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# First joint doctoral workshop

**organized by the University of Strasbourg/BETA and KIT on**

# Innovation, knowledge-based economies, and regional development

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*Innovation process of knowledge based technologies – The case of PEM fuel cell*
*Abstract of phd*

Bjoern Bertram

Knowledge is the result of different activities in research and development, becomes more and more a relevant factor of production and builds the base for the development of knowledge intensive technologies.

This dissertation aims at analyzing the innovation process of knowledge intensive technologies shortly before the market entry. The PEM fuel cell technologie, whose market entry was postponed several times and has not realized so far, is chosen as an example. The innovation process of this kind of technologie evolves in waves with parallel scientific and technological activities in double-boom cycles. According to the state of the art this typical process is mainly driven by the characteristics of the technology. This work examines the further drives of the innovation process, tries to explain the divergent evolution of the PEM fuel cell technologie and gives answer to the central questions of the knowledge genesis.

With the help of the innovations system approach, the research design of this thesis allows an organizational and institutional analysis of the knowledge intensive innovation process. The identification of the involved knowledge producing actors in science and technologie has been done with detailed publication- and patent-analysis. The method of social network analysis shows the cooperation between the actors both on national and international level. The institutional structure and influencing factors determine the innovation process and the actors itself. These innovation drives are identified and interpreted with the results of a survey among relevant actors.

This thesis shows that the development of knowledge intensive technologies is per se not only motivated by technological characteristics but influenced by a various set of drives.

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# Who is patenting in academia, for which reasons, and how it impacts on academics: lessons from a Japanese university

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Paper submitted on February 4th 2011

**Abstract**

In this paper, we study the perception and influence that academic patenting have on faculty members belonging to a research intensive Japanese university. We intend to contribute to the literature on both the use of patenting in academia and the influence it has on a researcher's agenda setting. We present the results of a survey sent to academic patentees, and focus our attention on three main questions: what is the patentees' motivation in engaging into patenting, what are the consequences of such an undertaking, and how does it influence their research agenda. To answer the last question, we ran an econometric analysis. Our main findings are the following. First, academic patenting does not seem to impede on the traditional missions of the faculty we surveyed. However, we observe slight differences between technological fields and types of researchers: effects tend to be more negative on the norms of open science in the life science fields, and scientists who qualified themselves as conducting mainly basic research are more likely to be negative about the effects of university patenting on academic freedom. Moreover, we found that the attitude towards patenting differs according to the the age of the researchers, the younger cohort being more active than their peers. Finally, we found that the main motivations and consequences to patent lie in the willingness to foster industrial collaboration and reputation of the scientists in the industrial sphere, rather than to pursue direct financial benefits.

**Keywords:** Academic patenting, open science, technology transfer

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# HOW AND WHY PILOTING A MAINLY TECHNICAL OBJECT? THE CASE STUDY OT THE ENGINEERING CHANGES MANAGEMENT IN THE ARIANE 5 PRODUCTION PROGRAM


## ABSTRACT

Since a few decades, studies regarding complex and high-risky productions have been developed through different theoretical perspectives (Perrow, 1999a; Weick, Sutcliffe, & Obstfeld, 1999). As the notion of "Complex Products and Systems" (COPS) appears, the "emerging properties" of COPS in the production phase have been pointed out (Hobday, 2000) and can be assimilated to the "engineering changes" (Diprima, 1982; Reidelbach, 1991).This paper studies the management of the engineering in the case study of the Ariane 5 production Program, thanks to the longitudinal action-research made inside the prime contractor of the European launcher. The engineering changes' implementation raises of course technical issues, as their characteristics concern predominantly technical difficulties. However, we propose here to analyze how and why an organization has to manage financially engineering changes. We will then discuss this analysis through the concepts of the Actor-Network Theory and its implications in terms of organizational practices.



## KEYWORDS

Complex Products and Systems, Engineering Changes, Actor-Network Theory, Space.

# Innovation Measurement in the Services Industry

## A Trademark Approach

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The importance of services for the economy has constantly risen over the last several decades. Today, the services sector accounts for a large part of value added and total employment in nearly all developed countries. Foresight studies mention that the importance of services will even continue to increase in the future. This is especially true for the so-called knowledge intensive services (KIS) and a smaller segment, the knowledge intensive business services (KIBS), which in some cases are even more related to information and knowledge, and are highly innovative.

But, innovation measurement in the knowledge intensive services industry is very complex due to the lack of adequate innovation indicators. Because innovation in services is different than innovation in manufacturing, there is a limited applicability of traditional innovation indicators such as expenditures for research and development (R&D) activities or patent counts.

A rather new empirical approach involves the analysis of trademarks for innovation measurement. There is a simple, but significant, advantage of trademarks for their use as an innovation indicator: All service innovations can be protected with trademarks. But not every new trademark is necessarily connected to a new, innovative product. However, applications for products that have no substantive difference from former ones represent only a minority in the overall demand for new trademarks.

Further, it can be assumed that trademarks are registered just shortly before the launch of the service in the market. It can also be assumed that products and services related to brands will indeed be launched, and that there will not be any significant selection process which, for instance occurs during patent registration and granting. Therefore, this thesis aims to explore the use and relevance of trademarks for service firms in depth. To do this, six research hypotheses are developed based on related literature.

Data from the German part of the Community Innovation Survey is used to explore whether there is a connection between trademark registration and innovation success.

Also, it is investigated which types of innovation (product, process, organisation, marketing) can be measured with trademarks as an indicator.

In a second step, an own survey in the field of knowledge intensive business services is conducted, in order to deepen the understanding of the connections between innovation and trademark protection. The sample includes Germany-based KIBS listed in the Amadeus company database. The conception of the survey and the item definitions correspond to recommendations given in the Oslo Manual concerning the measurement and interpretation of innovation survey data. A pretest with ten experts from appropriate firms is performed to optimise the questionnaire.

The main survey is carried out as an online survey with a sample of 6,000 KIBS. The return rate after follow-up is 278 KIBS (corresponding to a response rate of 4.63%). A non-response analysis is conducted in order to assess whether there are differences between responding and non-responding firms. There are no statistically significant differences between the comparison values of the two groups, so one can conclude that the survey is not distorted.

The results of two independent empirical studies show that a trademark can be used as an innovation indicator, at least for knowledge intensive (business) services, and mainly for product innovations. The results also show which firm-inside and environmental features of knowledge intensive business services explain the use of trademarks as an intellectual property protection measure. Also, it is shown that the main reason of KIBS to register trademarks seems to be to protect their new introduced goods or service products against imitation.

After the connection between trademark registration and innovation is established, the final goal is the development of a multi-indicator approach, taking into account a combination of trademarks with already existing innovation indicators. By doing so, researchers as well as policy makers and management can learn about the possibilities and limitations of trademarks as a new innovation indicator in order to better describe, understand, and benchmark innovation activities in the business services industry.

# Trademarks and patents: are they complementary or substitute protections of innovation?

## Extended Abstract

This paper proposes a theoretical approach to the use of trademarks as a mean to protect the benefits of product innovation, and their possible complementarity relationship with patents.

Several papers in the recent literature have raised the idea of a connection between trademark use and innovative activity (Schmoch 2003, Mendonça & al 2004, Greenhalgh & Rogers 2007). Indeed, the creation of a new trademark may help to the perception of the innovative product by consumers, and may constitute a basis for advertising it. Moreover, if a product is launched on the market under a certain brand name, consumers are likely to remain loyal to this pioneer brand, which has then good chances to become a reference, or even *the* reference on the market, even after competitors' entry. Thus trademarks can constitute a barrier to entry, which explains why they are sometimes considered as a mean to appropriate the benefits of innovations (Yale survey 1983).

Trademarks can be associated to other means of protection, such as secrecy (*Coca-Cola*), lead-time, or, most interestingly here, patents (*e.g.* in the pharmaceutical industry) (Davis 2006). The fact that trademarks and patents are often used jointly by firms has led several authors to investigate whether those assets are indeed complementary (Graham & Somaya 2006, Amara, Landy & Traoré 2007, Schwiebacher 2010). Those authors adopt an empirical approach, consisting in looking at the firm-level either at the correlation between trademark and patent use or at the impact of their joint or separate use on the firm's performance. The idea generally underlying in those studies is that trademarks are a proxy for marketing or reputational investments, whereas patents are a proxy for technological investments, so that the complementarity between those two intellectual property rights (IPR) actually reflects the complementarity between technological and reputational assets - which constitute a line of research in itself (Teece 1986, Graevenitz & Sandner 2009).

However this kind of approach does not address the mechanisms through which trademarks and patents could be intrinsically interdependent, which is the angle adopted here. The aim of our analysis is to determine how trademarks and patents, as IPRs protecting respectively a certain distinctive sign and a certain technology, could be interdependent. This implies beforehand to model the impact of

protecting a product by a trademark, which to our knowledge has never been the object of a theoretical model in the existing literature.

The general framework of the model is the one of a firm innovating in product in a certain point in time, e.g. following R&D expenses. The firm can then choose to register a product, a trademark, or both or neither of them. The patent function is to give a monopoly power on the product for a limited period. As far as the trademark function is concerned, we stick to the legal definition, which is to prevent other parties from benefiting from the reputation built by the firm by creating confusion on the origin of the product. We assume that the reputation of the firm is built by advertising expenses, which constitute a "reputation-capital". The firm is operating in a Cournot duopoly environment where the inverse demand function is positively impacted by the reputation-capital of the firm. When the pioneer firm chooses not to register a trademark, its reputation-capital cannot be appropriated, so that the competing firm also benefits from the positive impact of its advertising expenses, so that without making any advertising on its side, it will be able to sell the product at a price as high as the pioneer firm, by playing on confusion. This can be interpreted in saying that without a registered trademark, the advertising performed by a firm becomes advertising for the product in general and not for its own brand, so that competitors can benefit from it.

Based on this framework, we compare the intertemporal profit resulting from the various IPR strategies. More specifically, we study the complementarity between trademarks and patents based on the concept of supermodularity (Topkis 1996, Milgrom & Shannon 1994). We focus on the following inequality, where V is the intertemporal profit gained from innovation and the exponents indicate the presence or not of a trademark (TM) or a patent (PAT) :

$$V^{TM,PAT} + V^{0,0} > V^{TM,0} + V^{0,PAT}$$

If this inequality is verified, the two types of IPRs are complementary, and if the reverse inequality is shown, they are substitute.

The results of the model show that the complementarity or substitute relationship between trademarks and patents is not straightforward and varies according to the general context in which firms are operating. In a first step, we show that if firms are able to fully appropriate their advertising expenses as pure brand-advertising, then trademarks and patents are substitute, which suggests that trademarks are profitable for innovating firms, but the benefit gained from innovation is more important in the case where firms are not able to file a patent (e.g. in the service sectors). However, in a second step we show that if advertising expenses are not fully appropriated by the firm, that is if a share of those expenses contributes to the reputation of the product in general (product-advertising), then trademarks and

patents may have complementary effect, as the reputation gained in the monopoly period has an impact a posteriori on the trademark benefits after the patent is expired. More generally, the results of the model tend to show that the complementarity between patents and trademarks, when they are considered in their core function which is to protect various aspects of a firm activity, depends on various context elements, related both to the technological side –such as the length and strength of the patent, the ability of competitors to imitate the innovative technology – and on the reputational side – suchas the level of appropriability of advertising expenses by the firm. The optimal IPR strategy of firms may then vary from one context to another, from one firm to another. This variation should be taken into account when performing any empirical analyses on firms' IPR portfolios.

# *Temporal Structure of Firm Growth and the Impact of R&D*

Antje Schimke • Thomas Brenner

## EXTENDED ABSTRACT

The growth of firms has positive macro- and micro-economic effects. Therefore, firm growth, the related factors and its explanation is a well studied field of research in the economic literature. There exists a wide range of factors that are found to affect firm performance.

Usually the impacts of firm characteristics on firm growth are studied without explicitly considering time. Firm characteristics and firm growth are measured at the same point in time and their relationships are examined. Our study will especially focus on the temporal structure of the influence of firm characteristics, especially the impact of R&D activities.

R&D activities are repeatedly found to have a positive impact on firm growth (Banbury & Mitchell 1995, Del Monte & Papagni 2003, Adamou & Sasidharan 2007, Yang & Lin 2007). However, R&D activities have two further characteristics that make them a perfect factor for our study. First, it takes time for R&D activities to influence firm growth. Investments in R&D can be expected to lead to innovations in the following years and, as a consequence, to higher sales. However, this takes some time. Therefore, we do not expect that R&D investments lead to firm growth in the same year. However, the size of the time lag is unclear. Second, most firms show quite stable R&D activities, meaning that research-intensive firms usually remain research-intensive and firms that do not conduct R&D usually remain R&D-inactive. Thus, studying the relationship between R&D activities and firm growth at the same point in time, observing positive relationships implies that more R&D-intensive firms growth faster, on average. This relationship might be caused by many other characteristics of firms that are related with R&D activities. The question whether increasing R&D expenditures at one time does increase the growth rate in the future is not answer. We aim to obtain a clearer picture of the time structure of the effect of R&D activities.

In addition, we will also examine the time structure of the growth process itself, because it is impossible to study the first kind of time structure without knowing the latter.

The autocorrelation of firm growth has been repeatedly studied in the literature (Almus & Nerlinger 2000, Bottazzi & Secchi 2003, Coad 2006, Coad & Hölzl 2008). The findings vary. We repeat this analysis in order to see which results from the literature are confirmed and in order to obtain a comparison basis for the estimation of R&D activities' impact.

The study is based on a sample of 1000 firms operating in Europe. The data are recorded in the European Innovation Scoreboard, in the period from 2003 to 2006. The collected data provides the firm names as well as some information on R&D activities, sector affiliation and size, but is limited to firms with high R&D investments. We set up regression analysis to identify firm growth related factors that also come together with the subsequent periods of firms' growth performance. Especially, we study the impact of R&D expenditure and R&D capital expenditure on firm growth and the time gap of this impact.

We find confirmation for the finding from the literature that especially large firms show autocorrelation in their growth. For medium sized firms we do not find any autocorrelation. However, small firms show a very strong autocorrelation in growth with a time lag of one year.

Furthermore, we find that R&D expenditures and R&D capital expenditures have a positive impact on firm growth with a time gap of one year. This impact disappears if autocorrelation is included in the case of R&D expenditures, while it even strengthens for R&D capital expenditures if autocorrelation is included.

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