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The management and commercialisation of intellectual property in European universities

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The management and commercialisation of intellectual property in European universities

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ABSTRACT

This report presents the results of an empirical study that explores intellectual property (IP) management practices among universities in the European Union. The report presents models and processes of IP management and research commercialisation – and their interdependencies. Furthermore, the report identifies four main challenges for IP management, including lack of funding for proof-of-concept work, resource constraints, a broad range of technologies and industries with which technology transfer offices (TTOs) need to work, and a non-existent local industry combined with legitimacy problems when trying to partner internationally. All in all, these challenges typically make IP management in the university setting more difficult than in the private industry setting. The dominant and linear IP management process that focuses primarily on value capture – the appropriation model – is criticised, and interviewees see a need to shift focus to better interact with industry and focus more on value creation and utilisation rather than only on appropriation.

EXECUTIVE SUMMARY

In the Science, Research and Innovation Performance of the EU 2020 report ([1]) a need was identified for Europe to better valorise and utilise its research results. An important question – related to valorisation and utilisation – is how intellectual property (IP) is used and managed. Much research has covered and debated the process of commercialising university research results in general, and some research has identified good practices in terms of IP management models. However, we still have relatively limited knowledge about the IP management practices of the broad range of universities across different EU nations.

This report presents the results from an empirical study that explores intellectual property (IP) management practices among 21 universities in the European Union. The aim is to improve our understanding of what smart use of IP is in the university context. The studied universities include both top-ranked and lower-ranked ones. They represent 14 EU Member States, including six widening countries[2].

The report makes a number of contributions. First, it presents models and processes of IP management and research commercialisation – and their interdependencies. IP management involves training and research contracting, but the primary focus is on the patenting process. In most universities this follows a fairly linear selection process, in which inventions are disclosed and selected for patenting based on patentability and sometimes commercial potential. The focus in this process is on protecting research results and generating revenues of some sort. Some universities contrast this linear model with one where researchers are more involved in developing research results and engaging with industry, for example in well-organised postdoctoral programmes with funding for proof-of-concept activities.

The report also identifies four main challenges for IP management. One challenge is the lack of funding for proof-of-concept work. Another challenge is the resource constraints of technology transfer offices (TTOs), which push them to focus primarily on the patenting process rather than on interaction with industry. A third challenge is the broad range of technologies and industries with which TTOs need to work, which makes it difficult to understand the market sufficiently well. A fourth challenge, especially prevalent among universities in some of the widening countries, is that of a non-existent local industry and legitimacy problems when trying to partner internationally.

All in all, these challenges typically make IP management in the university setting more difficult than in the private industry setting. This insight highlights the complex reality that IP professionals in the university sector need to deal with.

The dominant and linear IP management process that focuses primarily on value capture – the appropriation model – is criticised in the report. The empirical study also finds a widespread agreement among the interviewees that there is a need to shift focus to better interact with industry and focus more on value creation and utilisation rather than only on appropriation – or in other words to focus both on continued value creation and value capture when managing IP. In this type of utilisation model for IP management, IP is used as a tool for and facilitator of interaction in addition to its protection function.

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1 *Science, Research and Innovation Performance of the EU 2020 – 11 recommendations for a fair, green and digital Europe*, European Commission Directorate-General for Research and Innovation, Publications Office of the European Union, Luxembourg, 2020 (https://ec.europa.eu/info/publications/science-research-and-innovation-performance-eu-2020_en).

2 Widening consists of three main actions, i.e. Teaming, Twinning and ERA Chairs, for which specific eligibility conditions apply. This ensures a targeted approach towards Widening Member States and Associated Countries. The six widening Member States covered by this study are Bulgaria, Croatia, Czechia, Estonia, Portugal and Slovakia.

The empirical data indicates large differences across nations and universities, which means that it is not meaningful to define what a smart use of IP is: this is completely contingent upon the specific case and context. Rather, we must first focus on what the smart use of IP is for. Therefore, the report develops a new definition, saying that for public universities, smart use of IP is the use of IP for facilitating continued value creation while enabling fair and reasonable value capture for the relevant stakeholders.

About the author

Marcus Holgersson is Associate Professor of Intellectual Property Management at Chalmers University of Technology, Sweden. His research focuses on the management and strategy of intellectual property. He has researched IP management in both private and public organisations, both small and large. His previous research has covered topics such as the governing function of IP in innovation ecosystems, the challenge of managing IP in the mergers and acquisition process, the role of IP in venture capital financing, IP management in universities and many more.

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1. INTRODUCTION

This report presents the results from an empirical study that explores intellectual property (IP) management practices among universities in the European Union. The background is an identified need for Europe to better valorise and utilise its research results, as argued in the European Commission's Science, Research and Innovation Performance of the EU 2020 report ([3]). The objective of this study is to explore IP management practices in European universities, and improve our understanding of what smart use of IP is in this setting. The results will provide input to the process of improving the utilisation of university research results.

Much research has been conducted on the topic of commercialisation of university research. The ability of universities and technology transfer offices (TTOs) to effectively and efficiently commercialise research results has been subject to research and debate over decades (e.g., Jacobsson et al., 2013, Kenney and Patton, 2009, Molas-Gallart et al., 2015). While this debate is clearly of relevance to the research here, our study does not aim to evaluate TTO activities. Rather, we want to broadly explore how IP is managed in the utilisation process among European universities, and identify strengths and challenges in the established practices.

In this report we summarise and analyse the main empirical results. We make a number of contributions. First, models and processes of IP management and research commercialisation – and their interdependencies – are presented. Second, the complexities and challenges of these processes are explored, and the important involvement of people is identified. Third, we conclude that the large variation in contextual and internal factors across universities makes the discussion of what smart use of IP is somewhat irrelevant. Instead, we argue that the relevant question is what smart use of IP is for. Drawing both from our empirical data and from previous research, we identify a need to better balance the focus on value capture with a focus on value creation in university IP management, and we provide a new definition in line with this argument.

After this introduction, the report continues with the empirical method, before the results are presented in some detail. Finally, the results are discussed in the conclusion.

2. METHOD

For the purposes of this project, a qualitative research approach was selected. Qualitative research is useful when trying to get in-depth understanding about problems or experiences (Bryman and Bell, 2007). More specifically, semi-structured interviews were selected to explore IP management practices throughout the EU. With such interviews there is room for flexibility, open discussions, and new ideas that can be followed up during the interviews (Bryman and Bell, 2007).

According to the project contract, data should be collected from at least 20 higher education institutions (typically universities), in at least 12 EU Member States, among which at least five should be widening countries. To meet these requirements, 15 EU Member States were sampled in the first phase of the project, including six widening countries. In each Member State we sampled two universities, one of the most

[3] *Science, Research and Innovation Performance of the EU 2020 – 11 recommendations for a fair, green and digital Europe*, European Commission Directorate-General for Research and Innovation, Publications Office of the European Union, Luxembourg, 2020 https://ec.europa.eu/info/research-and-innovation/strategy/support-policy-making/support-national-research-and-innovation-policy-making/srip-report_en#srip2020

prestigious universities and one lower-ranked university. All interviewees were given the opportunity to identify another university of specific relevance in their country. For four Member States this led to a third university being added to the sample. The sample thus consisted of 34 universities across 15 Member States. Using this sampling technique, we covered variation both in geography and university ranking. From previous research we know that there are differences in research commercialisation across Member States (Alshumaimri et al., 2010, Okamuro and Nishimura, 2013, Caldera and Debande, 2010) and across different universities (Battaglia et al., 2017, Wright et al., 2008). With our sampling we tried to include this variation, in order to avoid skewed results, for example due to success bias.

For our sampled universities we gathered contact data for the individuals responsible for technology transfer, research commercialisation, IP management or the equivalent. Thus, the respondents were well informed about the studied topic. Invitations to participate in an interview were emailed, and interviews were subsequently conducted with 21 out of the 34 sampled universities (62 %), representing 14 different EU Member States (see Figure 1 and Table 1 ([4])).

[4] An observation made as far back as the invitation phase of this project was that many participants were cautious about the aim of the study. They seemed aware that they were being continuously evaluated and maybe questioned, and many of them excused themselves for being understaffed almost from the starting point, giving reasons for why they could not work more proactively.

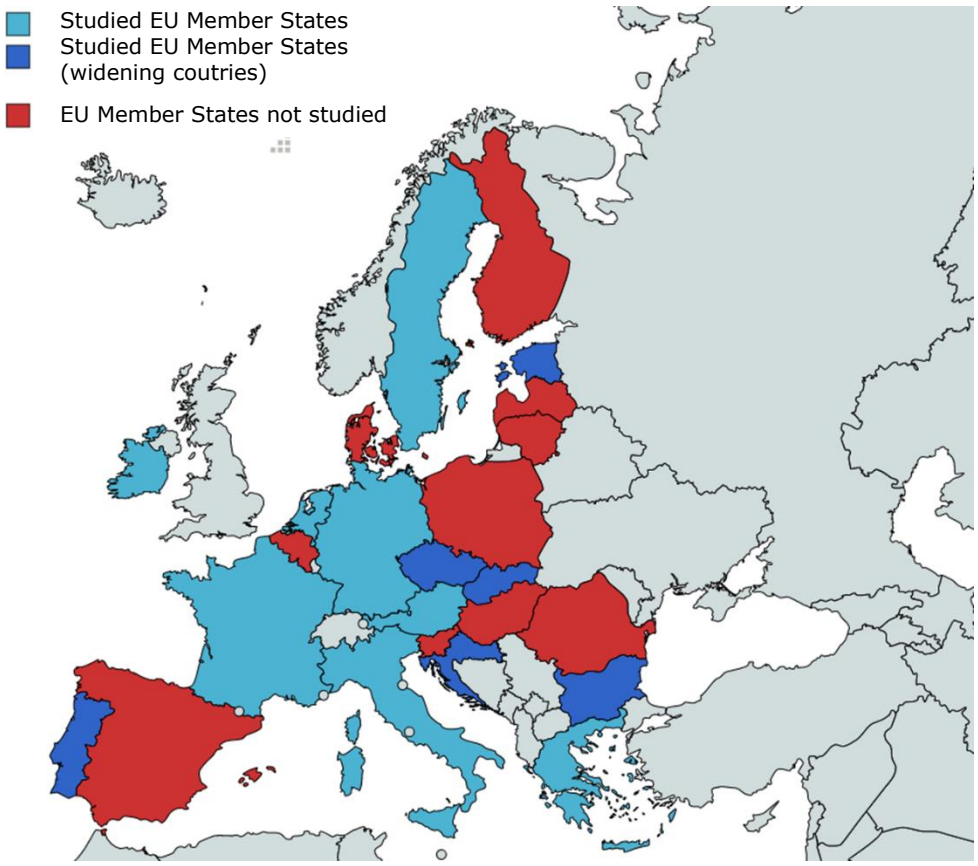

Figure 1. Geographical coverage of the interviews

The interviews were carried out through video calls and were recorded. They typically lasted around an hour (from 35 to 75 minutes). As described above, interviews were semi-structured, following a number of themes while remaining open to explore new topics that the interviewees introduced. The main themes around which the semi-structured interviews evolved include the typical process by which research results are protected and commercialised; if, how and by whom the evaluation of different ways of protecting research results are performed; if, how and by whom the evaluation of different ways of commercialising research results are performed; typical modes of commercialisation and who is involved in it; internal resources for dealing with IP matters; and major challenges that the interviewees experience as barriers against better utilisation and commercialisation of research results (see Table 2). In the next section, the main results from these interviews will be summarised.

Table 1. Member States and universities included in the interviews

Member State	University	Widening country
Bulgaria	Sofia University St. Kliment Ohridski	Yes
Czechia	Palacký University Olomouc	Yes
Czechia	Charles University	Yes
Germany	Leipzig University	No
Estonia	University of Tartu	Yes
Ireland	Maynooth University	No
Greece	Aristotle University of Thessaloniki	No
France	University of Strasbourg	No
France	University of Côte d'Azur	No
Croatia	University of Zagreb	Yes
Italy	Polytechnic University of Milan	No
Italy	University of Trieste	No
Netherlands	Delft University	No
Netherlands	Eindhoven University of Technology	No
Netherlands	Radboud University Nijmegen	No
Austria	University of Vienna	No
Portugal	Instituto Superior Técnico	Yes
Slovakia	Comenius University in Bratislava	Yes
Sweden	Royal Institute of Technology	No
Sweden	Örebro University	No
Sweden	Chalmers University of Technology	No

Table 2. Themes of semi-structured interviews

Main themes
Typical process for the protection and/or commercialisation of research results
Evaluation of protection (if, how and by whom)
Evaluation of commercialisation (if, how, and by whom)
Typical modes of commercialisation (including actors involved)
In-house resources for dealing with IP
Major challenges related to utilisation and commercialisation of research results

3. EMPIRICAL RESULTS

The summary and analysis of the empirical data follow below. We organise the presentation according to different themes, although these themes are interdependent. We include many examples from the empirical material, with the aim of giving the reader an in-depth and rich account of the phenomenon studied.

3.1. Models and processes of IP management

For many, but not all, of the studied universities, the work with IP management starts well before research has provided any results of potential commercial interest. According to the interviews, there are primarily two general activities that are carried out continuously aimed at the early phase of research and researchers.

First, IP management practices include activities to educate university researchers. This is an important step, since IP awareness is necessary to avoid some common mistakes – such as premature publishing – and to make sure that researchers contact the TTO (or equivalent) when there are potentially useful and valuable research results. The training is sometimes done broadly across the university, and sometimes more targeted at specific research projects – typically when they start.

> *Sometimes the process starts very early, just to prepare the researchers of the process – what is IP, requirements etc.*

In some of the studied universities this early educational effort is focused on the formalities of IP rights. In others, where more emphasis is placed on commercialisation rather than on protection, educational efforts are more focused on creating an understanding of industry problems related to a technical solution.

> *Instead we do the PhD student programme with a 1-2 week quick and dirty problem analysis. This is done together with an academic, for example a postdoc, who is involved in the technology. [The question they need to answer is:] Is there a problem?*

For most universities, patents are the most central type of intellectual property rights (IPR) to be managed, and some see the patenting process itself as an educational opportunity. They therefore want to make sure that a broad set of scientists and research groups get the chance to be involved in a patent application process at some point.

> *We want to give all teams the opportunity to experience the patent application process.*

Second, IP management practices include the early analysis of contracts when new research projects are started. This also includes the IP considerations of new collaborations in multi-party research projects, or in projects funded by industrial partners or other types of partners with claims on background and foreground IP.

> *The work starts already at the grant stage. We give advice on how to best shape the collaboration and make proper arrangements.*

Among some universities with less developed IP management practices, the educational efforts may be made even if IP considerations are not included at the starting point of new research projects. Part of the explanation for this is that these universities are less experienced with joint research projects with industry.

These two IP management activities – training and support for research project contracting – are central, but the main activity, as perceived by almost all interviewees,

is that of collecting data on new inventions, evaluating them and following through with IP protection and sometimes commercialisation. Most commonly, the default mode of protection is patenting. There are many reasons for this, including the nature of most inventions, the parallel publication processes of the researchers, which rule out trade secrets as an option, and the primary modes of commercialisation in which patents play an important role.

The process typically starts with an invention disclosure submitted by the inventors. This is evaluated by an employee of the TTO or IP unit, typically in a process involving interaction and discussion with the submitting researchers. A number of steps often follow, typically relating to a number of deadlines. For example, in many Member States the TTO needs to make a decision about whether or not they want to pursue patent protection for the invention, and if not hand back the right to the invention to the inventors within a specific time period. In many cases the TTO makes an initial simple and informal 'prior art' search at this early stage. A formal decision is made about whether or not to apply for a patent, a decision that is taken by different actors depending on university and Member State. But irrespective of actor (president, dean, head of faculty, head of TTO, etc.), the recommendation of the TTO is typically followed by that of the formal decision-maker. In other words, the TTO makes the de facto decision (except in cases where the ownership belongs to the inventor). The next step is to follow through with patent prosecution. In all cases, the dominant strategy is to consult external expertise in the patent prosecution stage. The universities cover a range of research areas that is too broad to allow for internal competence to deal with patent prosecution across all the different scientific fields.

In some cases, but not all, an evaluation of market potential is included before moving forward with patent protection. This also seems to be of increasing importance.

> *Now we are trying to become more business driven. Now we also try to focus on possible industrial applications when we evaluate if we should patent. Most inventions we receive are great, but some are very difficult to commercialise. We try to understand if industry is interested in buying the patents or to develop them further together.*

Overall, the process can in most cases be characterised as a linear innovation funnel, where inventions submitted to the TTO are evaluated based on their patentability and sometimes their commercial potential. Those that are patentable, with some level of commercial potential, are patented, which leads into commercialisation. Those that are not patentable are in many cases cancelled and not dealt with at all.

> *Officially we should deal with everything with commercial potential, but typically we only have time for the patents. The university is so big and our unit is so small. We don't have time for the larger perspective, to transfer knowledge in other ways that could benefit society.*

Many respondents are aware of this limitation, but nevertheless experience a major challenge due to time constraints. There is simply not enough time to work more with commercialisation activities. This also goes for the involvement of the researchers.

> *We would like to consult the professors more on commercialisation maturity. More on the business aspects. We try to satisfy everyone, so we might need to lower the quality because of the quantity … There is no time to focus on commercialisation.*

Despite these challenges, work is still going on to try to commercialise the IP resulting from university research. In the next section, we will discuss some of the main modes being used, and their interdependence with IP management.

3.2. Modes of commercialisation

The dominant modes of utilisation among the interviewed universities focus on some kind of commercial sales, as compared to less commercial types of utilisation. The most used mode varies across universities, but they include spinning off companies, licensing (to spin-offs, start-ups or established companies) and selling patents, along with collaboration and consulting. Much has been written on this topic in the academic literature already, and the studied universities have commercialisation that goes more or less in line with previous research findings (e.g., Holgersson and Aaboen, 2019, Kenney and Patton, 2009, Reed et al., 2021).

What is more important here is how this relates to IP management. The commercialisation processes are performed in parallel to the patenting process, which typically takes several years from the initial application to the granted patents. But compared to the situation in private firms, the timeline of the patenting process creates additional challenges for university research. This is because costs quickly rise when the patenting process moves into the national phase in which application fees need to be paid to several different patent offices. As a consequence the TTOs need to limit the internationalisation of their patent applications, or to make sure to work very fast in trying to commercialise the invention or secure funding for the patenting process, as explained by one interviewee.

> *We make priority filings in [the country of the university] … and after that make a Patent Cooperation Treaty (PCT) application to buy time. Time is always short … after that the national phase. We always need to have a private party to fund the national phase. So everything has to be in place within the 30 months [12 + 18 months]. Otherwise we have to drop it. We might sell it in the last minute for the cost of goods sold to stick to the EU State aid rules [counting hours and patent costs, etc.] … In this 30-month window we look for collaborators, partners and buyers.*

While this timeline is also of importance in private firms (Granstrand, 2018), university research is typically much more early stage, less related to an established line of research and exploitation through products and services on specific markets, and more dependent upon external resources for commercialisation. Thus, the relatively high commercial uncertainty related to university research is challenging for IP management to deal with. This also holds true in settings with a teachers' exemption.

> *The major challenge is the timeline for patent decisions [for example which countries to patent in]. Even if you use the 12 + 18-month route before it becomes a high cost. That imposes certain tensions in our system … It narrows the scope of projects we can work with if there is a patent involved. Sometimes researchers opportunistically file patents, and then are pushed to sell it to someone quickly due to these mounting costs.*

These uncertainties spill over to industrial buyers of inventions as well, and some universities utilise contracts with options to combine the continuous funding of the patenting process while limiting the risk for the industrial partner.

Sometimes we also sell options early on, if the company needs to decide. They pay for 1-2 years of patent costs and get the option to acquire the patent. Roughly 30 % of our commercialisation starts with this [type of option]. This may also be related to a research contract where we try to adapt the technology to the use case of the company. Much of our research is very early stage.

3.3. The complexity of university IP management

The challenge of matching the slow IP commercialisation efforts with the strictly paced patenting timeline and the associated growth in costs is only one out of several complexities that IP management in the university setting must deal with. One of the interviewees, who had shifted careers from one in industry to one in university TTO, summarised a number of complexities that add to the IP management challenges of universities (in contrast to private firms).

> *In the corporate world the decision on what to patent is relatively simple. In the university world, the decision is more complex, and must be dealt with from 0 to 30 months. First we receive the invention disclosure form. We have to consider all actors involved: other universities, companies, etc. We need to consider the research project's contractual requirements [and various modes of commercialisation] … A lot of our commercialisation is spin-offs … [or with] commercial partners.*

Hence, the complexity covers a number of dimensions. First, there may be several different entities with claims on the patented inventions, including individual researchers. These include various partners in the research project and/or organisations funding the research. It is often a challenge to understand who these different actors are, and who the inventors are. There is also a parallel process of research publishing that directly affects patenting and commercialisation. There is a mix of purposes, many of which are qualitatively different from the purposes of a business firm (we will develop this further below). There may also be laws limiting what is legal and/or legally feasible for the university to do, and this varies across Member States. For example, the commercial activities may be restricted.

> *As an administrative authority we cannot support the utilisation process when it comes too close to commercial activities … Hence, in general we try to work towards an exit.*

But transfers of ownership and the related pricing of technologies are also challenging due to EU State aid regulations. Needless to say, this challenge goes across Member States, as illustrated by a couple of interviewees.

> *The reason that the university keeps ownership are tax reasons – because transfer prices need to be right for legal reasons.*

> *Pricing is challenging. Even when we use the guidelines of the European Union. Sometimes using the guidelines for State aid leads to way too high prices … State aid regulations and the relation to pricing is tricky, and dangerous … We want to avoid State aid complaints.*

The upside of State aid regulations, as expressed by some of the interviewees, is however that they provide a compelling case for what the floor price (or minimum acceptable price) for a technology is, even in cases when the TTO lacks bargaining power. But overall, State aid regulations are perceived as challenging, partly because of a limited understanding of them and partly because of risk aversion.

Another dimension of complexity is that of the distributed scientists who are central to the utilisation of their research, but not necessarily interested in participating in it. We will develop this in the next section.

3.4. The involvement of researchers

Since the researchers and inventors are the ones with the best knowledge about their research results, they are central both to the patenting process and to the commercialisation process. Involving these actors is one of the most central activities for university IP management. The importance of this can be illustrated with the following quote.

> *You always need them! Sometimes there is some friction, and sometimes the researcher does not want to support the technology transfer, and if so we are not able to go through with it. For every project, we need to have the researcher involved. Otherwise it is impossible to license.*

The researchers do not only contribute with their scientific expertise. In many cases the commercialisation relies upon their established network with industry.

> *The most successful projects have been where the scientists have good contacts with industry and stay involved in the commercialisation.*
>
> *Researchers are very involved. We deal with lots of basic research so they are necessary. They know the technology and often have contacts with the right companies.*

However, it is not always easy to get researchers engaged with commercialisation activities. For example, in some universities in the widening countries a major challenge is to get the scientists to report their inventions in the first place. There are also differences between different universities in terms of the culture and attitude to commercialising research results, as expressed by one interviewee with experience from multiple high-ranked universities.

> *At [university X], collaboration with industry is completely natural. At [university Y], it's seen as negative.*

One interviewee also explained how researchers are often reserved in their initial contacts with the TTO. Sometimes, however, researchers who have a limited interest in commercialisation initially eventually embrace the idea of making a business of their results.

> *The scientists typically want to focus on their research, but we have to get them on board to package the idea. During that process they often start to fall in love with the idea of creating a business out of the research, and eventually they have created a start-up in which they try to commercialise their research.*

While it is challenging to involve the researchers, they may also turn out to be the remedy for some of the most important challenges when trying to better utilise university research results, as we will see below. But before that, the next section will focus on a number of additional major challenges.

3.5. Perceived challenges

A central theme in our data is what the interviewees perceive as major challenges inhibiting better utilisation of university research. In this section we will discuss the four most important challenges identified in this study; resource constraints, lack of proof-of-concept funding, lack of market knowledge and lack of local industry.

First, a constantly recurring challenge as expressed by the interviewees is that the TTOs (or equivalent) are underfunded and understaffed. For example, when one of the

interviewees was asked about how he and his only colleague worked towards the utilisation and commercialisation of the patents from their university, he quickly answered as follows.

> *Yes this is the problem, it is only the two of us.*

What he referred to was that for a TTO consisting of only two people it is impossible to find time for actively commercialising what they patent. This quote exemplifies a result that unifies and goes across all studied universities and their TTOs; the feeling of being understaffed without sufficient resources for the purpose they are supposed to fulfil.

> *The TTO resources are also a main challenge. If we had more resources we would have more inventions, and also increase contacts with industry.*

This challenge is in some cases further fuelled by the difficulty, as a public organisation, in hiring professionals with IP competence, which is highly valued in the private sector. One interviewee explained that the TTO often hires new people who stay for some time to learn, and then they take off for a job in the private sector.

Second, a major challenge expressed independently by almost every interviewee is that of having to deal with interesting research results at a too low technology readiness level (TRL), especially since there is a perceived lack of easily accessible funding for taking research from low TRLs to industrial prototypes at higher TRLs.

> *The most challenging thing is to develop basic research results to the stage where they are possible to commercialise. Previously we used standard research funding, but it was not intended for this. More and more scientists apply for validation research funding, for example after they have secured the IP with the help of the TTO.*

Some interviewees described the problem in more detail and specified the rough amount of funding that would be useful to mitigate the problem.

> *In the death valley, there is another small death valley where little money is needed to take results to an industrial prototype. Only around EUR 50 000-100 000 is needed, but it is very difficult to find. This funding is too risky for industry.*

Another interviewee made a similar observation about the challenge of making proof of concepts and the need for funding.

> *The biggest challenge is proof of concept funding, at least in [country X]. There is some, but some of it is too complex. We need it to be able to make the final push. It does not need to be much, but it must be simple. Around EUR 10 000-40 000 per project. This would take us very far. For example add a bit of industrial design. Create a more commercial prototype. Make it more appealing and understandable for industry.*

Even with the availability of proof of concept funding on both the EU () and the national levels, the difficult bureaucratic procedures and/or challenging administration limits their use, according to some interviewees:

> *In [country X] we have [had] the governmental POC [proof of concept] funding since the beginning of the year. We hope it should be the solution. But it is a difficult bureaucracy.*[5]

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[5] Recent research has analysed the effectiveness of the European Research Council's proof-of-concept programme, which was initiated in 2011 to improve the valorisation of research. The programme funds activities that aim to take research output and develop it into value propositions, including prototypes,

Apart from funding, a good connection to industry and understanding of its needs can help to efficiently and effectively take a research result from a low to a high(er) TRL.

> *The low TRL is partly a challenge … but … we have established networks with industry … The key is to have the network with industry partners.*

This relates to the third challenge for university IP management; to understand the industry and the market sufficiently well. If we again contrast it with IP management in private firms – which typically focus on a few specific technologies and one or a few main markets – university TTOs work with numerous different types of technologies across multiple scientific fields, and also need to reach out to all kinds of markets and industries. Hence, it would be practically impossible to staff TTOs with expertise spanning all the relevant scientific fields and all the relevant markets. One of the interviewees gave an example relating to lack of specific knowledge about component prices.

> *One example relates to sensors for the automotive market. The partners might say that they already have that sensor at a cost of EUR 10. And you don't know what the right price is. The partners have very, very good understanding and knowledge about the price of components, for example.*

Adding to this challenge is the fact that many of the research results from universities are at the forefront of technological development. For these technologies there might not even be an established market to interact with.

> *It is not only the two of us [TTO staff] who don't know about the market for these early stage technologies – nobody in the world knows.*

Fourth, a challenge that seems especially relevant in some widening countries is the lack of a well-developed national or regional industry to partner with. The experience from universities in some widening countries is that trying to partner with international firms is difficult due to the university's lack of reputation.

> *Companies tend to look for academic contacts in their own countries. They don't have experience with partnering with an unknown partner, and it would be an additional risk they are not willing to take … What seems to work at least is European Commission support for industry–academic partnerships. Since we have very good academics, we'll join larger academic networks together with more well-known universities. Then we are able to show industry what academic institutions can contribute to.*

3.6. Junior researchers as bridges between academia and industry

As described above, many TTOs rely heavily on the competence and market knowledge of the researchers and inventors, who often have good connections to the relevant industries and potential buyers of their inventions. It seems that getting the right researchers involved bridges the gap between academia and industry.

In some of the studied universities, the involvement of junior researchers has been taken a step further, specifically addressing the challenge of raising TRL levels and accessing the market.

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patents, market assessments, etc. Research has shown that this funding scheme significantly improves the level of valorisation. See MUNARI, F. & TOSCHI, L. 2021. The impact of public funding on science valorisation: an analysis of the ERC Proof-of-Concept Programme. Research Policy, 50, 104211.

For example, one of the studied universities has developed a programme in which a year of funding is given to postdocs for developing businesses based on their previous research. The funding is EUR 50 000 per project, and it provides an alternative to continuing with a strictly academic postdoc, or completely leaving academia for industry. While that programme is still young, it has so far been very successful.

Another university has a similar programme, but with a focus on involving PhD students in research of interest to industry from the beginning. This may represent a departure from a previous academic research result, as this example shows.

> *We can bring in a patent as a background IP, and [the industrial partner] can fully fund a PhD student to take the patent and technology further, and the partners will get the IP (background and foreground) in return … They have to pay the full 4 years [for the PhD] … But we must take both the academic and company logics in consideration. The PhD student should not work as a cheap engineer. The academic side is important.*

Another type of programme provides in-depth training and entrepreneurial experience among junior scientists early on. This, in turn, leads to having people with entrepreneurial mindsets working in every research group and it therefore raises the awareness of the opportunities and challenges of commercialisation and utilisation.

3.7. The objective of university IP management

While science is typically seen as something that should provide open and public research results, in form of published research publications, only very few of the studied universities have taken this broader objective of societal good into account in their commercialisation efforts. Many of them still have the default mode of protecting research results that are potentially of commercial interest. For example, one interviewee described that her TTO does not work towards the utilisation of unpatented research results.

> *There would be no way to profit, and we have limited resources. The inventors instead have the option to acquire the ownership by themselves, but we don't provide support for that process.*

While many interviewees instinctively argue that they would like to support the process of research utilisation in a broader sense, they are limited in terms of resources and in some sense guided by implicit or explicit evaluation criteria. One interviewee describes the measures by which her TTO is evaluated as follows.

> *Number of patent applications, return on investment, licence royalties, number of analysed contracts, number of finalised licence agreements, number of presented IP sessions [internal training], number of spin-offs.*

These types of evaluation measures are used in many other universities as well. However, some of them are also starting to realise there is an opportunity to affect how the objective and evaluation of TTOs evolve.

> *The numbers are too easy to look at. Income, numbers of licences, numbers of patents. We are evaluated on this. But impact – or the third mission – is still a relatively young part of our university. So we have a lot of freedom to try and impact the role and evaluation of the TTO.*

Needless to say, if the utilisation efforts are evaluated by measures such as the number of patents or licences, the focus will remain on these outcomes rather than less direct and less measurable – but maybe more valuable – outcomes. In contrast, a few of the

studied universities have a broader objective and a broader view of what research utilisation is and should be.

> *Our results are not financially driven. Making an impact is the goal. Making it used … Our science is based on open science. We protect when we have to protect. But only when it makes sense because otherwise others wouldn't [continue to] invest in it.*

With this line of reasoning patenting is sometimes necessary to enable utilisation and continued development. In some of the studied universities this is a more important guiding principle for whether to patent something than whether or not the university can make a profit from the patent. Another interviewee had a similar experience of focusing on various ways of making an impact, including open-source licensing.

> *When inventors want to do open licensing or open source we don't stand in the way. But we advise on some different types of licences.*

Another interviewee described how they want to facilitate positive impacts in the region where the university is situated.

> *We don't look for the best revenues, but for the best impact for the region.*

On the other hand, aiming at making an impact is a less precise target for a TTO, and may be challenging to translate into priorities, as one interviewee describes.

> *I need to decide what value is and prioritise what to focus on.*

Much research has already shown that the management of IP affects not only value capture, but also value creation (Holgersson et al., 2018, Somaya, 2012, Teece, 2018). Typically, people tend to think about value capture when they consider IP rights, but shifting perspective to one that includes both value creation and value capture may be a fruitful way to expand the view of IP management in European universities. If private firms consider their IP decisions' impact on both value creation and value capturesions, publicly funded research universities –being less dependent on making profits from their inventions – should be even more concerned about the impact of their IP decisions on value creation.

However, as we have explained here this does not mean that all research results should be made available for free use by everyone. There are often very good reasons to protect the research results with patents. For example, one reason is that there is a value-sharing scheme that incentivises the scientists.

> *The inventors often say 'I don't do it for the money' until the money starts to come, then we receive lots of questions. Actually, the money is an incentive for the inventors.*

Another reason is that the IP protection incentivises continued research and development investments by a buyer or licensee of the IP. A third reason is that the profits from the commercialisation of the IP may feed back into the value creation processes of the university.

> *We really want a social impact. The money is a priority, but a second priority. We want to be able to show that the funding of the science comes to use. Sometimes we ourselves also fund the development to get it out to the public. Both are needed, but impact is main priority.*

In general, universities that are good at creating an impact from their research results see the use of IP primarily as a tool for collaboration.

> *IP is one of the tools we can use for collaboration. There are only a few exceptions where income is meaningful. Often licences are offered almost for free up front, in return for the collaboration and PR, and with a running royalty rate with a potential to generate money … Patents and licensing is for us a way to structure collaboration. Patent is only a tool, sometimes a waste of money.*

Thus, while patents are indeed tools for capturing value, some universities increasingly focus on them as facilitators of value creation. This was further exemplified in another interview.

> *You want to get the best deal you can, but the best deal is not always the one with the most money. Sometimes it is about supporting a new start-up company with a favorable licence deal. This may lead to collaborations leading to new funding opportunities in collaboration with university researchers down the road.*

In this section we have tried to give a rich account of what IP management practices in universities are and what they are about to become. In the final section we will conclude with some of the main takeaways from this empirical dataset.

4. CONCLUDING DISCUSSION

Our empirical data, as presented above, provide some important takeaways for understanding what IP management is in the university setting and how IP is and should be used. For the purposes of this study, we want to highlight especially three aspects of major importance for policy-makers; the large variation across European universities, the different models of IP management, and a direction towards a smart use of IP.

4.1. Large variation

When exploring the practice of IP management across European universities, a main finding is that it is very difficult to generalise. The universities and their IP management practices differ along several dimensions, and we will specially mention seven of them here.

1. To start with, some universities are very basic in terms of IP awareness and capabilities, while others have great competence and strive to work efficiently with the resources they have.

2. Whether or not there is a teachers' exemption directly affect the extent to which a TTO function takes ownership of the IP issue – both literally and figuratively speaking.

3. There are also differences in terms of which entity legally owns the IP. This is more generally complicated by the funding and contract situation of the specific research project, which might involve several actors.

4. National regulations also differ in terms of the possibility for TTOs or university holding companies to take ownership in spin-offs or not – which directly affects the range of options IP management has to work with.

5. There are big differences in terms of how TTOs are evaluated. The evaluation of TTOs is a big and ongoing question where much work has been done and still needs to be done (Kenney and Patton, 2009, Pfister et al., 2021, Reed et al., 2021). Our conclusion here is that these differences naturally affect how IP is used and managed.

6. Moreover, some TTOs are organised within a single university, while others work across several universities, which also affects how they manage IP.

7. Finally, there are large cultural differences among the faculties of different universities in terms of how they look upon commercialisation.

All these differences lead us to a simple yet important and powerful conclusion: IP management is not and should not be the same throughout different universities in different EU Member States.

4.2. Models of IP management

When discussing the models of IP management in European universities it is first and foremost necessary to acknowledge the fact that the dominant model of enabling the use of research results is that of freely publishing the results. Publication is an IP strategy just as much as patenting is (Holgersson and Wallin, 2017, Peters et al., 2013, Ziegler et al., 2014).

However, looking more narrowly at the results where the university actively tries to support the utilisation of potentially useful inventions through the activities of a TTO or equivalent, we can, to put it in a somewhat simplified way, see two dominant models in the data. These models confirm previous research based on literature reviews (Holgersson and Aaboen, 2019).

The majority of the studied universities employ a linear model, focusing on protecting and selling research results. In this approach invention disclosures are collected, inventions are evaluated on patentability and sometimes commercial potential, and those that are promising continue into the patenting process. This model is closely associated with evaluations based on numbers of patents, licences and licensing revenues (Caldera and Debande, 2010, Chapple et al., 2005), and is thus driven towards these modes of commercialisation. What we find here is, however, that there are typically not enough resources for TTOs to focus extensively on the commercialisation in the end. This linear appropriation model is in line with what has been described – and to some extent criticised – in previous research (e.g. Holgersson and Aaboen, 2019, Kenney and Patton, 2009, Siegel et al., 2007) (see Table 3).

Table 3. The appropriation vs utilisation modes of TTOs (Holgersson and Aaboen, 2019, p. 4)

	Appropriation mode of TTOs	Utilisation mode of TTOs
Aim	Maximising private value	Maximising total welfare
Success measure	Patents, licences, spin-offs	To be developed
Main activity	Evaluation, search, contracting	Diffusion, support, contracting
Role of IP	Innovation protection	Innovation governance

What has been less clear from previous research is the seemingly widespread view – at least in this study – among TTO professionals that they want to do more and something different than the linear model to support the utilisation of research results. However, they are to some extent restricted due to the established evaluation measures and limited resources. A few of

our interviewees already work with this alternative type of utilisation model of IP management. These models enable the utilisation of research results in a broad sense and use IP rights primarily as tools and facilitators for continuous development and collaboration.

We can conclude that the shift from an appropriation to a utilisation mode of TTOs – which has been recommended by research – is a shift that also resonates well with what many of our interviewees see the need for – and a shift in line with – EU policy (e.g., Bogers et al., 2018).

4.3. Towards a smart use of IP

There is no one right way to manage IP in the university sector. We already know from research on IP strategy and management that it must be aligned with the general strategy, business model and industrial context (Holgersson et al., 2018, Reitzig, 2007, Somaya, 2012, Teece, 2018).

The question of 'what is a smart use of IP' among universities and public research organisations is thus less relevant as a point of departure than the question of 'what is smart use of IP for'. In other words, what is the purpose of using IP? What is the objective for actors managing IP in universities? Without knowing the purpose it is impossible to say whether or not a specific type of management or strategy is a smart way to fulfill that purpose.

A follow-up question is whether the current ways of evaluating TTOs push them in the right direction. The findings from this study in the European context echo the message from Kenney and Patton's paper focused on the US context: 'The institutional arrangements within which TLOs [technology licensing offices] are embedded have encouraged some of them to become revenue maximisers, rather than facilitators of technology dissemination for the good of the entire society' (Kenney and Patton, 2009, p. 1407).

While the tendency to focus on revenue maximisation through patenting and licence/patent sales is also seen in the European setting, we also see what seems to be an increasing focus on utilisation more broadly. There is much awareness among the majority of the interviewees about the need to become more focused on the actual use of research results, and not only the protection and sales of them.

We know that IP management affects both value creation and value capture (Holgersson et al., 2018, Teece, 2018). To date, university TTOs seem to have put too much emphasis on value capture at the expense of value creation. Increasingly loud voices are now arguing for the need to better balance this, both in our interviews here and in previous research (Kenney and Patton, 2009, Reed et al., 2021). In other words, we need to define the smart use of IP in terms of what it contributes to. As a final contribution, we therefore propose a new definition of the smart use of IP. With this definition, we highlight the balanced focus on both value creation and value capture, and that the created value should be distributed across multiple stakeholders in a fair and reasonable way. Public research universities are after all different to private firms opting for profit and/or growth maximisation. Our definition is: for public universities, smart use of IP is the use of IP for facilitating continued value creation while enabling fair and reasonable value capture for the relevant stakeholders.

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This report presents the results of an empirical study that explores intellectual property (IP) management practices among universities in the European Union. The report presents models and processes of IP management and research commercialisation – and their interdependencies. Furthermore, the report identifies four main challenges for IP management, including lack of funding for proof-of-concept work, resource constraints, a broad range of technologies and industries with which technology transfer offices (TTOs) need to work, and a non-existent local industry combined with legitimacy problems when trying to partner internationally. All in all, these challenges typically make IP management in the university setting more difficult than in the private industry setting. The dominant and linear IP management process that focuses primarily on value capture – the appropriation model – is criticised, and interviewees see a need to shift focus to better interact with industry and focus more on value creation and utilisation rather than only on appropriation.

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