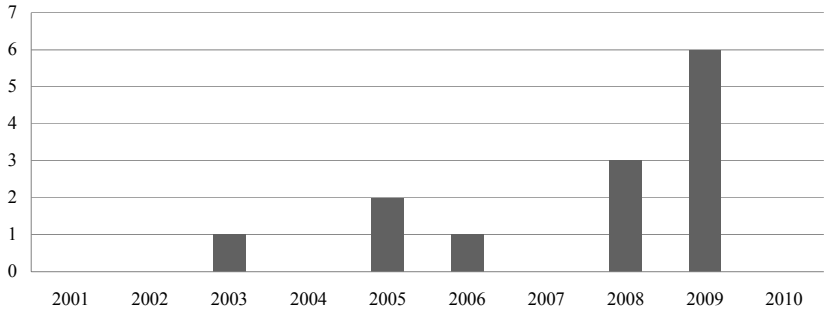

Fig. 12. EP applications of the Tallinn University of Technology.

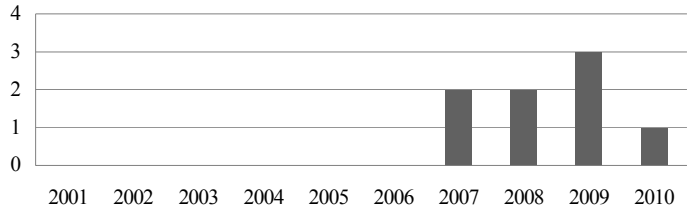

Fig. 13. EP applications of the University of Tartu.

made by the employees of the universities outside the university are created in the framework of international cooperation or in start-ups.

Despite little experience in patenting, the other essential problems, preventing the universities of Estonia from patenting, are the financial ones. The average cost of an European patent is about 5100 euros [18]. Fee for the validation and annual fees for continued validity are added. Possible expenditures on court disputes in case of infringement of the patent or in case of making an opposition should be taken into account [19]. Despite that, the high indicators planned by the R&D strategy of Tallinn University of Technology for the years 2005–2015 [20] exceed significantly the actual achievements. Besides evident overestimation of the possibilities, one of the reasons for the low number of patenting of the universities of Estonia is the lack of patenting strategy, which is mandatory at the universities of UK and USA.

6. NEW DEVELOPMENTS IN PROTECTION OF INVENTIONS IN ESTONIA

EU Commission recommendation on the management of intellectual property in knowledge transfer activities and code of practice for universities and other public research organisations exist. According to point 4 of this recommendation, universities and other public research organizations are requested to be responsible for broad dissemination of knowledge, created with public funds, by taking steps to encourage open access to research results, while enabling, where appropriate, the related intellectual property to be protected [21]. In case of Estonia it should be taken into account that nowadays Tallinn University of Technology and the University of Tartu are the sole multidisciplinary scientific centres and therefore they are obliged to deal not only with the key technological high-tech areas but also with other areas required by the economy of Estonia in order to ensure sustainable socio-economic development.

In case of start-up and spin-off enterprises, dealing with product development, it is inevidently required that innovative products are protected either by patents or utility models. For the time being, taking into account too high patent fees, it is recommended to file a utility model application with the Estonian Patent Office, especially taking into account the fact that since 1 January 2012 the Utility

Models Act [22] has been amended. Making a state of art search during the examination of the utility model at the Patent Office is new in principle. The report of the state of art search is forwarded to the applicant, who may on the basis of the report make amendments in the application before the registration of the utility model to ensure better protection of the utility model. The second amendment concerns the licence of right. The licence of right is a nonexclusive license and everybody may get it. The licence of right is granted mainly in case the owner of the invention does not want or cannot use her/his invention herself/himself mainly due to the lack of financial means. The licence of right is particularly appropriate for the universities to commercialize technical solutions, accompanying basic research and applied research, which would otherwise not be used on a broader scale. Start-ups also can use the licence of right successfully.

7. CONCLUSIONS

In knowledge-based economy, innovation is predominantly based on the legal protection system of intellectual property. Innovation is successful production, research and use of new products (product innovations) in social as well as economic spheres. Globalization of the world economy led to the need for protection of your products from the competitors. Patents as indicators of technological innovation enable *inter alia* to find out the directions of development, the leading firms and institutions of scientific research in a particular field. In Estonia, the key technologies are the information and telecommunication technology, biotechnology and materials technology, research of which is concentrated mainly at the Tallinn University of Technology and the University of Tartu. Arrangement of production in these fields (areas) requires large investments. Therefore international cooperation has to be preferred in the field of high technology. The analysis shows that the number of applications, filed with the Estonian Patent Office, and the number of issued patents in the years 2005–2011 are low. The ratio of the enforced patents belonging to the fields of key technologies is low, which means little interest in investing in these fields. The number of patents issued to Tallinn University of Technology and the University of Tartu is also low, because publication of scientific achievements is preferred to patenting and patenting strategy does not exist. Amendments to the Utility Models Act, enforced on 1 January 2012, encourages to use the new kind of licence, the licence of right, enabling the universities to commercialize their technical solutions.

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Innovatsioon, tootearendus ja patendid ülikoolides

Raul Kartus ja Ants Kukrus

Teadmistepõhises majanduses baseerub innovatsioon oluliselt intellektuaalomandi õiguskaitse süsteemil. Innovatsioon on edukas uudistoodete tootmine, uurimine ja kasutuselevõtt sotsiaal- ning majandussfääris. Maailma majanduse globaliseerumine ja infotehnoloogia tormiline areng on esitanud uued väljakutsed tootearendusele, kus uuteks väljunditeks on teadmustooted ehk infokaubad. Patendid kui tehnoloogilise innovatsiooni indikaatorid võimaldavad muuhulgas välja selgitada teaduse ja tehnika arengusuunad ning vastava valdkonna juhtivad firmad ja uurimisasutused.

Eestis on võtmetehnoloogiateks info- ja telekommunikatsioonitehnoloogia, biotehnoloogia ning materjaliteadus, mille uurimine on koondunud peamiselt Tallinna Tehnikaülikooli ja Tartu Ülikooli. Nimetatud valdkondade alusel tootmise organiseerimine nõuab suuri investeeringuid, mistõttu tuleb kõrgtehnoloogia valdkonnas eelistada rahvusvahelist koostööd.

Analüüs näitab, et aastatel 2005–2011 Euroopa Patendiametile (EPA) esitatud taotluste ja väljaantud patentide arv on väike. Võtmetehnoloogia valdkondadesse kuuluvate patentide jõustamise suhtarv on väike, mis muuhulgas näitab vähest huvi nendesse valdkondadesse investeerimise vastu. Väike on ka TTÜ-le ja TÜ-le välja antud patentide arv, kuna patentimisele eelistatakse teadussaavutuste publitseerimist ja puudub patentimisstrateegia.

1. jaanuarist 2012 jõustunud kasuliku mudeli seaduse täiendused näevad ette Patendiametis tehnikataseme otsingu tegemist ja uue litsentsi liigi, avaliku lihtlitsentsi kasutuselevõttu, mis võimaldab ülikoolidel oma tehnilisi lahendusi kommertsialiseerida.