Patent or Perish: On the nature of, and motivation for, patenting amongst university researchers

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Abstract

This presentation records the preliminary results of a qualitative project designed to explore the nature of, and motivation for, patenting activity amongst academics at a Swedish technical university. The research is motivated by the question: What are the implications of 'lärarundantaget' for the exploitation of university research?

Nineteen interviews were conducted with twenty-one current or former university employees about the origins, process, and fate of a particular patent they had invented whilst working at the university. Of the nineteen patent case-studies, eight patents were being used in a manufactured technology or were being developed for manufacture by the patent owner or a licensee firm. A further eight of the patents were not being used in a manufactured product by the patent owner or a licensee, though in four of these cases a prototype had been developed. In the three remaining cases, the inventor did not know whether the patent was being exploited, having given or sold the patent to another firm or organization.

All except one of the eight patents which were being exploited or developed for exploitation were owned by university spin-off firms (that is to say firms which had spun-off from the university at some point in time) (the exception was jointly owned by a firm and a university professor within one of the University’s Kompetenscentra). None of the four patents owned by large firms was being exploited.

The results of the interview study highlight the diversity in the types of links academics have with industry and in the ways they manage these relations. Similarly, academics patent for a range of social and economic reasons, and not necessarily primarily in order to benefit financially from any commercialization further downstream.

A number of factors associated with the research and exploitation process as well as with the technology itself, were identified as accounting for whether or not a research result was eventually exploited. These included: the nature and duration of the academic inventor’s relation with industry and/or with users; the obviousness of applications; the availability of capital and/or of marketing expertise; a further important factor appeared to be the degree of control the inventor had over the fate of the patent, a factor closely related to patent ownership.

The data seem to suggest that rather than being concerned with reform of the system whereby university employees have ownership rights to their own results, policy makers should ask what advantages are to be gained from the proposed alternative which advocates that the university should play a stronger role in the management and exploitation of intellectual property.

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1 A Swedish Law of 1949 grants ownership of commercially exploitable inventions generated by employees to their employers. University based teachers and researchers are excepted from this law, and thus have the right to own and exploit their own research results. This law by which teachers and researchers at universities have ownership rights to their own research results is referred to as ‘lärarundantaget’. For simplicity, I will use this Swedish term ‘lärarundantag’ throughout the text.
1. Aims of study

This study takes as its twin points of departure the recognition that a university can play a central role in fostering regional growth, and the current Swedish policy debate on possible changes to the rules relating to the ownership of university patents. A central aim of the study is to assess how university patenting actually functions under the current system represented by the lärarundantag, and whether there is a greater role to be played by the university in identifying and managing ideas with commercial potential. This is done by focusing on the nature and role of patenting amongst Linköping University researchers. Particular focus is on the relationship between the management of patents and their exploitation, and here the issue of patent ownership plays a central role.

This research is the qualitative sequel to a quantitative study which mapped and analysed patenting activity in East Gotha (Schild 1999). The quantitative study mapped patenting activity amongst Linköping University scientists, and examined the contribution of the university to overall patenting activity in Östergötland. An analysis of the ownership profile of the university-invented patents showed that a large number of university spin-offs and other small local firms were listed as the owners of the university-invented patents. Though these data constituted a very narrow and specific type of measure of university-industry interaction, they were interpreted as indicating the significance of local networks of small firms and the university for innovative activity in the region. In particular, the apparent importance of university spin-offs as launch-pads for commercializing university inventions suggested that the university not only enhances the innovative strength of the existing industries in the region, it also shapes the industrial structure in a very direct way. This current study can be thought of as the qualitative complement to the quantitative work in its attempt to unearth some of the mechanisms underlying the relations implied there.

Focus is on the management and exploitation of university patents, and no attempt is made here to assess the economic contribution of university patenting within the region. Nor is this study centrally concerned with the larger question of the role played by intellectual property rights (IPR) in the innovation system.

Some definitions

Patents are a form of intellectual property right; intellectual property ‘protects applications of ideas and information that are of commercial value’ (Cornish 1996 p.5). The three main types of intellectual property right are patents for inventions, copyright for ‘literary and artistic works and associated products’ (including software and
databases) and trade marks (ibid. p.6). Less straightforwardly, know-how and confidential information may also be considered forms of intellectual property. Within the systems of innovation approach to understanding innovation, the intellectual property system may be understood as a particular type of ‘institution’ with important implications for technological innovation (Edquist and Johnson 1997).

The central units of analysis for this study are referred to throughout the text as university patents. These are here defined as European patent applications filed between 1980 and 1996 with at least one inventor who is an employee of Linköping University, or who was working at the university when the research resulting in the patent was carried out.

2. Background

The economic role of the university

The recognition that industrialized economies now appear to be entering a new techno-economic paradigm characterized by generic science-based technologies has prompted a resurgence of research interest in the relationship between public sector research and national and regional wealth creation. Whilst the potential and actual economic importance of public sector research is not in question, there is less certainty in the literature about the mechanisms underlying this contribution (see especially Salter and Martin 1999).

The putative close association between the research base and wealth creation has implications for the economic significance and role of the university. According to several authors, universities are now more than ever expected to make a direct contribution to innovation (Ziman 1994, Gibbons et al. 1994, Etzkowitz and Leydesdorff (eds.) 1997), resulting in a corresponding trend towards ‘entrepreneurial’ universities (Slaughter and Leslie 1997, Clark 1998).

There is policy pressure on universities, not only to conduct industrially relevant research, but also to adopt closer and more pervasive links with industry and to ‘play a more dynamic, direct and immediate role in the technical and innovative efforts of their country in general, and of the region in which they are situated in particular’ (Herskovic 1989 p.71). University-industry technology transfer takes place through a number of direct and indirect, formal and informal mechanisms. Examples of modes of technology transfer include the creation of spin-off companies, and the transfer of technological expertise through consultancy, patenting, and licensing. Knowledge transfer is also achieved through structures such as science parks, industrial liaison offices, and entrepreneur training (Jones-Evans et al. 1997 p.3, Brett et al. 1991).

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2 As Cornish notes ‘One characteristic shared by all types of intellectual property to date is that the rights granted are essentially negative: they are rights to stop others doing certain things - rights in other words to stop [others] from exploiting them without the licence of the right owner.’ (1996 pp.5-6).

3 Such as biotechnology, information and communication technologies, and new materials.
University patenting appears to be an increasingly significant aspect of university activity. Statistics on university patenting in the UK and the US indicate the considerable revenues that can be reaped from university patents (Smith 1997 p.97, Etzkowitz 1997), suggesting the importance of adopting appropriate systems for managing intellectual property rights within universities (Webster and Packer 1997).

However, ownership of intellectual property emanating from university research is a thorny if salient issue. This is because the traditional concept of the university as an autonomous institution, and its current greater involvement in commercial activities, would appear to be at variance with one another. For example, patenting might be expected to inhibit free collaboration and information exchange between scientists in academia, and between academia and other organizations. At the heart of this perceived conflict lies the question of what, if anything, is special about the university as a producer of knowledge. This study is almost by default tacitly underpinned by the normative assumption that increased interaction between Linköping University and industry benefits the local economy and indeed the university itself. However, this normative assumption is not taken for granted, and will be touched on in the conclusion.

The role played by university patenting in technology transfer is not only of interest to policy-makers seeking to realize the potential economic value of university research, but also relates to a broader economic and sociological debate on the dynamics of knowledge flows in the innovation system, and indeed on the nature of the relationship between science and technology.

The 'lärarundantag’

In Sweden, the so-called lärarundantag, ‘teacher exception clause’, means in theory that university staff have ownership rights to their own research results, and thus control over any IPR. Thus researchers themselves are responsible for finding funding for patent applications and any licensing agreements (though government grants and loans may be available for this). However, current practice in relation to IPR ownership in universities is more complex than the lärarundantag would suggest. In cases where research is sponsored by industry, researchers often sign agreements with their sponsors relating to the ownership of any IPR that might result. Patent companies have been established in connection with several Swedish universities, to which university staff can voluntarily hand over their patent rights and gain a proportion of any financial profit from the patent in return (SOU 1998:128 p.163). The first such patent company was established at Linköping University in 1994/95, Forskarpent i Linköping AB.

The lärarundantag is currently being debated. The debate centres on the question of how a shift away from researcher ownership of research results to university ownership, would affect the contribution of universities to regional and national wealth creation. The parliamentary report, Forskning 2000, suggests that university teachers’ unions begin negotiations with universities in the anticipation that universities will take over the ownership rights to patents generated in the course of academics’ research.
In the USA, it is now common practice for universities to retain ownership of IPR generated by their staff, even if the research is carried out collaboratively with the sponsor. Since the passage of the Bayh-Dole Act in 1980, many US research universities have established patent offices to manage and exploit the IPR, and patenting at US universities has increased dramatically. Income from licensing is becoming an important income source for some universities. Likewise, in the UK exploitation rights were devolved to universities in 1985, when most universities devised their own policies on IPR ownership (Harvey 1996). This policy of devolved IPR is based on the belief that greater university control over IPR will enhance technology transfer.

The ongoing policy debate in Sweden and abroad appears to embrace the idea that ownership of intellectual property is key to the effectiveness of knowledge transfer. This is in turn suggestive of a linear understanding of the role of intellectual property in innovation and the economy, a perspective which appears to be supported and fuelled by universities and public research funding agencies themselves, as they attempt to enhance the economic benefits of their research activities by implementing new intellectual property management policies (Handscombe 1989, Harvey 1996).

There is little consensus over what kind of intellectual property management and ownership system is best in order to derive maximum economic benefit from university research. By investigating whether indeed the lärarundantag appears to hinder commercialization of research results (as the recent SOU proposal would seem to suggest), this research project can go some way in addressing this uncertainty. Specifically, the results can inform the current debate in Sweden on how a possible shift away from researcher ownership of university IPR to full or part university ownership might affect Swedish universities’ contribution to innovative activities.

3. Research Questions

This study seeks to explore the relationship between the management and exploitation of university patents. It does this by investigating the nature and management of, and motivation for, patenting at Linköping University, and by focusing on the consequences of the lärarundantag for this university patenting activity.

The main question is:

- How does the local management of university patents relate to their exploitation?

This question will be addressed by following the course taken by a number of case-studies of university patents from idea through to commercialization or failure. The more detailed questions used for conducting and analysing the case-studies included:

- Why did the academics bother to file for patents? (This relates to the nature of a patent and the role of patenting.)
How do university researchers manage their patents?

- How is ownership dealt with? (for example in industrial collaborations)
- How did they finance the patent?
- What did they do with the granted patent?

What factors appear to account for whether the patent idea is commercialized or not?

How important is Forskarpatent AB, the university patent company, for patenting and technology transfer?

To what degree is exploitation of university patents geographically concentrated?

How does patenting activity affect the process of academic research (such as publishing practices) and researchers’ working life?

4. Method: Following patents

In order to investigate how researchers manage patenting and how academic patenting relates to technology transfer, this study seeks to trace the nature of academic patenting as a process. The aim is to follow academic patent claims from birth as research ideas to maturity as economically viable innovations or indeed to death as failed inventions or innovations. The primary unit of analysis for this study is the project represented in a university patent.

Identifying university patents

A note is in order here on the distinction between patent inventors and patent applicants. The patent applicant is normally the firm, other organization, or individual(s) responsible for the patent costs, and which/who becomes the owner if the patent is granted. The applicant is usually (but by no means always) distinct from the inventor(s), who has or have developed the idea represented in the patent. Applicants can be grouped according to patent ownership category: firms, public organizations, and individuals.

European patent applications with origins in Linköping University research were identified by matching the inventor names listed on East Gothia European patent applications (1980-1996) with the names of Linköping University staff as listed in the university telephone directories from 1990 up to and including 1998 (Schild 1999 Chapter 9). A total of 88 (approximately 14%) of the East Gothia European patent applications had at least one inventor who is or was recently a member of staff at Linköping University; these make up the set of ‘university patents’ (ibid.).

Each university patent was allocated to a university department by identifying the departmental affiliation of the current or recent university-based inventor. A key to the

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4 It should be borne in mind that Linköping University staff may be responsible for some European patent applications which do not appear in this sub-set because they do not appear in the original set of East Gothia patents. Only patents listing an inventor address or an applicant address in East Gothia appear in the data.
abbreviations of university departments is provided in the appendix below (Table 1). Each university patent was also allocated to a patent ownership category on the assumption that the patent applicant was also the patent owner (Schild 1999 Chapter 9).

Small firms constituted the most important group of university patent owners, followed by private individuals (the inventors themselves), and by large firms. University patents were more likely to be owned by small firms and by public/semi public organizations than East Gothia patents as a whole, whilst the latter were more likely to be owned by large firms than the university patents (Schild 1999 Chapter 9).

**Identifying and studying patent case-studies**

The broad focus of the current study is how the management of university patents affects the likelihood for exploitation. The choice of case-study university patents was based on the assumption that different types of patent applicant among the university patents, are broadly representative of different forms of patent management and university-industry interaction. In order to capture a range of forms of ownership within the set of cases, potential patent cases were initially selected on the basis of type of applicant, on the assumption that the patent applicant is normally the patent owner.

University patents with an applicant falling into one of the following four groups were initially chosen: small firms; large firms; *Forskarpatent AB* (Linköping University patent company); and the inventor(s) himself/themselves. As this yielded too large a number of case-studies, a further selection was made on the basis of the university department of the inventor(s). The three departments with the most patent applications (according to inventor affiliation) were chosen; they were: the Department of Physics and Measurement Technology (IFM); the Department of Electrical Engineering (ISY); and the Department of Biomedical engineering (IMT). All three departments are within the Institute of Technology faculty. The earliest patent applications (those filed in 1980, 1981, and 1982) were eliminated from the pool of potential case-studies, as it was reasoned that inventors may have difficulty recalling specific details about a process which took place more than fifteen years ago. Finally, unnecessary duplicate patents - those containing the same applicant/inventor combination - were also eliminated from the set of potential case-studies, leaving 32 case-study patent applications. This relatively large pool of case-studies allowed for an expected attrition of cases.

The intention was to interview at least one inventor listed on each case-study patent application. When selecting respondent-inventors, priority was given to those inventors listed in the phone book in 1998 (that is those who were still at the university when this research was carried out).

Twenty-one university inventors/researchers were interviewed about a specific patent they had invented or helped to invent. Two inventors of two of the case-study patents were interviewed together. Thus the data set consists of nineteen patent case-studies. All respondent-inventors were still employed by the university when the interviews were conducted, except two, both of whom were doctoral students when the inventive work was done. One of these is now employed by ABB Corporate Research, but is
Based at the university, the other was formally CEO of a university spin-off company, and is now working at IMC AB, Linköping.\footnote{Since writing this paper, IMC AB has merged with IOF (Institut för Optisk Forskning), and has moved to Norrköping.}

Semi-structured interviews were conducted with the 21 respondents who were asked about the course taken by the project behind the patent on which they were listed as inventor. The structure of the interview questionnaire was as follows:

**Background**  
Respondent’s professional setting and general industrial involvement

**Origins and nature of work for which a patent was filed**  
Background information about the research project  
Funding of project and resources

**The patent application process**  
The decision to patent  
Patenting route and costs  
Support structures  
Changes over time

**Then what? Fate of invention subsequent to patent application**  
Economic outcome  
Implications for research activities and links with industry

**Conclusion**  
General: advantages/disadvantages of patenting; will they patent again

**Describing the case-study data**

For the sake of brevity, the Swedish abbreviations for the three relevant university departments will be used throughout the text. These are: IFM (Department of Physics and Measurement Technology); ISY (Department of Electrical Engineering); and IMT (Department of Biomedical engineering); see key Table 1 (appendix).

Table 2 shows how the 19 patent case-studies are distributed between groups of cases within an ownership-category by inventor-department matrix. An analysis of the data revealed that it was useful to divide the patents owned by the category ‘small firms’ into those that were owned by companies which had spun-off from Linköping University, and those owned by small companies that had not spun-off from Linköping University (although this last category may of course include companies which had spun-off from other Swedish universities).

The interviews revealed that the patent applicant was indeed the same as the patent owner, except in two cases. In both cases, the patent was applied for by the inventor(s) himself/themselves, and is now owned by a university spin-off company. In Table 2 below, these two patents are listed as being owned by spin-offs. In a third case where the patent was applied for by the the inventors themselves, ownership of the patent is in the process of being taken over by a firm collaborating closely with the research group.
This company is working within the framework of IMT’s Kompetenscentrum NIMED. In Table 2 this patent is still listed as being owned by the inventors.

### Table 2. Distribution of patent case-studies by patent ownership category and departmental affiliation of respondent-inventors

<table>
<thead>
<tr>
<th>University department of respondent-inventor(s)</th>
<th>Patent ownership category</th>
<th>LiU spin-off</th>
<th>Large firm</th>
<th>Inventors themselves</th>
<th>Other small firm</th>
<th>Forskar-patent AB</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics and Measurement Technology (IFM)</td>
<td></td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Electrical Engineering (ISY)</td>
<td></td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Biomedical engineering (IMT)</td>
<td></td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>9</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>19</td>
</tr>
</tbody>
</table>

The names of the owners of the patent case-studies are listed below:

**Linköping University Spin-offs**
(including the following information where known: which department spun-off from; year founded; current location; firm activity; and approximate number of employees)

- AB Varilab (IFM/Chalmers; early 1980s; Huddinge; sensor product)
- Context Vision AB (ISY; 1983; Mjärdevi, Linköping)
- Integrated Vision Products AB (ISY; 1980s; Mjärdevi, Linköping; 15)
- Lisca AB (IMT; 1997/98; Berzelius, Linköping; manufacturing; 4)
- Optovent AB (IMT; 1993; Sundbyberg; manufacturing; 5-6)
- Sectra AB (ISY; 1978; Mjärdevi, Linköping; 155)
- Sensistor AB (IFM/Chalmers; 1981?; Linköping; 12)
- Silicon Construction Sweden AB (IFM; 1980s; Mjärdevi, Linköping; licences out technology; 10)
- Unilink AB (IMT, 1981/82; Linköping; licenses out technology; 3)

**Large firms**

- Telia
- Neste OY
- ABB (2 case-studies)

**Inventors**
(indicating department of owners)

- IMT Inventors (2 case-studies, 1 taken over by Fält Elektronik within NIMED)
- IFM inventors
5. The context: A note on patenting activity at Linköping university

Linköping University is a technologically oriented university, closely connected with a successful science park, Mjärdevi, where several university spin-off companies are located. It was the first Swedish university to establish a university holding company to manage academics’ patent applications and exploitation. **Forskarpatent i Linköping AB** was set up 1994/95 in an attempt to encourage university researchers to patent through the university, and to enable the university to reap a share of any income resulting from the patents. There was some expectation that **Forskarpatent** would generate revenues for the university from patent royalties. One of the initial owners of **Forskarpatent**, the Technology Bridge Foundation (*TeknikBroStiftelsen*) has now sold its share to the university.

The following data draws on Schild (1999). Amongst university departments, IFM had the most European patent applications. Within this department, the most important divisions in terms of number of patents were Applied Physics, Material Physics, and Electronic Devices. The commercial success of research conducted in IFM’s Electronic Devices group is apparent; all IFM spin-offs listed as applicants of university patents were from this group. In 1995 IFM gained funding for a new collaborative research centre for bio- and chemical sensor science and technology, **Kompetenscentrum S-Sence** (Swedish Sensor Centre). This is funded by collaborating small and large firms, NUTEK, and the university, in equal proportions. This centre will be referred to throughout the text as **Kompetenscentrum S-Sence**, or just S-Sence. IFM’s patents are relatively evenly spread over the range of ownership classes.

Other departments active in patenting included ISY, and its Computer Vision Lab in particular. The commercial success of research conducted in the Computer Vision Lab

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6 By March 1998, twenty-eight patents had been applied for through **Forskarpatent i Linköping AB** (note that not all will have been EPO patents); five of these had by then been granted, and ten rejected. Of those granted, three were generating revenues for **Forskarpatent**. However, as long as Swedish university employees have ownership rights to their own research results, **Forskarpatent**’s status and role is unclear. It has met considerable structural and economic problems and has failed to live up to the expectations held out for it. Should there be a change in policy, such that university researchers no longer have right of ownership of their research results, as now seems possible, the University will need a new organization to manage academic patenting in the interests of the University, the inventors’ departments, and the inventors themselves.

7 When comparing departments in terms of patenting, it should be remembered that the departments vary greatly in size. For example, the Department of Physics and Measurement Technology is a very large department, whilst Biomedical Engineering is far more modest in size. Further, the importance of patenting as a means of protecting inventions differs between fields of technology.
is also apparent from the data. The quantitative data revealed that ISY’s patents were mostly applied for by small firms, three of which were university spin-offs.

IMT carries out research relating to the application of microelectronics and information processing in medicine. In 1995, IMT also gained a new collaborative research centre, Centre of Excellence in Non-Invasive Medical Measurements (Kompetenscentrum NIMED), to which industry, NUTEK and the university each contributes a third of the funding. In a similar way to S-Sense, a mix of small and large firms are members of NIMED (such as Siemens and two IMT spin-offs). In relation to its size, IMT and particularly NIMED, was very active in patenting.

Differences between university departments in the degree to which they patent should perhaps be partly understood in the light of variations between fields of technology in the size of the gap between academic research and industrial application, and in the effectiveness of patents as a means of protecting inventions. A department’s or a research group’s funding structure can also have a significant impact on its patenting rate. For example, university research groups funded by large firms, such as ABB, and by funding bodies seeking to foster university-industry cooperation, such as NUTEK, may be strongly encouraged to patent by their sponsors.

The following four sections, labelled: The research process; The patening process; The technology; The exploitation process, will seek to describe the course taken by university patents from idea to market, or to failure. An attempt will also be made to tease out those factors which appeared to differentiate those patent case-studies that eventually became a product and were exploited, and those that did not. It is suggested that such factors can be identified at every stage of the process from idea to market.

6. The research process

Research funding

Table 3 (appendix) shows how the research projects which resulted in the 19 patent case-studies were funded, and also how the patents themselves were financed. The Table sorts the patents according to type of patent owner, in the following order: large firms; Forskarpentent; Inventors; Small firms; Liu spin-off firms. Unless otherwise stated, this order will be followed in all the tables presented. The importance of NUTEK or its earlier incarnation STU for funding the research resulting in a patent is clear; NUTEK funded or part funded 13 of the 19 projects. NUTEK/STU has also been fairly important in financing patent applications costs, primarily in the form of conditional loans. The question of the financing of patents will be returned to in part 7.

Some of the interview data suggest that the heavy dependence of researchers on NUTEK for funding, is not unproblematic. NUTEK places significant emphasis on the importance of the exploitation of research results. Some researchers reported that

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8 In order to protect respondents’ identity, quotes are not attributed, but are referenced with a letter of the alphabet.
patenting was almost a necessary evil in order to secure further research funding from NUTEK. It was something that took much time and energy, with little hope of reward, but future research funding depended on it.

In one extreme example, a professor who was dependent on NUTEK for funding and who had a successful start-up company, felt squeezed between NUTEK and the University, which he seemed to feel was wary of industrial activities over which it had no control. After starting up his company to launch a successful technology he had patented, he had negotiated an agreement with the University allowing him to work half time for his company, and half time at the University. He reported, however, that when his business began to succeed, the University went back on this agreement, forcing him to take three years’ leave in order to devote himself fully to the company. He felt bitter about this, suggesting that succeeding on NUTEK’s terms, meant failing on the University’s terms. He felt that as soon as he had met with business success, the University did not want to know.

At least one researcher voiced anger at NUTEK’s recent requirement for researchers to have an industrial partner on board at an early stage when applying for development money. This researcher from IMT pointed out that it is difficult to get a firm interested in a new idea at an early stage, and that it ought to be possible to get funding to test an idea out without an industrial partner. More seriously, several researchers felt unease at NUTEK’s industrial orientation (‘it’s become just a little too much product development for my taste’ / ’det har blivit litt för mycket produktutveckling för min smak’ L p.4). Others were pragmatic and cultivated relationships with firms willing to use their results, as it stood them in good stead when applying for money (L p.4).

Several professors and other university staff among my respondents appeared to circumvent this apparent impasse between funding structures and their own interests by getting doctoral students to carry out their commercially promising projects. These doctoral students became co-inventors on any resulting patents, and subsequently often went to work in a spin-off firm.

**Managing collaborative relations with industry**

The sometimes problematic relations with industrial partners was a recurring theme in the interviews. Several respondents were very critical of how collaboration with industry worked in practice, particularly in the cases of more formalized types of collaboration, such as within the Kompetenscentra, in consortia and in EU projects.

Some researchers working in NIMED for example, voiced disappointment at the one-sidedness of the industrial collaboration. One contrasted the experience of collaborating with small firms in NIMED with collaborating with the larger firms. Working with the smaller firms was a positive experience with close contact and frequent discussions on projects. Working with some of the large firms however, reminded him of contract research; in such cases, contact between the firm and the IMT researchers was reduced to infrequent meetings at which the latter would merely report their results. The large firms simply appeared uninterested.
In general, collaborative firms were perceived as passive partners, receiving much more from the collaboration than they put in. As one IMT professor remarked about NIMED:

Dom kom till dukat bord, fick med sig mycket hem, universitetsforskarna är besvikna, för det dom serverades från företag var kanske inte så jävlig spännande (R p.7)

They came to a set table, took a lot away with them, the university researchers are disappointed, because what they were served up by the firms was maybe not that exciting.

Collaborating firms were also seen as secretive, only willing to share commercially uninteresting results. The same respondent felt particularly strongly about an EU project involving industrial partners:

Och då upplever jag den här konflikten väldigt stärkt, för att man vet aldrig om en person som kommer från ett företag säljer sina instrument, eller om man talar om [gjorde upptäckt?] ... och man vet inte heller om vilka resultat som läges fram i från ett företag... Dom värdefullaste resultaten i kommersiellt synpunkt dom lägger man aldrig fram i ett sånt där Samarbetet, utan dom undanhåller man. Man talar om det som er mindre het kommersiellt. När den ene stjäl och den andre gir, vad, det är min stärka känsla (R p.7)

And that’s when I feel this conflict very strongly, because you never know if a person from a company is selling his instruments, or if he’s talking about his [discoveries?] … and nor do you know what kind of results the company is presenting. … In such a collaboration, they never present their results which are most valuable from a commercial perspective, but keep them to themselves. They talk about things that are less hot commercially. When one steals, and the other gives, that’s my strong feeling.

Researchers also expressed a more pervasive dissatisfaction if not despondency with the degree of industrial orientation forced upon them in their daily work. They commented that working with industry meant short time-frames, incompatible with difficult theoretical problems, and that they were becoming product developers rather than researchers. As one IFM researcher bemoaned:

Vi måste också vara, eller våra projekt måste vara av industriell relevans som det heter... Vi måste helst ha företag med i styrelse av dessa konsortium, eller materialprogram, det skal helst finnes patent, det skal finnes gemensamma doktorander, så kallade industri doktorander, och all ting ska vara väldigt tillämpad helst, helst ska man inte göra någon grundforskning alls, utan man ska göra någon ting tillämpad, så känner man, fast det inte uttalad så (D p.4).

We also have to be, or our projects have to be industrially relevant as it’s called... We have preferably to have companies on the boards of these consortia, or material science programmes, preferably there should be patents, there should preferably be joint research students, so-called industrial research students, and everything has to be preferably very applied, preferably you shouldn’t do any basic research at all, but you’re supposed to do something applied, that’s how it feels, but it’s not stated explicitly in that way.

However, most of the examples reported where industrial collaboration had clearly not worked for the academics as intended, related to institutionalized forms of collaboration such as the Kompetenscentra. Other respondents commented that to be successful, collaboration with big firms has to be long-term and based on personal relationships. In one IFM professor’s experience, the best collaborations with industry are those based on an ongoing dialogue over several years, during which joint interests may emerge. He further suggested that having an industrial partner at the start of a commercially interesting project increases the likelihood that a patent based on university research will eventually end up in a product (E).
Another indication that the gulf between university research work and industrial activities is perhaps not the yawning chasm some respondents seemed to indicate, is that there appeared to be considerable traffic in personnel from one sector to the other (not just from university to industry, but also the reverse). None of the respondents who had made such a change expressed any difficulty about it. Indeed, some university staff appeared to identify particularly closely with Mjärdevi, which at least one ISY researcher regarded as almost his moral duty to support.

Managing the relationship between publishing and patenting

An area in which the apparently conflicting interests and practices of university researchers and industry might be expected to be evident is in the relationship between publishing and patenting. It is generally acknowledged that university researchers publish and firms patent, and the two activities are often portrayed as at variance with one another. Some of the data does suggest that the university researchers instinctively thought of publication before patenting. However, researchers followed a number of different strategies to manage the publication/patenting relationship, and on the surface at least, few reported this as a problem.

One of the most common strategies employed to avoid any conflict between publication and patenting was to allow collaborating firms to vet any texts being prepared for publication or presentation. Researchers in the Kompetenscentra and also some working with other industrial partners, reported that they always sent any draft papers to their collaborating firms, which then scrutinized them. For example, an ISY researcher working with Sectra reported that he always checks with the firm whether he can publish a particular result, but that this is never a problem as long as he does not refer to Sectra’s products (L p.4).

In the case of the two Kompetenscentra especially, students’ exam work was regularly submitted to collaborating firms first, and kept secret until the firm or firms had checked whether the work was patentable, and until any patents had been filed (B p.7, U). One IMT researcher reported that in his department students’ exam work was sometimes presented behind closed doors in case it contained a commercially interesting idea which needed to be patented. This entailed delaying publication of the student’s work for about six months. Although the University did not approve of this practice, there was nothing it could do, and students were keen to have their results exploited (U p.14).

Submitting draft publications for assessment by collaborating firms of course entails delay of publication, as does a decision to patent. For this reason, a second strategy in the management of the relationship between publishing and patenting was to rush a patent application through, so that the university inventor could go to a conference and talk freely about the results (an invention is protected as soon as the patent application is filed). A Swedish patent application can be written relatively quickly in Swedish, whilst offering sufficient protection.

One researcher whose CV lacks publications for two years when he was involved in a start-up company, mentioned that forfeiting quick publication of research results was a
disadvantage in the academic world, and for this reason it was important that the lärarundantag provided him with a ‘carrot’ (L p.11).

Much of the data then, suggest that whilst patenting and publication are at variance with one another, the relationship between the two is managed relatively easily. However, there are other indications in the data that problems do arise as a result of this conflict.

During the early days of the Kompetenscentra there was considerable uncertainty among researchers about how to manage IPR resulting from work carried out within them. In one case, a group of researchers had published some commercially interesting results just as S-Sense was starting up. Realizing their mistake, they very quickly applied for a patent through Forskarpenton, unaware that the two collaborating firms were keen to patent the idea themselves. This caused great problems with the two firms involved which proved difficult to solve. As one of the researchers involved commented:

Så det där blev alltså fel att göra, och det har blivit väldigt mycket problem med det sen då. ... Så förste två åren tror jag, så brukade vi ägna ett par timmar ut av varje projektmöte [with companies] åt att diskutera det här med patenten, och det var ju inte så bra. ... Och jag hade väldigt gärna gjort om det hår om det hade gått, men det var liksom redan gjort då, så ... (B pp.2-3).

So that was wrong to do that, and that’s caused very big problems afterwards. … Like the first two years, I think, we used to spend a couple of hours of each project meeting [with companies] discussing this issue with the patents, which was not good. .. And I wish it was possible to undo the damage [caused by the researchers applying for the patent themselves], but once it was done, it was done, so…

At the time of the fieldwork for this study, both NIMED and S-Sense were in the process of developing policies on how to manage any IPR on results produced within them, and were engaging the University’s lawyer in this process. When these Kompetenscentra were established, NUTEK proposed that all the companies involved should have equal rights to exploit any results, and that the University would compensate the university researchers involved. This did not work however, because as none of the companies had exclusive rights to exploit, none felt secure enough to do so, particularly as a central idea behind the Kompetenscentra was to have competing firms working together. Now, under the newly devised arrangements for S-Sense, university researchers sign away their rights to ownership of IPR, and are treated as though they were employees of the relevant firm or firms for compensation purposes. Exploitation rights go to the company which participated in developing the patented invention.

In a similar, if less spectacular case, a former doctoral student who had been sponsored indirectly by ABB through NUTEK recounted that he had published a potentially interesting finding, and that this had prevented ABB from patenting it. However, in this case, this does not appear to have caused much, if any friction, as improvements on the basic idea could be, and were later, patented. The inventor in question is now an employee of ABB, though based at the University, and has clearly absorbed their patenting culture (‘Nu patentsöker vi all ting i princip som kommer’ / ‘Now we apply for a patent for in principle everything that turns up’ (H p.8)).

Other evidence suggests that in fact, university researchers and firms do not have such different attitudes towards patenting in relation to publishing. Several researchers had evidently bought into the industrial mode of thinking about patenting as being
paramount, or at least saw no conflict at all between the two activities. Perhaps this is because the same knowledge leads to both. Thus one chemist, who not only patents with industry, but also writes all his publications together with companies (‘patent och publikationer går hand i hand’ (‘patents and publications go hand in hand) just gives his collaborating firm his results in the form of a publication, ‘så får dom göra vad dom vill med det’ (I p.7).

At least one researcher, recognizing the central importance of patenting any promising results, claimed that he patented in order to publish without risking losing control of his idea, ‘så at vi tycker [patentering] främjar publicering’ / ‘so we believe it [patenting] furthers publishing’ (A p.7). Other researchers even appeared to have adopted an industrial view of the role of publication as being part of an economic strategy. One who had previously worked in industry related publishing to its strategic role in stopping other firms from patenting (G) (if an idea is already in the public domain, it cannot be patented). In another interesting case, two professors at IMT used publishing as a way of marketing their already patented idea to the medical profession who were the potential users. They published around the invention to demonstrate that the new device actually worked, and to get it known in research and medical circles. For them, publication served as a form of scientific marketing which could ultimately lead to commercial sales (Q, R p.9).

7. The patenting process

7.1 Why patent…..?

When asked why they patented, respondents gave two sets of replies which mirror the two sets of attitudes among researchers embodied in the previous section: those who saw patenting as a necessary evil which went hand-in-hand with the increasing industrial orientation of their work, and those who identified strongly with industrial interests and wanted to patent. In the context of the broader question of this paper, it could be said that no amount of manipulating policies for managing IPR in universities will ever surmount this divide.

…..to get research funding

The first set of reasons given for patenting then, are related to patents being seen as a reward (like publications) that would stand the researchers in good stead when seeking further research grants, especially from NUTEK. Several respondents mentioned that they had used patenting as an argument to get money (eg. L p.9). Thus patenting was seen as important not so much for technology transfer, as to increase the chances of getting further research funding (U). As on of the IMT professors put it:
Vi har ju alltid ... ansett som en merit vid kommande ansökningstillfällen när man ha kunnat visa att man har fått patent, som en del av sin forskning eller fört någon forskningsresultat vidare till industriell exploatering, det er en merit vid kommande ansökningar (Q p.3).
Well, we have always ...regarded it as a merit for future grant applications when you can show that you’ve got a patent as a part of your research, or followed some research result through to industrial exploitation, that’s a merit for future applications.

...to cement a relationship with industry

Related to the role of patenting in securing research funding, is the role played by university patenting in cementing a relationship with a particular firm (eg B p.7). This is particularly the case when an employee of the firm paying for the patent was included as a co-inventor (even though he or she may not have contributed substantially to the work). As pointed out in section 5.1 above, funding agencies such as NUTEK look favourably on a proposal where an industrial partner is included at an early stage of the project, because this is perceived to enhance the chances of exploitation. In one example, an ISY researcher saw his ongoing collaboration with Sectra as crucial to his success in winning research funding. Through including Sectra’s CEO as a co-inventor on patents, and giving them exploitation rights, he could simultaneously demonstrate to potential funders that he had a company prepared to accept the results and apply them, and cement further his relationship with the firm (L).

.....patenting attracts students

By the same token that patenting with industry cemented relations with the firm in question, so it could also form an indirect means of attracting students to the research group. This is because students keen to work in industry after graduating are naturally attracted to research groups with strong interaction with industrial partners. In addition, doctoral students welcomed the opportunity of being listed as an inventor on a patent, in the same way that they would welcome the opportunity to publish (B, I, L). They would also think it exiting to be involved in exploitation.

.....to keep the research ticking over

Patenting was seen by some as an unwritten work responsibility, and an integral part of their work routine, because it was perceived as necessary in order to keep research groups alive and active. This largely, again, because patenting was linked to success in getting a research grants and in attracting companies to the research activity within the group.

One IMT researcher in particular commented that the central importance of patenting was never made explicit to him when he started his job at the university, but is something he had gradually grown to realize as he learned how the research system worked. Though he was aware of colleagues who did not bother about patenting, he felt he could not neglect this aspect of his work, as it was so fundamentally related to the economic well-being of his department. He described this situation thus: 

För att man ska utveckla idéerna, så måste vi få pengar till forskningen, och då måste man redan på ett tidigt stadium tänka på det här med patent och så vidare. Så man sitter och jobbar med sådana saker som gör patent för institutionens bästa, för att vi ska få pengar till institutionen att kunde avlöna våra
anställda, vi har ju tekniker här som jobbar, får vi inte in pengar så kan inte dom jobba. ... Så på det sättet, man kan inte bara tänka på sig själv ... (U p.16).

For us to develop our ideas we need to bring in money for our research, and then you really need to already be thinking about patents and stuff at an early stage. So you’re sitting working with things that result in patents for the good of the department, so that we can bring in money for the department to pay our staff, I mean we’ve got technicians here who work, if we don’t bring in money, they can’t work. … So in that way, you can’t just think about yourself…

It should perhaps be added that IMT’s departmental culture appeared to be conducive to experimenting with technology and patenting, (‘[patentering] sitter i väggarna här’ (‘[patenting] is in the walls here’ (S p.10-11)). This was attributed to the aims and interests of a long-standing professor.

An IFM researcher recognizing a similar necessity to patent in order to survive, clearly found patenting more of a burden than the IMT researcher cited above. He felt that patenting was yet another role expected of him by the university, in addition to his work as a teacher and researcher. Patenting work was largely unrewarded, and was something that had to be squeezed in between five and nine o’clock in the evening. He was clearly unhappy about the intense pressure to be industrially oriented in his work, commenting with some cynicism that the only advantage he could see in patenting was if it helped Sweden become more competitive:


I suppose I see patents at the university as a way of subsidising company work, if I’m honest. I mean, my salary and my work isn’t put to the benefit of myself or my university, but it benefits the company. And this is a type of societal support, state support for the companies and for Sweden. It doesn’t really matter what you call it. We function very much as technological developers for big companies. It’s not the small companies that benefit – it’s the big companies.

.....to keep control over the idea and its exploitaton

The second group of reasons given for patenting were especially expressed by researchers who identified relatively strongly with industrial activities, and who were keen to keep control over the exploitation of their own patentable ideas.

Some researchers who had at some time been involved in starting a company, appeared keen to support the company by handing over their patents to it, whether they were still owners of the company or not. In these cases, the patent could perform a number of different functions for the spin-off, all of which served to increase the firm’s competetiveness and value.

One respondent involved in the spin-off Context Vision, suggested that one of the reasons the company had patented the technology was in an attempt to win risk capital investment. In this case, the patent may have been said to perform a symbolic role by demonstrating that there was a strong technological base to the business idea and by concretizing the firm’s central selling point.(L p.2).
In another case, a university inventor’s involvement in a number of spin-off companies had made him very aware of the importance of patents for companies, and especially for companies dependent on a particular technology area. He part-owned the spin-off that owned the case-study patent he had invented, and justified the importance of the patent primarily in terms of its role in protecting the firm. He clearly felt some responsibility in making sure the particular company could derive benefit from his research results. If another company obtained a strategic patent, it could block his own company. He explained that the patent in question would not be exploited for many years, but that ‘det vore väldigt obehagligt om företagen inte fick möjlighet att få skydd för sina tekniker för at någon annan har fått patenten’ / ‘it would be very unfortunate if the company wasn’t able to protect its own technology because another company got the patent’ (N p.7).

In a similar vein, and with a desire to enhance the competitiveness of a firm in which the university researcher had interests, another respondent reported that they sometimes held on to patentable ideas before applying for a patent, and then subsequently applied for two or three patents together. This was because a patent application becomes public, with the risk that a competitor in the same technology area will gain new ideas from the published patent (without actually infringing the patent), which they in turn could patent (U p.15).

.....to support local firms

At a more abstract level, some respondents appeared particularly conscious of the university’s industrial role, and its importance in building up Mjärdevi firms. One researcher especially appeared to be somewhat of an evangelist for university patenting. He reported that he tried to encourage colleagues and students to think in terms of patenting, both because he thought it important to give local firms a competitive edge, and because it was actually possible to make money from patenting (N p.10). For this ISY researcher, patenting was a ‘reflex’.

.....in the hope of economic gain

Many respondents mentioned the hope of being able to earn some money from the patent as one reason for patenting. There are a number of routes by which it is possible to make money on a patent. One is for the inventor to attempt to exploit the patent themselves by starting a firm. A far more common route is to sell or give the patent to a firm (perhaps one owned by the inventor him or herself) which will then either manufacture the technology, licence it out to other firms, or merely keep the patent for its patent portfolio. Whichever route they choose for their patent, inventors may be compensated either by royalties on a percentage of the sales of any product closely linked to the patent, or by a one-off payment. In several cases where inventors sold their patents to firms, they were compensated with a nominal sum as though they were employees of the firm. Table 4 indicates the different compensation arrangements among the patent case-studies.
Whilst one IMT researcher suggested that a researcher could get anything between SEK 50,000 and several millions through the sale of a patent (U p.7), few respondents appeared to make much if any money on the particular patents they were interviewed about. The reality is that it would be too expensive for firms to pay a percentage of sales to the inventors of the patents they buy in. Companies often operate with small margins anyway, and are much more likely to be willing to buy the patent for a one-off sum, than to incur the uncertain cost of paying royalties on any future profits (H, N). In short, university patents are not generally the gold-mine the discussion on lärarundantaget would have us believe. Perhaps this is one possible explanation why Forskarpent AB was unsuccessful in selling its patents.

7.2 Why not patent.....?

.....Because financing for a patent is hard to come by

Table 3 showed how the case-study patents were financed. The funding of patents is of course intimately related to ownership. Thus if a researcher is keen to keep control of his or her patentable idea, funding has to be found from somewhere else than a company interested in the technology (unless the company belongs to the researcher). Significantly, perhaps in light of IMT’s entrepreneurial spirit, all the patents (except for one) which were not funded by the company-owner were invented by IMT researchers. In an attempt to have control over their own inventions, IMT researchers have clearly been creative in their efforts to fund their own patents. For example, they had used project money to fund patenting, subsequently making sure it was paid back in some way (Q, U).

The lack of funding available for university researchers to patent their findings was cited as a considerable problem by several respondents. As Table 3 shows, NUTEK has supported this type of activity, but is now apparently less willing to do so, leaving a considerable gap. The heavy costs of patenting go to engaging the services of a patent attorney who formulates the patent claims, and handles the legal issues surrounding the patent application. If a patent attorney is not used, a Swedish patent application can be as cheap as SEK 3000. However, the very specialized patent language means it is almost impossible for a non-specialist to write a patent application. Gaining comprehensive patent protection in a number of countries costs several hundred thousand kronor for one patent.

After making the first Swedish patent application, the patent system allows one year during which the inventor can decide whether to take it further or not. Several respondents reported that they applied first for a Swedish patent and used the year of grace to try and interest a company in buying the patent. In one of the case-studies, the inventor had paid for the Swedish patent application privately, and used the first year after filing to generate income on sales of his product. He had then used this income to finance further patenting. However, this is a particularly successful product, and this route would not be possible with the vast majority of patents.
Because the process of patenting takes up a lot of time and is unrewarding

Almost all the respondents made reference to the enormous amount of time patenting takes. Even if they had a patent attorney to formulate the patent claims, the inventors had to write the guidelines for the patent, and describe the idea. It was also necessary to keep in close contact with the patent attorney, as misunderstandings about the precise nature of the patent claims inevitably arose. The inventor normally needs to help the patent engineer define the limits of the technology, with texts going back and forth from patent engineer to inventor (N, L p.8). Because of the amount of time patenting takes - time which ate into their other work duties - respondents felt it important that they were compensated in some way for this.

Having an organization such as Forskarpatent AB to deal with patent applications would not reduce the amount of work necessary, as it is a very interactive process between the patent engineer and the inventor himself. As one researcher put it: Jag tycker nog att det finns stora svårigheter ändå mellan forskare och Forskarpatent, genom att allt det praktiska arbetet med patentformulering, formulering av vad som er nytt och vad som inte är nytt, göra referens undersökningar, håla reda på i princip, om det finns tidigare liknande patent, det faller oftast på forskaren, och det er ett jättearbete (D p.12)

I still think there are big problems between researchers and Forskarpatent [the University Holding Company to manage researchers’ patents], because all the practical work with formulating the patent, formulating what’s new and what’s not new, checking references, checking if there are earlier similar patents, that work more often than not falls to the researcher, and that’s a tremendous amount of work.

7.3 Implications for lärarundantaget

This section has identified two groups of reasons accounting for academic patenting, which each appeared to be associated with two types of university inventors. The first group of inventors largely only patented because their research funding depended on it, and it was just perceived as an unwelcome part of their job. These researchers identified more with the traditional university roles of teaching and researching than with its economic role. For them, patenting was largely a chore. The second group of inventors appeared to identify much more strongly with industrial interests, and patented because they were interested in maintaining control over the development and exploitation of their ideas. Researchers in this group had often been involved at some point in spin-off companies. They identified strongly with the economic role of the university.

If the lärarundantag is abolished and IPR ownership rights taken away from university inventors, neither of these groups will bother to patent. For the first group, this would take away even the little carrot they had. If all patents were to go through a Forskarpatent type of organization, they would still have to do the behind-the-scenes work relating to patenting, but would have perhaps even less of a hope of economic reward. For the second group, abolishing the lärarundantag would take away their very reason for patenting: control over their own inventions. As one of them commented ‘det gäller å smida mens järnet är varmt’ / ‘it’s a matter of striking while the iron is hot’ (U p.12), in case the lärarundantag is withdrawn. The divide between these two groups
of respondents can never be bridged by manipulating policies relating to patent ownership.

8. The technology: patentability and exploitability

Some of the reasons for patenting, as well as some factors accounting for whether a patent is exploited or not, need to be sought in the nature of the technology itself. This section explores how the nature of the idea or technology in question may affect whether it is patented and exploited or not. As background data, Table 5 shows the types of technologies and use areas of the case-study patents.

8.1 Patentability

*Fields of technology (and departments) differ in patentability*

IMT research seemed to involve little distinction between research/development and product. Their work was already partly defined by user needs. Thus IMT research seemed more patentable, and these patents appeared highly exploitable, compared to for example IFM research. Patenting was not so important in electrical engineering (especially computing) because of the very fast development of this field: there may be no time to patent. In such cases, it is more important to get to the market before competitors than to have a patent (J p.6).

*The importance of demarcating the technology and identifying the patent claims*

Patentability not only varies according to the broad field of technology, it may also vary between ideas in the same field. For it to be possible to write a patent, and state clearly is being protected, the idea has to be distinct from other ideas. One inventor stated that a central criterion for whether he patented or not was whether the idea was ‘tillräckligt avgränsbar och annorlunda’ / ’sufficiently definable and different’ (L). In his case, one of the most difficult things about his patent was ringing in the invention. When they thought they had succeeded, they found they had included elements of already existing technology, which then needed to be cut out, this complicated the whole patenting process (L p.9,10).

*The importance of identifying applications for the technology*

IMT researchers work near a particular market, and a particular area of application, it is thus relatively easy for them to formulate a patent around a particular application. As an IMT professor admitted:  

Vi arbetar oerhört nära marknaden, och nära industrien, och nära tillämpningen. Vi finns på ett sjukhus där vi har patienter vägg i vägg - ja vi er ganska tillämpade (Q p.7).

We work really close to the market, and close to the industry, and close to the application. We’re located in a hospital campus where we are next door to patients – yes, we are quite applied.
This is not always the case for ISY and IFM researchers working on more general principles. For these researchers, it may often be difficult to decide where the applications are (L p.5).

8.2 Exploitability

The relationship between patent and product and the importance of prototypes

The relationship between patents and products varies, and the degree to which they overlap has implications for the value of the patent. It is often difficult to know how important a particular patent is in a product; for example, a product may use ten patented ideas (N). The mismatch between patent and product partially accounts for why it may be difficult for a firm to deal in royalties with each inventor, and by the same token, why it is very difficult to sell a patent by royalty revenues.

The greater the overlap between patent and product the greater the value of the patent. Thus to market a patent it is important to for the inventor to develop a prototype, so that the patent is not just an idea on paper. By having a prototype, the inventor can not only show that the method is possible, but also how closely the patent relates to the product, thus indicating the value of the patent (N p.3). If the patented idea creates the product, or is centrally important for a product, and especially if there is a prototype, the inventor is in a strong negotiating position regarding royalty agreements with any manufacturing firm. But even if the patent is central to the product, the maximum an inventor can realistically expect to receive is approximately four to five percent of sales (N p.4). Perhaps this mismatch between patents and products is not so apparent in IMT patents, as again, the work of the department is to some extent already defined by users’ needs.

Where a patent is central for a product, it can serve the important role of defining the product, and thus facilitate marketing, if the aim is to license out the patent. Equally, the packaging of a patent allows firms to deal in ideas and inventions in a form which cannot be directly stolen (though the quality of this protection varies from country to country) (O p.5).

In short, in terms of exploitation, the possibility of creating a product is more important than having a patent. However, even when a product idea has crystalized it may not be straightforward to manufacture the product. In one of the case-studies, the product idea fell by the wayside whilst the inventors were trying to manufacture a product. The team found at this late stage that the were phenomena that were ‘oförklarliga, obeskrivbare och obrottliga ... Maxwells demoner’ / ‘inexplicable, undescrivable and unsolvable. … Maxwell’s demons’. As one of the inventors pointed out, ‘Det är en sak å göre enstaka prover i et laboratorium, det er en annan sak om man ska tillvärka en produkt’ / It’s one thing to do individual tests in a laboratory, it’s another thing to manufacture a product.’ (O p.6).
Related to the distinction between patent and product is that between types of patent, specifically basic or generic patents and patents relating to particular applications of the basic patent. It would appear that basic or generic patents tend to be more conceptual, and it may be unclear who the users are (C p.8). To be in a position to market a basic or generic patent to potential licensees, it is necessary to be familiar with the technology, particularly as user groups may not be clearly defined (C p.8).

9. The exploitation process

Details on the exploitation of each case-study can be found in Table 6 (appendix).

9.1 Barriers to exploitation

The problem of finding a market for an invention

Almost half the patents in the data set related to products with medical applications. Several of the inventors responsible for these patents reported difficulty in breaking into medical markets. This difficulty can be traced to two sources of institutional constraint: strict regulations, especially in the USA; and conservative users, particularly amongst the medical profession. Several IMT respondents reported particular difficulty getting their new medical devices approved by the US Food and Drug Administration (FDA). In at least two of these cases, the inventors (who were attempting to exploit the technology themselves) had set up daughter companies in the US whose main task was to gain FDA approval. Similarly, introducing a medical innovation into the Swedish market, such as a new material for implantables, requires carrying out medical trials, and building up experience among the medical profession, which takes time and can be expensive (D p.3).

A conservative attitude to innovations amongst user doctors was frequently cited as a barrier to exploitation. The reasons for this conservativeness was succinctly expressed by an IFM researcher who had developed an improvement to the material used in titanium teeth:

It’s very conservative, in the sense that if something works OK, they don’t want to change it. The doctors are very conservative, and that’s quite understandable, because they are a large group of people. They know what they’ve got, and they know what their patients can tolerate, and they know approximately what to expect. So if you come with a new product, or a modified product of the same...
type that they’re already using where there’s no ‘case record’ – it’s really difficult, and if just one single negative article appears in the newspaper, or if they get a bad result which can be traced back to the change, then it may signal the end of the whole product chain, it may be the end of the whole company.

His patent had been taken over by a small firm, which had not succeeded in exploiting the invention. As this inventor pointed out, it is perhaps more difficult to introduce an improvement to an already existing implantable than to introduce an entirely new product or technology:

Om man har en ‘success rate’ på 95 till 97%, att då föreslå förändringar i processen er väldigt svårt, därför att då behöver man en ny 20 års period att vise på klinisk framgångsrike resultat, ... Det enda chansen nästen att få någon ting nytt som kommer, det måste vara antingen helt ny produkt, eller helt ny teknologi. Förbättring i redan existerande implantage er oerhörd svårt (D p.3).

If they’ve got a 95-97% ‘success rate’, to then suggest changes in the process is very difficult, because you then need a new 20-year period to demonstrate clinically successful results, ... Almost the only chance to introduce something new, is either an entirely new product, or an entirely new technology. To introduce an improvement to an already existing implant material is very difficult.

Similar observations about the unwillingness of the medical profession to adopt innovations were made by IMT researchers. One IMT respondent who had collaborated with a plastic surgeon in developing a devise for attaching blood vessels together, had foreseen this problem. In order to help market his innovation among medics, he had included the head of plastic surgery at the hospital as a co-inventor on his patent, even though the latter had not contributed substantially to the development work; he described the plastic surgeon concerned as a ‘galjonsfigur som går ut och marknads- talar om att det här är en bra produkt’ / ‘a kind of figure head who goes out and talks about this being a good product’ (S p.5).

A second barrier to exploiting the university inventions appeared to be the intransigence encountered amongst Swedish firms, in their reluctance to buy licenses to the patented technology. The inventor of the blood vessel fastener mentioned above had tried and failed to find a Swedish firm to manufacture the product, despite winning IVAs gold medal for this work. He succeeded however, in selling an exclusive licence first to Johnson & Johson, then to 3M, and then to Medical Company Alliances, all in the USA. In his experience, Swedish firms only saw the potential problems and were suspicious of an invention they had not been involved in. He contrasted the attitude of the Swedish firms he had had contact with (’jag har ett inträck av at svenska företag er ganska försiktige och väldigt rädda för att ta risker’ / ‘My impression is that Swedish companies are quite careful and very frightened of taking risks’ (S p.4)) with the positive attitude of their US counterparts.

The mismatch between how university inventors and firms view patents

The way companies view patents, which appeared to be fundamentally different from how university inventors viewed them, seemed to account for the non-exploitation of some of the university patents. Whilst university inventors primarily saw patents as the first stage to exploiting an idea, the companies on whom they were often dependent for buying their patents, were primarily interested in patents in order to strengthen their patent portfolios in a particular area of technology. Several of the university patents in
the data set which remained unexploited were sitting in firms’ patent portfolios. Firms increased their own value through owning a strong patent portfolio, which gave them a means of negotiating with other competing and collaborating companies. In this context patents act as a kind of currency to be exchanged, and the content of the patents, and the identity of the inventor is less relevant. Patent portfolios are important for both small and large firms. Inventors at times expressed frustration at their invention remaining unused in this way (D).

9.2 Factors accounting for successful exploitation

Three factors accounting for successful exploitation of university patents are identified here: the importance of personal and ongoing contact with firms and users; an appropriate division of labour between technology development and marketing at the exploitation stage; and the availability of capital at the exploitation stage.

The importance of personal and ongoing contact with firms and users

As mentioned in the previous section, some respondents reported a reluctance amongst particularly large Swedish firms to buy university inventions. In cases, where inventors had succeeded in attracting the interest of large Swedish companies in their research and commercialization activities, such links were almost invariably based on personal and long-standing contacts with the firms. As an IFM professor pointed out, in order to succeed in commercially developing an idea, it is almost necessary to have an industrial partner on board right from the beginning. If a firm has participated in defining the project from the start, it is more likely to be interested in the results (eg E p.3) (and perhaps this is a reason why Forskarpent failed to sell many licences to industry). It should however be pointed out that the case-studies include two recent spin-offs from IMT which were successfully exploiting university inventions without the backing of a large company.

Trust was mentioned as a factor accounting for a successful university-firm relationship. In fact, one striking feature of the data is the strong links between university researchers and local firms, especially between ISY and Mjärdevi firms. All three ISY spin-offs in the data are located in Mjärdevi. It was clear from the case-studies that ISY in particular, but also IFM, had strong links with former students who had subsequently gone on to work in industry, either in Mjärdevi or elsewhere. Such collaborations were cited by university inventors as examples of successful relationships with industry. Indeed, one ISY researcher maintained that he was driven by the ambition to help build up the activity in Mjärdevi, so that his department’s students would not move to Stockholm.

These former students who had the advantage of knowing about the work at the university, often forged a valuable bridge between their current firm and their former university department. Indeed, their firms, whether big or small, often approached the university if they had a particular problem which needed solving (L pp.2-3). This type of request was the origins of at least two of the case-study patents. Another clear trend
is that doctoral students who have finished their studies regularly go on to work in a company that a senior member of staff in their university department had helped establish. This is at least the case with Varilab, Sectra, Sensistor, and probably IVP and Context Vision too.

For IMT inventors, personal contact with the users of their technologies appeared to be a central driving force in the department’s activities. The importance of being next to hospital departments was seen as an important advantage. Users of IMT technology (usually doctors) played important roles at every stage of the development of an idea. They came to IMT researchers with specific needs, which could become the seed of a new patent; they helped IMT researchers gain quick access to patients for trials and so avoid having to go through all the formal channels as an external firm would have to; and they tried out the new products in a clinical setting. All except one of the five IMT inventors reported close collaboration with hospital clinicians.

One of the IMT inventors suggested that personal and ongoing contact with the users of a new device might improve the chances of the technology gaining a market. For example, he reported that potential users were often initially sceptical to a new device. However, an ongoing contact with the inventor might give the user the opportunity to reflect and change his mind:

We’ve noticed quite often here, when there are… new ideas that you have, you know, a new technology, or new device, and when you present it to a doctor, …I mean we do do some kind of market assessment ourselves, … you have to remember that there is a slowness in the system also. Many people [medics] – people react very differently to a new technology – are very sceptical at first, and the ones who are sometimes sceptical first time round, when you’ve talked to them a few times,… - I’ve got an example of that – I’ve got someone here who was very sceptical first time round, then after a year … when he’d heard a bit more about it, then he comes to me and says, ‘What a great idea this is!’ , and he’s changed his mind, he’s sort of given himself a chance to understand what it’s actually about, and to think about it, and the idea itself was maybe described better and better as time went on.

This would not have been possible without an ongoing and personal contact. This IMT inventor commented that such an opportunity would have been missed had he patented through Forskarpatent, who would have carried out a market evaluation and the patent might have ended on the shelf (U 11-12).

In another of the IMT case-studies, the inventor, who had set up his own company to launch his patented idea, was aware of the need for his company to diversify into more products. His aim was to do this by developing other products required by the same group that used his first product. IMT appeared to be particularly outward oriented with its large range of contacts among medical companies and the medical profession. This
was reason enough for IMT inventors with successful spin-off companies to want to remain in their university jobs, despite it being difficult for them to juggle a regular job with a company. Thus when the owner of Optovent was asked why he remained at the University, he replied:

Jag har jo en väldigt stor kontaktät - ... och jag ser ju att jag har ju väldigt mycket kontakter här på sjukhuset, i branschen, med kollegor, jag skulle nog bli ganska isolerat om jag satte mig i liten firma ensam och trodd att jag ska utveckla medicinsk teknik (T p.10).

I mean I’ve got a very large contact net. - … and I can see that I’ve got a lot of contacts here at the hospital, in the industry, with colleagues, I mean I would become quite isolated if I sat in a little firm alone, thinking that I could develop medical technology.

The importance of an appropriate division of labour

Several university inventors pointed out that academics are not the right people to run companies to exploit ideas (eg A, B, C). Examples were given where university researchers had tried and failed to run a spin-off company (B). It was not possible to successfully exploit an idea alone, but there needed to be a clear division of labour between the inventor or engineer and entrepreneur or market expert; it was impossible for one and the same person to carry out all these tasks (C p.4,6, D p.12).

The importance of the availability of capital

Risk capital was cited by at least two of the respondents as the key to exploitation (A, D). It was seen as being the deciding factor between being able to exploit one’s own ideas and losing them all to companies (D p.11). However, views varied as to its availability in Sweden (A, O). One inventor suggested that venture capital existed in Sweden, but that few had the expertise to work with it in the right way (O); further the Swedish tax system was perceived as a problem, 'Man får inte bli rik på det sättet att man blir rik genom sitt arbete, utan man får bare bli rik med hjälp ut av Loket .. [det är det ända sättet] man kan bli rik på som er socialt akceptabelt i Sverige' / 'You're not supposed to get rich by getting rich from your work, the only acceptable way of getting rich is with the help of Loket [Swedish TV lotto show] … [that’s the only way] you can get rich which is socially acceptable in Sweden' (O p.3). An IFM professor suggested that having a patent was not as centrally important for gaining risk money as personal contacts, marketing, and a product (A p.9).

9.3 The central issue of inventor control and its implications for the Forskarpatent concept and lärarundantaget

A strong theme throughout the interview data is that of control. University inventors almost invariably (though there were exceptions) identified with their patent to the extent that they wanted to maintain some sort of control over its fate. This was true even for a number of those who patented because they felt they had to, rather than because they wanted to (as identified in section 6.3 above). Inventors differed of course in the degree of control and responsibility they wanted over the fate of their invention.
Respondents expressed different reasons for wanting some kind of control over their patent. Five such reasons can be identified. These were: a desire to be kept informed about the patent’s status, and about what intentions any owner or licensee firm had for the patent; a desire to make sure an effort was made to exploit the patent, and that it did not just sit in some firm’s patent portfolio; a desire to have some say in who was to exploit the patent; and a desire to be directly involved in the exploitation. Another central issue raised by respondents was that any initiatives taken over the fate of the patent should be voluntary.

Table 6 indicates that there appears to be a strong positive relationship between the university inventor being involved in the further development and commercialization of the patent, and the likelihood that a prototype is produced and that the patent reaches the manufacture stage. It might therefore be conjectured that it is not only a matter of inventors desiring some form of control over their invention, but that this is also a necessary condition for successful exploitation.

Respondants were on the whole negatively disposed to Forskarpatent for the very reason that they perceived that patenting through Forskarpatent precluded exerting much control over what happened to the patent. The data bears out their doubts.

Thus of two respondents who had submitted patents to Forskarpatent, one did not know whether the patent had been granted, and the other did not know how far the patent in question had come in the exploitation phase (E, B). A third had given up trying to patent through Forskarpatent, as in his experience, ‘det händer ingenting’ / ‘nothing happens’ for years after submitting a patent idea to them. This researcher now has a successful start-up company, and in his view, managing patents ‘by committee’ as he put it, serves no purpose, as nothing gets done (P). A fourth respondent felt strongly that Forskarpatent did not favour local firms, as he believed they should. What happened to his patents was clearly not a value-free issue for him:

For example, if I get an idea [and think] ‘this can be [sold/given to] Sectra [local company]’ or something, which works with image communication, and which I would still like to support because it’s in Mjärdevi [local science park] in Linköping. If I’m forced to go to Forskarpatent, and Forskarpatent says, ‘Yes, but we’re going to sell this to Nokia’, or, - Somehow I feel that I’ve lost control.

He would rather keep hold of his patent than give it to a firm which was not in Mjärdevi. In yet a further case, an inventor felt strongly that he wanted to follow his ideas through to the end, particularly as patenting and exploitation is not a linear process, as the Forskarpatent concept would seem to suggest. He pointed out that even after a patent has been filed, the patented idea has not been exhausted and still needs developing. Submitting his patent to Forskarpatent would probably make it difficult to follow it up (U).

The case-studies indicate a relatively strong co-variance between type of patent owner and whether the patent was successfully exploited or not. Those patents which were
exploited are also those owned by Linköping University spin-off companies (see Table 6). Thus it would seem that it was the patents of those inventors who had been involved in exploiting their own inventions (i.e., those who made full use of the opportunities afforded by the lärarundantag) that became exploited (and presumably this is the same group of inventors identifying strongly with industrial interests, as suggested in section 6.3). In light of this finding, it would appear to be a mistake to do away with the very mechanism that allows enterprise amongst university inventors. And if the alternative is to channel all university patents through a Forskarpent-like organization, that would be a double whammy.
References


## Appendices

### Table 1 Key to abbreviations used

<table>
<thead>
<tr>
<th>Department</th>
<th>Group name (English)</th>
<th>Group name (Swedish)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFM</td>
<td>Inst. för fysik och mätteknik</td>
<td>Dept. of Physics and Measurement Technology</td>
</tr>
<tr>
<td>IMC AB</td>
<td>Industriellt mikroelektronikcentrum</td>
<td></td>
</tr>
<tr>
<td>IMT</td>
<td>Inst. för medicinsk teknik</td>
<td>Dept. of Biomedical Engineering</td>
</tr>
<tr>
<td>ISY</td>
<td>Inst. för systemteknik</td>
<td>Dept. of Electrical Engineering</td>
</tr>
<tr>
<td>NIMED</td>
<td>Kompetenscentrum Noninvasiv medicinsk mätteknik</td>
<td>Centre of Excellence in Non-Invasive MEDical Measurements</td>
</tr>
<tr>
<td>NSC</td>
<td>Nationellt superdatorcentrum</td>
<td>National Supercomputer Centre</td>
</tr>
<tr>
<td>S-SENCE</td>
<td>Kompetenscentrum Swedish Sensor Centre</td>
<td>Centre for Bio- and Chemical Sensor Science and Technology</td>
</tr>
</tbody>
</table>

### Translations of University group and centre names

<table>
<thead>
<tr>
<th>Department</th>
<th>Group name (English)</th>
<th>Group name (Swedish)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFM</td>
<td>Applied Physics</td>
<td>Tillämpad fysik</td>
</tr>
<tr>
<td></td>
<td>Chemistry</td>
<td>Kemi</td>
</tr>
<tr>
<td></td>
<td>Electronic Devices</td>
<td>Elektroniska komponenter</td>
</tr>
<tr>
<td></td>
<td>Material Science</td>
<td>Materiefysik</td>
</tr>
<tr>
<td></td>
<td>Physics</td>
<td>Fysik</td>
</tr>
<tr>
<td></td>
<td>Semiconductor Physics</td>
<td>Yt- och halvledarfysik</td>
</tr>
<tr>
<td></td>
<td>S-Sence: Swedish Sensor Centre, Centre for bio-and chemical sensor science and technology</td>
<td>Kompetenscentrum S-Sence</td>
</tr>
<tr>
<td>IMT</td>
<td>Biomedical Instrumentation</td>
<td>Biomedicinsk instrumentteknik</td>
</tr>
<tr>
<td></td>
<td>NIMED: Center of Excellence in Non-Invasive MEDical Measurements</td>
<td>Kompetenscentrum NIMED</td>
</tr>
<tr>
<td></td>
<td>Physiological Measurements</td>
<td>Noninvasiv medicinsk mätteknik</td>
</tr>
<tr>
<td></td>
<td>Physiological Measurements (Development group)</td>
<td>Fysiologisk mätteknik</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Utvecklingsgrupp)</td>
</tr>
<tr>
<td>ISY</td>
<td>Computer Vision Laboratory</td>
<td>Bildbehandling</td>
</tr>
<tr>
<td></td>
<td>Image Coding</td>
<td>Bildkodning</td>
</tr>
<tr>
<td></td>
<td>Information Theory</td>
<td>Informationsteori</td>
</tr>
<tr>
<td>Other</td>
<td>Interconnect and Packaging (IMC AB)</td>
<td>Elektronikbyggsätt (IMC AB)</td>
</tr>
<tr>
<td></td>
<td>National Supercomputer Centre (NSC)</td>
<td>Nationellt superdatorcentrum (NSC)</td>
</tr>
</tbody>
</table>
### Table 3 Funding of research and financing of patent

<table>
<thead>
<tr>
<th>Patent owner</th>
<th>Dept. of inventor</th>
<th>Date of patent</th>
<th>Who paid for research?</th>
<th>How financed patent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB</td>
<td>IFM</td>
<td>1995</td>
<td>ABB &amp; NUTEK &amp; TFR</td>
<td>ABB</td>
</tr>
<tr>
<td>ABB</td>
<td>IFM/ABB</td>
<td>1996</td>
<td>NUTEK &amp; indirectly ABB.</td>
<td>ABB</td>
</tr>
<tr>
<td>Neste OY</td>
<td>IFM</td>
<td>1990</td>
<td>Neste OY</td>
<td>Neste OY</td>
</tr>
<tr>
<td>Telia</td>
<td>ISY</td>
<td>1989</td>
<td>Televerket, doktorand wrote thesis on it</td>
<td>Televerket</td>
</tr>
<tr>
<td>Forskarpatent</td>
<td>IFM</td>
<td>1995</td>
<td>?</td>
<td>Forskarpatent</td>
</tr>
<tr>
<td>Inventors</td>
<td>IFM</td>
<td>1985</td>
<td>Didnt get paid, did work in freetime</td>
<td>Grytsbruk träddrageri (kr 250,000)</td>
</tr>
<tr>
<td>Inventors/ Fält Elektronik</td>
<td>IMT</td>
<td>1991</td>
<td>NUTEK for development work, then became NIMED project</td>
<td>Institute’s project money kr 430,000 &amp; NUTEK turned a blind eye. Now Fält taken over all the costs &amp; repay the institute</td>
</tr>
<tr>
<td>Ellem Bioteknik</td>
<td>IFM</td>
<td>1990</td>
<td>NUTEK (now SSF Material utvecklings progr. Kosortium)</td>
<td>Ellem? or Nobel Biocare?</td>
</tr>
<tr>
<td>Medivir</td>
<td>IFM</td>
<td>1991</td>
<td>Medivir &amp; NUTEK</td>
<td>Medivir</td>
</tr>
<tr>
<td>Sensistor (Spin-off)</td>
<td>IFM / sensistor</td>
<td>1991</td>
<td>STU then NUTEK. Sensistor also had funding from NUTEK</td>
<td>Sensistor through loan from NUTEK</td>
</tr>
<tr>
<td>Varilab (Spin-off)</td>
<td>IFM</td>
<td>1990</td>
<td>NUTEK then Astra</td>
<td>Nycomed money</td>
</tr>
<tr>
<td>Context Vision (Spin-off)</td>
<td>ISY</td>
<td>1986</td>
<td>NUTEK</td>
<td>Context Vision</td>
</tr>
<tr>
<td>Lisca (Spin-off)</td>
<td>IMT /Lisca</td>
<td>1990</td>
<td>NUTEK (Novare Kapital supports Lisca AB)</td>
<td>Patent costs so far 1/2 mill. Lisca AB paid through sales. Set up firm in order to pay patent costs</td>
</tr>
<tr>
<td>Optovent (Spin-off)</td>
<td>IMT</td>
<td>1994</td>
<td>At beginning his companion invested kr 100,000s, was much free work, and didnt take out salaries.</td>
<td>IMT Prof. got NUTEK to pay for 1st Swedish patent. Optovent paid the other patents</td>
</tr>
<tr>
<td>Sectra (Spin-off)</td>
<td>ISY</td>
<td>1996</td>
<td>NUTEK</td>
<td>Sectra</td>
</tr>
<tr>
<td>Sicon (Spin-off)</td>
<td>IFM</td>
<td>1993</td>
<td>NUTEK (CERN money)</td>
<td>Sicon</td>
</tr>
<tr>
<td>IVP (Spin-off)</td>
<td>ISY</td>
<td>1993</td>
<td>NUTEK</td>
<td>IVP</td>
</tr>
<tr>
<td>Unlink (Spin-off)</td>
<td>IMT</td>
<td>1983</td>
<td>Done in own time, as IMT not interested in surgical instruments at the time. But got development money from Linköing Univ &amp; loan from STU, kr 200,000 which they paid back.</td>
<td>STU</td>
</tr>
</tbody>
</table>
### Table 4. Notes on compensation to patent inventor for each case-study patent

<table>
<thead>
<tr>
<th>Patent owner</th>
<th>Dept.</th>
<th>How financed patent</th>
<th>Compensation to inventors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB</td>
<td>IFM</td>
<td>ABB</td>
<td>As ABB employee, lump sum every new patent authority</td>
</tr>
<tr>
<td>ABB</td>
<td>was IFM now ABB</td>
<td>ABB</td>
<td>is ABB employee &amp; was indirectly then too</td>
</tr>
<tr>
<td>Neste OY</td>
<td>IFM</td>
<td>Neste OY</td>
<td>As though employed by Neste - got compensation (20 000)</td>
</tr>
<tr>
<td>Telia</td>
<td>ISY</td>
<td>Televerket</td>
<td>% sales</td>
</tr>
<tr>
<td>Forskarpatent</td>
<td>IFM</td>
<td>Forskarpatent</td>
<td>% of license sales 2-3000</td>
</tr>
<tr>
<td>2 inventors</td>
<td>IFM</td>
<td>Grytsbruk träddrageri (250,000)</td>
<td>inventors granted patent ownership as compensation for work done</td>
</tr>
<tr>
<td>4 inventors themselves</td>
<td>IFM</td>
<td>NUTEK paid the Swedish patent, others were paid by a number of firms, through options avtal, who had right of first refusal</td>
<td>had agreement between inventors about %, no money ever came out of it</td>
</tr>
<tr>
<td>inventors/ Fält Elektronik</td>
<td>IFM</td>
<td>payed patent costs from institutes project money 430,000 &amp; NUTEK turned a blind eye. Now Fält taken over all the costs &amp; repay money to the institute</td>
<td>licence agreement between him, Öberg &amp; Fält, is described how much royalties they get if product is sold. Royalty agreement w.Fält is on sales of product &amp; on sales of licenses.</td>
</tr>
<tr>
<td>Ellem Bioteknik</td>
<td>IFM</td>
<td>either through Bränemarks company or Nobel Biocare, Bjursten got this funding</td>
<td>? for earlier patent was 3% of any profits</td>
</tr>
<tr>
<td>Medivir</td>
<td>IFM</td>
<td>Medivir</td>
<td>one of the inventors had agreement with Medivir &amp; he had agreement with the other inventors</td>
</tr>
<tr>
<td>Sensistor (Spin-off)</td>
<td>was VD sensistor &amp; before that doktorand tillämpad fysik</td>
<td>Sensitor through vilkorslån from NUTEK</td>
<td>-</td>
</tr>
<tr>
<td>Varrilab (Spin-off)</td>
<td>IFM</td>
<td>Nycomed money</td>
<td>-</td>
</tr>
<tr>
<td>Context Vision (Spin-off)</td>
<td>ISY</td>
<td>Context Vision</td>
<td>Context Vision had agreement with university &amp; NUTEK Context Vision paid sum to ISY &amp; had royalty agreement with NUTEK who sponsored the research</td>
</tr>
<tr>
<td>Lisca (Spin-off)</td>
<td>tjl. from IMT Lisca</td>
<td>total patent costs so far, 1/2 mill. Lisca AB paid through forsäljning. Set up firm in order to pay patent costs</td>
<td>-</td>
</tr>
<tr>
<td>Optovent (Spin-off)</td>
<td>IMT</td>
<td>Öberg got NUTEK to pay for 1st Swedish patent. Optovent paid the other patents</td>
<td>Optovent in NIMED &amp; pays loads of money in to make sure institution gets back time and resources put in. 2 firms in NIMED are IMT spin-offs.</td>
</tr>
<tr>
<td>Sectra (Spin-off)</td>
<td>ISY</td>
<td>Sectra</td>
<td>% royalty on sales discussed between inventors what it was worth &amp; shared equally, but not seen any money yet. Royalties relate to particular product where the patent is implemented.</td>
</tr>
<tr>
<td>Sicon (Spin-off)</td>
<td>IFM</td>
<td>Sicon</td>
<td>inventor Svensson part owns Sicon: licence revenue</td>
</tr>
<tr>
<td>IVP (Spin-off)</td>
<td>ISY</td>
<td>IVP</td>
<td>agreement VIP &amp; inventors, each country that patent accepted in, 2 inventors get a sum (5000?), because they didnt know it was patentable, so contract was lump sum for each country</td>
</tr>
<tr>
<td>Unlink (Spin-off)</td>
<td>IMT</td>
<td>STU</td>
<td>All royalty money goes into Unlink, and reinvested in other innovations. Didnt take out salaries. lot of royalty money coming in. Can either have high downpayment &amp; low royalty or opposite, they got low downpayment &amp; high royalty from Johnson&amp;Johnson</td>
</tr>
</tbody>
</table>
Table 5 Technology, product and area of application of case-study patents, sorted by whether exploited or not

<table>
<thead>
<tr>
<th>Patent owner</th>
<th>Technology/ product description</th>
<th>Area of exploitation/ potential market</th>
<th>Manufactured by owner or other licensee?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forskarp.</td>
<td>high temperature chemical sensors</td>
<td>Generic patent: wide area of application</td>
<td>doesnt know</td>
</tr>
<tr>
<td>Ellem Bioteknik</td>
<td>biomaterial titanium, way of improving surface</td>
<td>Medical, implant titanium teeth</td>
<td>doesnt know</td>
</tr>
<tr>
<td>Medivir</td>
<td>organic synthesis, to make derivatives against viruses</td>
<td>Pharmaceuticals</td>
<td>doesnt know</td>
</tr>
<tr>
<td>ABB</td>
<td>silicon carbide as semiconductor material</td>
<td>how manufacture silicon carbide components</td>
<td>N</td>
</tr>
<tr>
<td>Neste OY</td>
<td>polymer material electronics to build components</td>
<td>Build components with new material</td>
<td>N</td>
</tr>
<tr>
<td>Telia</td>
<td>encryption with source coding</td>
<td>Cryptology, data security, video on demand</td>
<td>N</td>
</tr>
<tr>
<td>inventors</td>
<td>detector to measure temperature without contact</td>
<td>Device for improving wire production</td>
<td>N</td>
</tr>
<tr>
<td>inventors</td>
<td>flow meter, measure unine flow</td>
<td>Medical</td>
<td>N</td>
</tr>
<tr>
<td>Sensistor (Spin-off)</td>
<td>electrochemical measuring electrode, chemical sensors</td>
<td>?</td>
<td>N</td>
</tr>
<tr>
<td>IVP (Spin-off)</td>
<td>smart sensors, semi conductors, silicon technology not developed yet enough to produce</td>
<td>Unclear who needs the technology</td>
<td>N</td>
</tr>
<tr>
<td>ABB</td>
<td>reactor/susceptor for growing silicon carbide crystals</td>
<td>to develop components with silicon carbide</td>
<td>N (infringement by Lund firm)</td>
</tr>
<tr>
<td>Varilab (Spin-off)</td>
<td>sensor eg measure light absorption</td>
<td>Medical sector for blood analysis</td>
<td>Y</td>
</tr>
<tr>
<td>Context Vision (Spin-off)</td>
<td>apparatus to do with computer vision</td>
<td>?</td>
<td>Y</td>
</tr>
<tr>
<td>Lisca (Spin-off)</td>
<td>blood flow meter, laser doppler, generic imaging technology.</td>
<td>Medical</td>
<td>Y</td>
</tr>
<tr>
<td>Optovent (Spin-off)</td>
<td>instrument to measure breathing, electronics, optical methods.</td>
<td>Medical, patient observation, eg ambulance use.</td>
<td>Y</td>
</tr>
<tr>
<td>Sectra (Spin-off)</td>
<td>Angio, signal &amp; picture handling.</td>
<td>Medical, teleradiologi, image processing</td>
<td>Y</td>
</tr>
<tr>
<td>Unlink (Spin-off)</td>
<td>instrument to attach together blood vessels in plastic surgery</td>
<td>Medical</td>
<td>Y</td>
</tr>
<tr>
<td>inventors/ Fält Elek.</td>
<td>optics, non-invasive. Measure breathing rate with light, eg if breast is opened up.</td>
<td>Medical, Can observe pateint without disturbing</td>
<td>Y being developed</td>
</tr>
<tr>
<td>Sicon (Spin-off)</td>
<td>Analogue to digital converter micro electronics</td>
<td>Generic wide area</td>
<td>Y being developed (infringement by US firm)</td>
</tr>
</tbody>
</table>
Table 6  Exploitation of case-study patents sorted by type of owner

<table>
<thead>
<tr>
<th>dept.</th>
<th>Owner</th>
<th>Is there prototype or product?</th>
<th>Is it manufactured by owner or other licensee</th>
<th>Is respondent-inventor (or other university inventor) involved in further development of product/commercialization?</th>
</tr>
</thead>
<tbody>
<tr>
<td>IFM</td>
<td>Big ABB</td>
<td>being developed</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>IFM/ABB</td>
<td>Big ABB</td>
<td>Y</td>
<td>N (but patent infringement by Lund firm)</td>
<td>N</td>
</tr>
<tr>
<td>IFM</td>
<td>Big Neste OY</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>ISY</td>
<td>Big Telia</td>
<td>N, future?</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>IFM</td>
<td>Forskarpatent</td>
<td>doesnt know</td>
<td>doesnt know</td>
<td>N</td>
</tr>
<tr>
<td>IFM</td>
<td>Inventors</td>
<td>Y</td>
<td>N</td>
<td>Y (but let patent go)</td>
</tr>
<tr>
<td>IMT</td>
<td>Inventors</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>IMT</td>
<td>Inventors/ Fält Elektronik (NIMED)</td>
<td>Y being developed</td>
<td>Y (is NIMED project)</td>
<td></td>
</tr>
<tr>
<td>IFM</td>
<td>Small Ellem Bioteknik (sells licenses, Malmö)</td>
<td>doesnt know</td>
<td>doesnt know</td>
<td>N</td>
</tr>
<tr>
<td>IFM</td>
<td>Small Medivir (forskningsbolaget, Stockholm)</td>
<td>N</td>
<td>doesnt know</td>
<td>N</td>
</tr>
<tr>
<td>ISY</td>
<td>Spin-off Context Vision (Mjärdevi)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ISY</td>
<td>Spin-off IVP (Mjärdevi)</td>
<td>N, future?</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>IMT/Lisca AB</td>
<td>Spin-off Lisca (Berzelius)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>IMT</td>
<td>Spin-off Optovent (Sundbyberg)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ISY</td>
<td>Spin-off Sectra (Mjärdevi)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>ISY/Sensistor AB</td>
<td>Spin-off Sensistor</td>
<td>N, technical problems</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>IFM</td>
<td>Spin-off Sicon (konsult företag, Mjärdevi)</td>
<td>Y</td>
<td>being developed (also patent infringement by US firm)</td>
<td>Prototype Y; commercialization N</td>
</tr>
<tr>
<td>IMT</td>
<td>Spin-off Unilink (Linköping, only licenses out)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>IFM</td>
<td>Spin-off Varilab (Stockholm)</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>