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Getting out of the Ivory Tower – New Perspectives on the Entrepreneurial University

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Getting out of the Ivory Tower – New Perspectives on the Entrepreneurial University

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Abstract:

Based on theoretical considerations about the “third mission” of universities and the discussion of the nature of different university-industry relations, we conclude that the entrepreneurial university is a manifold institution with direct ways to transfer technology from academia to industry as well as indirect connections to industry via entrepreneurship education and training. While existing literature usually deals with one or another linking mechanism separately, our central hypothesis is that direct and indirect mechanisms should be interrelated and mutually complementary. We emphasize the importance of a more holistic view and empirically investigate the scope and interrelatedness of entrepreneurship education and direct technology transfer mechanisms at German universities. We find a variety of activities in both fields and evidence for an identification of HEI with the mission of knowledge commercialisation. Furthermore, it shows that the HEIs' technology transfer facilities and the entrepreneurship education providers co-operate in support of the creation of innovative start-ups.

JEL-Classification: L26, M13, O34

Keywords: Entrepreneurial university, entrepreneurship education, technology transfer

Introduction

Entrepreneurial activity is recognized to have a stimulating effect on economic development. New firm formation and in particular the creation of academic spin-offs is expected to contribute to structural change, economic development, job gains, and the innovativeness of firms, regions, and nations (Audretsch et al., 2006; Reynolds et al., 2006; Fritsch and Mueller, 2004; van Stel and Storey, 2004). While patenting, licensing, and research joint ventures have traditionally been the most popular mechanism for the commercialization of university-based intellectual property, today the support of innovative academic spin-offs is also an important mechanism for the commercialisation of new knowledge and ideas (Siegel et al. 2003; 2007). It is shown that there has been a tremendous increase in the creation of spin-offs from universities in European countries (Wright et al., 2004; Mustar et al., 2006).

Today, universities increasingly operate within an open innovation system, interacting with firms and governmental institutions instead of being a closed research institution (Chesbrough, 2003; Etzkowitz, 2004). In the United States, one milestone to this development was the Bayh-Dole-Act. It provides incentives for universities to patent scientific results which afterwards can be transferred and commercialised in business enterprises. Today, most European countries have also enacted legislation that is quite similar to Bayh-Dole. The result of changes in legislation and institutional pressure from policy makers caused by the "innovation paradox"¹ has led to the establishment of technology transfer offices in order to facilitate technological diffusion through the licensing of a university-based technology.

Also, policy makers support the encouragement of universities to become more entrepreneurial and – more generally spoken – to foster entrepreneurial mindsets in the economy and society. The growing recognition of the enlarged mission of the university has also led to further facilities and institutions, such as incubators, sciences parks as well as entrepreneurship education and training which call for the responsibility of the universities to address the need for entrepreneurial competence.

In this paper, we discuss the nature of business-academia links and emphasize the importance of a holistic view and empirically investigate the scope and interrelatedness of technology transfer mechanisms and entrepreneurship education and training at German higher education institutions (HEI). The commercialization of academic research and development (R&D) through cooperation with business enterprises and the set up of innovative new ventures are regarded as direct ways of technology transfer into economic

value added. On the other hand, a rather indirect way of knowledge commercialisation is looked at, namely entrepreneurship education and training of students and university staff.

The central hypothesis of the paper is that direct and indirect mechanisms, i.e. entrepreneurship education and technology transfer activities, should be interrelated and mutually complementary. Also, universities engaged in technology transfer and entrepreneurial activity should commit themselves at their universities' profile or mission statement.

We empirically analyse universities' modes to become entrepreneurial universities through these direct and indirect ways of linking academia to business (and vice versa). It complements recent studies on academic entrepreneurship by taking a broader perspective, namely a combined view on entrepreneurship education and training as well as technology transfer activities represented by technology transfer offices, incubators and science parks. We use a unique dataset comprising 49 higher education institutions in Germany to scrutinize the scope and interrelatedness of entrepreneurial education and technology transfer activities.

The remainder of this article is organized as follows. In the next section, we discuss the nature of an entrepreneurial university with its different ways to access market in direct and indirect ways. In the concluding sections, we show empirical evidence from German higher education institutions concerning technology transfer and entrepreneurship education and training. We conclude with a summary and policy implications.

What is an Entrepreneurial University?

There is a structural shift at European Universities from their traditional missions of education and research to a third task, the commercialization of new knowledge for economic development (Etzkowitz et al., 2000). In particular, the new role of an entrepreneurial university is to facilitate entrepreneurial activity through various instruments such as infrastructure, education and training, consulting, and support.

An entrepreneurial university is a contradiction in itself. Universities' key contribution and traditional core is generating new knowledge in their basic disciplines. Today, we have an extension of universities' research and teaching tasks with technology transfer capabilities which was traditionally fulfilled by industry players. *"It is this 'capitalisation of knowledge' that is the heart of a new mission for the university, linking universities more tightly to users of knowledge and establishing the university as an economic actor in its own right"* (Etzkowitz, 2004). The traditional institution with the primary task of the conservation and transmission of

knowledge has changed into an institution where knowledge is not only created but also put into practical utilization.

As shown, investments in knowledge creation such as public research funding are necessary but not sufficient for generating innovation and growth. As regional and national examples show, pure investment in new knowledge is no guarantee for innovations generating growth, jobs and international competitiveness. All mechanisms of university technology transfer help fostering the commercialisation of knowledge. The development of university technology transfer as a professional field also offers new career perspectives to university employees but also for students (Siegel et al., 2007; Mosey et al., 2006). As a consequence, universities are confronted with a demand to develop business planning and venturing skills. Competencies are needed to start and lead a business. Thus, the education, training and consulting does also play an important role as an indirect mechanism and has strong consequences of the role universities play today.

The development of university technology transfer as a professional field also offers new career perspectives to university employees but also for students (Siegel et al., 2007; Mosey et al., 2006). As a consequence, universities are confronted with a demand to develop business planning and venturing skills. Competencies are needed to start and lead a business. Thus, the education, training and consulting does also play an important role as an indirect mechanism and has strong consequences of the role universities play today.

As a consequence, an entrepreneurial university consists of direct and indirect mechanisms to link academia to business activities. Technology transfer facilities such as technology transfer offices, incubators, and university-based science parks are set up in order to patent, license, and create new firms. Also, an university engaged in technology transfer and entrepreneurship education would commit themselves to the task of knowledge transfer in general if not to entrepreneurial activities in particular at their universities' profile or mission statement. Finally, entrepreneurship education, training and consulting at the university fulfils the task of supporting entrepreneurial competencies.

The Entrepreneurial University as a Fuzzy Subject of Research

The entrepreneurial university is characterized by traditional mechanism for the commercialization of university-based intellectual property such as patenting, licensing and research joint ventures. In recent time, the role of incubators and science parks as well as of entrepreneurship education and training has gained more and more importance.

By reviewing literature on these topics, one must recognize that although research is growing very fast, the field still remains fragmented (for a literature review see Rothaermel et al., 2007). There is no overarching framework that encompasses the different research fields such as the technology diffusion process through intermediaries such as technology transfer offices and incubators and science parks which support new spin-offs. Also, there is no clear link between technology transfer mechanisms on the one hand side and entrepreneurship education, training and consulting on the other hand side. At a entrepreneurial university, teachers and instructors of entrepreneurship should be important intermediaries to link academia to business in the long run. And – even more important – there is a clear need of distinct skills to identify opportunities, plan, start and grow a business. As a result, universities are more and more confronted with a need to establish entrepreneurship training and to assist students and university employees who seek support to start a new business.

In the following section, we discuss theoretical consideration on both, direct and indirect mechanisms of knowledge commercialization, in particular, technology transfer and entrepreneurship education, training and consulting.

Technology Transfer and Intellectual Property Regime

Technology transfer refers to the process where invention or intellectual property from academic research is commercialized through licensing or conveyance to a for-profit organisation. This process starting with the invention may end with technology licenses to existing firms or the start-up of a new company (Friedman and Silberman, 2003; Thursby et al., 2001).

The role of an intermediary concerning new inventions is usually undertaken by the technology transfer office (TTO). The TTO traditionally identifies, evaluates, and selects academic inventions for patent application. It evaluates the commercial value of a new technology discovered or of an idea recognized by university faculty members, students or staff members. The TTO seeks potential cooperation partners who have the capability, interest and resources to take on to the development of the new technology. Nearly all research universities have such technology transfer offices. They are usually named technology transfer office or technology transfer centre, or the like.

After an invention is conveyed to the TTO, it is responsible for checking its patent potential. In case of a successful patenting procedure, the university owns the intellectual property rights and is able to license the patented technology to for-profit organisation outside the university. If there is no existing firm that fits to the invented technology or the inventors' intent is to

realize the new idea on its own, a new venture has to be set up. National and regional policy makers often support new firm formation by providing seed funding and incubation capabilities (Etzkowitz et al., 2005).

In Germany, since 1999 researchers are obliged to announce inventions to their university. In 2002, with the employer invention law, inventions belong to the employer and not to the professor. According to that law, 22 technology transfer institutions (*Patentverwertungsagenturen*) were established which take care of IP management. If there is a commercial use of a license, license income from the technology are shared between the institution and the inventor. There are usually several years from patenting a technology and the realisation of license income. The increasing interest in university technology transfer to the private sector for commercialization can also be seen in a number of empirical studies on university technology transfer and the productivity of technology transfer mechanism (for an overview see Friedman and Silberman, 2003).

Policy makers have launched support schemes, such as programs to facilitate technology oriented start-ups. Public funds and incubation programs aim at addressing the financing and knowledge gap. Spin-offs may profit from business support and low cost facilities and infrastructure. Financing in the early pre-seed phase of the new venture have also been introduced in most European countries by government as in particular at such early stage attracting venture capitalist is difficult (Clarysee et al., 2007; Wright et al., 2006). In Germany, public policy instruments like the EXIST programme with a budget of 50 million Euro were established by the Federal Ministry of Education and Research. The program assists spin-off through seed capital and management support.

Entrepreneurship Education and Training

An indirect way to access markets and to contribute to innovation driven economic development is the education and training of entrepreneurship activity. Entrepreneurship education and training have been widely introduced at European universities as they play a key role in the creation of new ventures. Education and training promote the set up of new ventures by students after graduating from university and supports general employment prospects of graduates by developing entrepreneurial mindsets, also in the sense of intrapreneurship, i.e within existing firms.

Likewise, investments in entrepreneurship education are done in order to foster the establishment of new ventures and the knowledge transfer from university to market. As education and training includes the establishment and implementation of a new firm, it is

obvious that courses and programs are much closer connected to real business activities as to other disciplines. Contents are applied in a more action-oriented mode and often entrepreneurs act as guest speakers in the curricula. This action-oriented mode is also given through the development of business plans for start-ups but also for new products and services for existing SME. The development of business plans allows students to integrate accounting, economics, finance, marketing, and other general business subjects. Thus, entrepreneurship education can be seen as a highly integrative and interdisciplinary discipline, also because it is quite new and outside traditional disciplines. Theoretical approaches are rooted in other domains and mostly transferred to the field of start-ups and SME.

Entrepreneurship courses deal with very different topics. Empirical analyses from curricula in the United States show that the analyzed syllabi encompass more than 100 different topics. Similar approaches are very sparse to find and the content of courses *"varies so much that it was difficult to detect if they even have a common purpose"* (Fiet, 2001). Most of the topics stem from the established literature of other disciplines such as strategic management, organization theory, management, finance and economics, and psychology. The fact that they have their roots in other domains indicates that the syllabi do not emphasize a particular single domain. Accredited theoretical and didactical targets do not exist so far. Nevertheless, very different conceptual approaches and curricula design contribute to further develop entrepreneurship to an accredited discipline.

These aspects have strong impact on course design as they do not emphasize a certain domain and teachers necessarily need to experiment with curricula. More important, an academic curriculum or a single course for entrepreneurship is a dependent variable. Because it is a very action-oriented and applied discipline, it more importantly depends on the combined interaction of the teacher, the students and the environment in which the learning process takes place (Hindle, 2007). The role of the university is also changing with respect to the mode of instruction, i.e. methods and instruments teaching entrepreneurship. Entrepreneurship education requires more than a mere imparting of business knowledge such as financing, controlling or marketing.

Furthermore, target groups of entrepreneurship programs and training are not only reduced to those who intend to start up a business. Hills (2003) observes a high diversity of the target population as motivation and choice decision to participate in a course can also occur due to academic restrictions, as the course is mandatory and a core course in the curriculum. Students could also solely be interested in the topic of entrepreneurship but plan to work as a company employee later.

In Germany, the actual assignment of chairs for entrepreneurship has started in 1998. This year as a starting point marks the subsequent creation of entrepreneurship chairs at universities as well as at universities of applied sciences. At the beginning of 2007, the German Association for Entrepreneurship Research FGF (Förderkreis Gründungs-Forschung e.V.) recorded 54 entrepreneurship professorships at both universities and universities of applied sciences in Germany, and further positions which are vacant or planned.

As mentioned above, existing empirical studies deal with the issue of entrepreneurship education and university based technology transfer activities separately. This is not very surprising in the face of the fact that both fields are rather new for European universities. However, after several years of installation activities, it seems promising to ask whether and in how far the different activities remain sporadic or whether they form part of a holistic concept already. In this paper we are particularly interested in the scope and interrelatedness of entrepreneurship education and technology transfer at German higher education institutions.

Data Collection and Description of the Sample

Given the particularity of the research interest, the empirical part of this paper is based on own data collection. We focus on higher education institutions (HEI) that have at least one actively operating professor of entrepreneurship and collect detailed information on both entrepreneurship education and technology transfer activities. The relevant HEI in the sense of this study, which in Germany comprise universities and universities of applied sciences, have been identified from the list of entrepreneurship professors provided by the FGF.²

In Germany, the bulk of entrepreneurship education is provided through specially assigned entrepreneurship chairs. Additional but few courses are offered by other chairs. Our selection criterion, i.e. at least one actively operating entrepreneurship chair (professor), makes sure that we cover HEI regularly offering entrepreneurship education.³ At the time we run the survey (spring 2007) we identified 49 HEI with at least one occupied entrepreneurship chair (professor for entrepreneurship). In addition to the basic information available from the FGF, we focused the data collection on the types and content of entrepreneurship courses and the technology transfer characteristics, such as the availability of TTO, incubator, and science park. General information on the HEI, the entrepreneurship chairs and courses has mostly been taken from the internet pages. Missing or incomplete information has been filled in through written requests. Some information, such as on the co-operation between professors and technology transfer offices, has been collected by telephone interviews exclusively. As a

result, we created a comprehensive data base on entrepreneurship education and technology transfer facilities with unique and nearly full information for all 49 HEI.

In the sample, universities and universities of applied sciences are nearly equally represented, i.e. 22 universities (including four technical universities) and 25 universities of applied sciences. They differ with respect to their educational assignment but also with respect to size and age. In Germany, universities of applied sciences provide undergraduate education mainly in engineering and in management. They are more practically oriented, not at least because of the transition from the universities' diploma to bachelor degrees which has been implemented by most universities of applied sciences in Germany. Universities (including technical universities) engage in more theoretical work and only universities have the right to award a doctor degree.

The size of the HEI in our sample, expressed as total number of students enrolled in the winter term 2006-07, varies between 300 and 47,500. The small HEI are mostly private schools with few but specialized programs, often in the field of business, economics, or computer science. Around 21 HEI have more than 10,000 students enrolled; they present predominantly universities; only two universities of applied sciences have more than 10,000 students.

Scope of Entrepreneurship Education

Together, the 49 HEI in the survey account for 54 actively operating entrepreneurship professors. In the following, the term entrepreneurship professor is used for both, the entrepreneurship chair and the entrepreneurship professor (mainly active at universities of applied sciences).⁴

Nearly half of the entrepreneurship professors (25) are "*Stiftungsprofessuren*", which means that a newly established professorship is initially financed externally (not by the HEI), for example through a company, a foundation, or any other private or public organizations. Commonly, the agreement between the HEI and the founder places the full financing responsibility for the chair on the part of the HEI after a period of five years. In our sample, for example three chairs are financed by the KfW banking group, one is financed by the software company SAP etc.

From previous studies on entrepreneurship education in Germany and German-speaking countries (Klandt, 2004; Achleitner et al., 2007; Koch, 2003; Wagner et al., 2006) we know that the courses are mostly offered through the faculty of economics where most of the entrepreneurship professors belong to. Our study confirms these findings. The vast majority

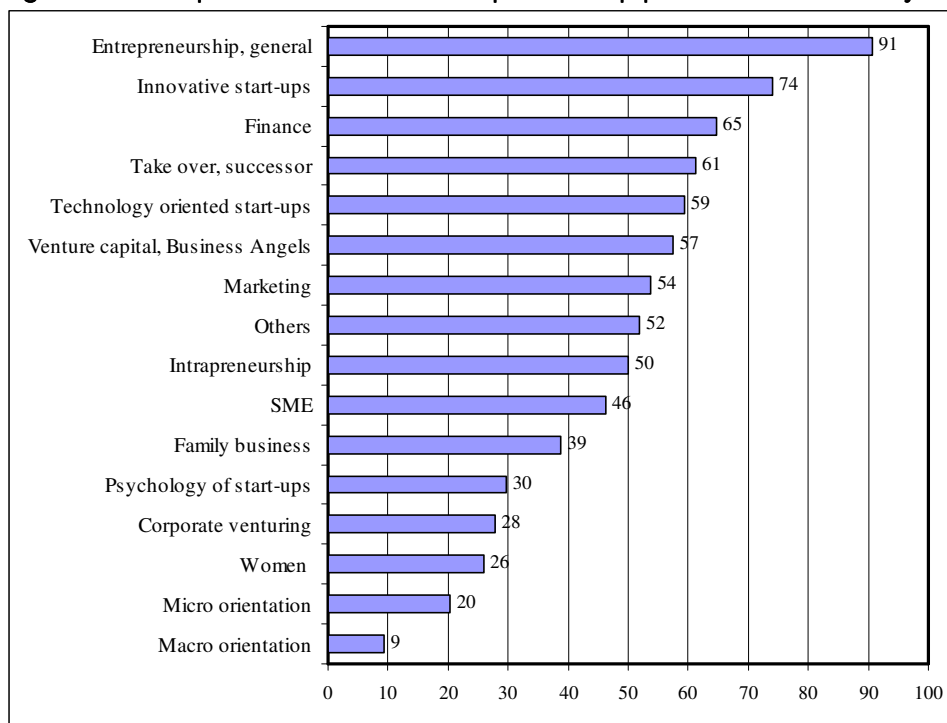
of professors (43 out of 54) belong to an economics faculty (economics or business administration). The rest belongs to social sciences (2), computer science (2), engineering (3), education sciences (1), natural science (1), and others (2).⁵

Figure 1 Faculty affiliation of entrepreneurship chairs

	Frequency	Percentage
Economics	43	79,6 %
Engineering sciences	3	5,6 %
Computer sciences	2	3,7 %
Social sciences	2	3,7 %
Pedagogic / Education	1	1,9 %
Natural sciences	1	1,9 %
Others	2	3,7 %
Total	54	100,0%

Source: Own data collection.

As shown in Figure 2, the entrepreneurship professors focus on different specializations. Not very surprising, nearly all professors deal with “entrepreneurship in general” (over 90%) in their courses and programs, followed by “innovative start-ups” as an important field, too. Also, education frequently focuses on the field of “finance” and “take over / business successor”. In Germany, today many small and medium sized firms face increasing difficulties in finding adequate successors for the firm – possibly a reason for the relatively high priority. Interestingly, the topic of “intrapreneurship” has been addressed by every second professor as a field they focus on.

Figure 2 Specialization of the entrepreneurship professors in Germany

Source of data: FGF, own calculations (multiple answers possible).

As regards the target group of entrepreneurship education one can distinguish “future entrepreneurs” and “future entrepreneurship researchers”. The vast majority of entrepreneurship professors state that they intend to educate both, future entrepreneurs as well as future entrepreneurship researchers. This underlines the broad understanding of entrepreneurship education which is not simply aimed at students interested in becoming self-employed some time. Overall, the HEI included in the survey offer 250 entrepreneurship courses throughout an academic year using different types of instruction. The two most prominent types are lectures and seminars, which together make up for around 75% of all courses.

Figure 3 Types of Instruction

	Frequency	Percentage
Lectures	97	38,8 %
Seminars	91	36,4 %
Exercise courses	19	7,6 %
Combinations thereof	21	8,4 %
Others	10	4,0 %
Not announced	12	4,8 %
Total	250	100,0 %

Source: Own data collection

The courses have different target groups with respect to the student's stage of academic career (advancement). What is clearly shown by the data is that the entrepreneurship courses are predominantly offered for advanced students. About 46% of all courses have explicitly been announced for the "*Hauptstudium*", which basically means graduate level (master).

In order to get an insight into the content of the courses, the titles and descriptions of all 250 courses have been analysed and categories been build accordingly. It shows that most courses fall into the group "Introduction to Entrepreneurship/Fundamentals of Entrepreneurship" (38%). This corresponds to the high priority of "entrepreneurship, general" expressed as a field of interest by the entrepreneurship professors (see Figure 2). The second largest group consists of courses dealing with "business plan development" (26.4%), including the topic of business simulation. Some courses offer deeper insights into particular aspects related to entrepreneurship, such as "entrepreneurial finance" (9.6%), "legal aspects" (4.4%), "marketing" (2%). Another group of courses deals with "soft skills" explicitly related to entrepreneurial activities (8.4%). In the category "other topics" fall courses on e.g. intrapreneurship, entrepreneurial human resource management, growth management and internationalization of entrepreneurial activities.

Figure 4 Content of entrepreneurship courses

	Frequency	Percentage
Principles of Entrepreneurship (Introductory courses)	95	38,0 %
Business plan development	66	26,4 %
Entrepreneurial Finance	24	9,6 %
Soft skills	21	8,4 %
Legal aspects	11	4,4 %
Commercialisation	5	2,0 %
Marketing	5	2,0 %
Other topics	23	9,2 %
Total	250	9,2 %

Source: Own data collection

From the analysis of the topics of courses there is not much evidence that entire courses deal with the subject of entrepreneurship and technology transfer. We found only five courses dealing explicitly with the topic of knowledge commercialization or technology transfer. The course titles are for example "IPR and patenting", "Spin-offs from public research", "HEI as an incubator for entrepreneurial activity". However, one can assume that aspects like

patenting, joint science-industry projects etc. are also part of other courses, especially those courses that deal with legal aspects.

In the following, we will go further by addressing the scope of technology transfer activities and their linkages to entrepreneurship education.

Scope of Technology Transfer Activities

In order to scrutinize whether and to what degree the HEI take part in overall technology transfer processes, we collected data on the aspects on technology transfer such as the self-image of the HEI, the availability of technology transfer facilities such as technology transfer offices, incubators, science parks, entrepreneurship counselling, and patenting information services.

Technology Transfer and Entrepreneurial Activity in the HEIs' Mission Statements

In a first step, we analysed the publicly available **mission statements** of all HEI in our sample whether (a) commercialization of knowledge in general and (b) entrepreneurship activities in particular are mentioned as one of the HEI's mission in the text. One would expect that schools engaged in entrepreneurship education by employing a professor for entrepreneurship would commit themselves at least to the task of knowledge transfer in general if not to entrepreneurial activities in particular. We took the mission statements from the HEIs' internet pages where they were easily accessible. Partially they named differently, such as profile, mission statement, university concept etc. They are usually rather brief and comprehensive descriptions of the HEIs' self-image and core competencies.

As a result of our analysis, it shows that the vast majority, that means 40 out of the 49 HEI, mention commercialization of knowledge in the sense of technology transfer as an important task in their mission statement. Given the fact that entrepreneurial activities are one form of technology transfer and assuming that HEI have this in mind when putting together a profile, we can conclude that there is a strong commitment and awareness of the importance of knowledge commercialization activities at the level of the HEI as a whole. In addition, 15 out of 49 HEI, that means nearly every third HEI, explicitly mentioned entrepreneurship activities as an important task of the HEI. Overall, the document analysis of mission statements can be interpreted as a substantial commitment of the HEI to technology transfer activities including entrepreneurial activities.

Infrastructure and Services of the HEI in Support of Knowledge Commercialization

In a further step we analyzed the availability of infrastructure and services for knowledge commercialization at the HEI in our sample in order to see whether and to what degree the commitment to knowledge commercialization is reflected in practical support through infrastructure facilities or information services.

As regards infrastructure facilities, we distinguish “technology transfer offices”, “incubators”, and “science parks” in our database. With respect to services, usually offered through the above mentioned facilities, we identified “entrepreneurship counselling” (*Gründungsberatung*) and “patenting information service”.⁶

Figure 5 Infrastructure and services of the HEI in support of knowledge commercialization and mission statement information

Practical support of knowledge commercialisation	Yes	No	Not announced
<i>Infrastructure:</i>			
technology transfer offices	42	6	1
incubators	19	29	1
science parks	9	39	1
<i>Services:</i>			
entrepreneurship counselling	41	8	-
patenting information service	21	27	1
<i>Mission statements:</i>			
Technology transfer	40	9	-
Entrepreneurship activity	15	34	-

Source: Own data collection

The vast majority of HEI in our survey have their own technology transfer office. We define them as an information centre or helpdesk providing services for researchers and students around commercialization activities in general, such as patenting, innovative start-ups, spin-offs, industry cooperation etc. They are usually named technology transfer office or technology transfer centre, sometimes other terms exist. We identified 42 HEI with a technology transfer office in the above described sense (86%). The six HEI without a technology transfer office are mostly small HEI, especially small private schools where the absence of such a facility is mainly a matter of resources.

Less HEI in our sample have incubator facilities. The general idea of an incubator is to offer promising entrepreneurs particular support in an early stage of their start-up activity. The support usually includes the provision of physical space (rooms, labs), management coaching, administrative services, technical support, business networking, advice on intellectual property rights, and sources of financing. Incubators can differ as regards the scope of support, as regards the target group (people with advanced business plans or pre-entrepreneurial ideas), and as regards location (integrated in the HEI buildings or in an affiliated organisation etc.) (Stahlecker and Lo, 2004). In our survey we did not differentiate between such differences of incubators. We identified any facility as an incubator that corresponds to the general definition outlined above. Finally, we found 19 HEI in our sample offering any incubator facilities.

We consider science parks as a location where firms and other organizations focus on product development and innovation in high-tech branches (different from industrial parks where firms focus on manufacturing). In Germany, science parks are usually associated with or operated by public research or higher education institutions, and can also be called technology or research park. In our sample, we found nine HEI that are affiliated with or run their own science park, typically larger universities with a focus on engineering or natural sciences.

With respect to the provision of services, the data show that TTO are usually in charge of providing entrepreneurial counselling (*Gründungsberatung*) for the members of the HEI, also and especially in the early stage of business ideas. The absence of a technology transfer office does, however, not automatically mean that there is no counselling service on entrepreneurial activities etc. If we look at the provision of entrepreneurial counselling, we see that some of the HEI without a TTO offer entrepreneurial counselling anyway. Often it then takes place through the professor for entrepreneurship in person. In total, 41 HEI do explicitly offer entrepreneurship counselling for researchers, students and other members of the HEI.

21 HEI engage in patenting information services. Information services around patenting have strongly increased in Germany after the change of the so-called “professor privilege” in 2002. Since 2002, university scientists are no more exclusive owner of their inventions. They now have to announce every invention at the university, which in turn checks within a certain time period whether the university intends to file a patent application. After the abolishment of the “professor privilege”, patenting became a much stronger topic at German HEI.

In some cases the tasks between the different types of technology transfer activities as described above may overlap. The division of labour between the facilities may differ among the HEI. For example, entrepreneurial counselling is provided through a technology transfer office at one HEI while somewhere else it is provided through an office at the incubator.

Overall, nearly each HEI included in our sample has one or another infrastructure facility and information service in support of technology transfer. Best equipped are the technical universities where technology transfer is nearly inherent. Most interestingly, the four technical universities in our survey exhibit the full program, which means a technology transfer office, incubator and science park facilities as well as entrepreneurship and patenting counselling. But one has to keep in mind that they are large universities specialized in engineering, natural sciences and / or information science.

Co-operation between Entrepreneurship Professors and Technology Transfer Activities

Based on our assumption that a link between entrepreneurship education provided by the professors and the HEIs' overall technology transfer support is a necessity for an entrepreneurial university, a link in the sense of continuous co-operation between the two sides would be highly desirable.

First, we identified the place mainly responsible for counselling on entrepreneurship activities at each HEI. It turned out that mostly the technology transfer offices are in charge, while sometimes a service point at the incubator or science park is responsible. Through telephone interviews, we asked whether co-operation with the entrepreneurship professor regularly exists. From those cases where data could be collected (missing values for 14 cases) only two HEI indicated a lack of co-operation. In 17 cases the entrepreneurship professor and the relevant infrastructure facility actively co-operate. Furthermore, in 16 cases the entrepreneurship professor itself is the provider of entrepreneurship counselling at the relevant HEI. An engagement of the professors in the HEIs' overall technology transfer activities, not only with respect to entrepreneurship counselling, seems to be nothing unusual. For example, there are cases where the professor holds a position in local associations in support of entrepreneurial activities, business development etc.

Figure 6 Cooperation between entrepreneurship counselling points and entrepreneurship education providers (professors)

	Frequency	Percentage
Cooperation exists	17	34,7 %
Chair itself provides counselling	16	32,7 %
Lack of cooperation	2	4,1 %
Not announced	14	28,6 %
Total	49	100,00 %

Source: Own data collection

Future synergy potentials are particularly given in the cooperation of education contents. Entrepreneurship education contents and methods need to be customized as only few courses are entirely devoted to the subject of technology transfer or knowledge commercialization. Topics like intellectual property rights, patent application, licensing etc. should play a more important role in the entrepreneurship curricula. It would contribute to a better link and co-operation with technology transfer activities. Vice versa, technology transfer consultants could also benefit from a complementary supply in business planning and venturing.

The intention to also collect data on the number of new ventures resulting from the entrepreneurship education and training as well as from the technology transfer activities of the HEI has unfortunately proved to be impossible. Most offices and professors state that there is no documentation of start-ups, also because the final outcome of business ideas discussed in the technology transfer offices or somewhere else at the HEI remains unknown. In addition, a business idea born at the HEI becomes real only years after a student's graduation or a researcher's leaving.

Summary and Conclusion

The entrepreneurial university has no strong tradition in Europe. But the recognition of entrepreneurial activities as an important factor for economic development has increased over time and through this the acceptance of the third mission of universities. As a result, there have been numerous activities to make European universities more entrepreneurial. A look at German higher education institutions shows that much has been reached already. Technology transfer offices, incubators, entrepreneurship professors etc. are not rare institutions anymore. In spring 2007, there are 49 higher education institutions with together 54 actively operating professors for entrepreneurship in Germany. The content analyses of entrepreneurship courses documents a large variety of issues dealt with, whereby fundamentals of entrepreneurship and business plan development play the most important role. Only few courses are entirely devoted to the subject of technology transfer or knowledge commercialization. But topics like intellectual property rights, patent application, licensing etc. often form part of other courses.

As regards the complementarity between entrepreneurship education and technology transfer, one can tell that the vast majority of higher education institutions in our sample has a technology transfer office in charge of counselling and support services in different fields, such as industry cooperation, patenting, start-ups etc.. Depending on the size and

specialization of the higher education institutions we also found other infrastructure facilities in charge of technology transfer including start-up support. Beyond this, we found evidence that there is a vital interaction between TTO and entrepreneurship professors. Very often, the entrepreneurship professor holds also a position at the university's infrastructure facilities for knowledge commercialization, especially in the field of entrepreneurship counselling (*Gründungsberatung*). These interconnections built through persons in key positions are particularly valuable since start-up ideas generated by students in class can be further developed and assessed through the facilities of *Gründungsberatung* and technology transfer.

In general, one can conclude that entrepreneurship education has gained much importance and acknowledgement over the last ten years at German HEI. Many of the HEI included in the survey explicitly mention "entrepreneurship" (*Existenzgründung*) in their mission statement. But in order to fulfil the legally subscribed mission of German universities to become more entrepreneurial, there seems to be a need to increase the number of entrepreneurship professors as well as a strengthening of the technology transfer facilities. Thereby, endowed professorships (*Stiftungsprofessuren*) will probably remain an important institution.

Also, as said before, a measurable outcome of entrepreneurship education is so far not possible to measure. Therefore, quantitative analyses of the effects will only be possible in the long run, but should be regarded as a major challenge for future research in the field of entrepreneurship education.

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¹ European policy-makers believe in the so-called “innovation paradox” which emphasizes that Europe leads in producing publications, but lacks commercial skills. (European Report on S&T Indicators, 1994; EC Green Paper on Innovation, 1995).

² We thank the FGF for the provision of information and friendly support. The list includes the name and address of the HEI, the name and specialisation of the professors and some other general information. It lists HEI with occupied, vacant, and planned chairs. Our empirical study is restricted to HEI which have at least one specially assigned entrepreneurship professor. For HEI with vacant or planned chairs the information relevant for this study would hardly be detectable.

³ The FGF provides a list of “entrepreneurship affiliated” chairs, but this is an exemplary and selective list. Achleitner et al. (2007) identify 45 entrepreneurship affiliated chairs in Germany. However, it remains difficult to generate a reliable and full list of HEI providing entrepreneurial education in Germany.

⁴ In the German system, not all professors automatically hold a chair (*Lehrstuhl*) in the sense that they have a (tenured) position with additional financial resources for personnel and research. This applies especially for universities of applied sciences where professors usually do not have assistants and further resources for research. Two entrepreneurship professors in our sample are honorary professors. Honorary professor is a title awarded to people that have a particular connection to a HEI for several years, give at least one lecture each semester etc. while regularly working somewhere else.

⁵ In the case of “Others” we could not identify the faculty because no typical differentiation between faculties existed at that HEI.

⁶ These categories do not follow any particular (international) standard and they are strongly connected to the German technology transfer system. To identify these categories we started with an explorative study of what is offered at the HEI at all and then determined adequate categories accordingly.