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Understanding the Role of Intellectual Property in Digital Technology-based Startups

Decisions and Dynamics

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Abstract

Intellectual property (IP) has taken a central place as a source of competitive advantage in firms' strategies. However, our knowledge on how IP is used by these firms in the digital age is still limited. The increasing prevalence of digital technologies further emphasizes the importance of intangible assets such as IP, while raising an open question with regard to how these assets should be selected and used to support business models and strategies. This thesis aims to address this question in the context of digital technology-based startups, which are in many ways at the forefront of advancing new digital technologies, business models and industries. By conducting a multiple case study of seven startups over the course of two years, the development of these startups' IP strategies was mapped and analyzed resulting in two empirical papers on top of a literature review.

This thesis notes the impact of the characteristics of digital technologies on the process and dynamics of IP strategy formation. Digital technology is systemic and can be developed on a more or less ongoing basis. As a result, IP decisions need to be flexible to enable and adapt to changes in technologies, business models and strategies. Moreover, the development of IP strategy through successive decision-making is based on available means to allow for goals to emerge rather than to be set in advance. The design of IP strategy therefore ends up fitting the design of digital technology in terms of its systemic structure and its development in which all outcomes cannot be envisioned in advance but are prepared for through incompleteness and flexibility in the design of decision-making.

Keywords: Intellectual property, digitalization, entrepreneurship, decision making, effectuation

List of appended papers

Paper I - The Business of Intellectual Property: A Literature Review of IP Management Research
Holgersson, M. and van Santen, S.
Published in Stockholm Intellectual Property Law Review

Contribution: Executed and wrote the structured literature review for the time period 2016 – 2018, involved in paper discussions, writing for introduction and discussion.

Paper II - Business model change and intellectual property strategy: Strategizing for dynamic consistency in digital innovation
Holgersson, M. and van Santen, S.
Presented at the Open and User Innovation conference, 2019
Under review at the Journal of Product Innovation Management

Contribution: Collected and analyzed data, conceptual development, collaborative writing in all sections of the paper (i.e. writing was a collaborative endeavor).

Paper III - The role of intellectual property decisions in the new venture creation process
Van Santen, S. and Holgersson, M.
Presented at the R&D Management conference, 2019
Presented at the Academy of Management Annual Meeting, 2019

Contribution: Collected and analyzed data, conceptual development, writing of the paper.

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Lastly, to you who is reading this, thank you for taking the time to be a part of my thesis. I hope it will be a good read.

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1. Introduction

With the onset of the digital economy, digital technologies increasingly take the forefront as opposed to the physical technologies of the industrial age (Granstrand 1999, Rachinger, Rauter et al. 2018). Development of the products, markets and industries based around these technologies is driven in large part by new ventures. These digital technology-based startups are engaged in simultaneous processes of technology development and business model development, in the course of which they make decisions regarding the management of their intellectual property (IP). These decisions take on a central importance in a digital economy based on intangible assets but are similarly difficult to plan and enact as a result of the nature of digital technologies and their development.

For one, digital technology is different from physical technology in terms of its structure, stability and codifiability. Most digital technologies are systems technologies, made up of many different assembled components (Shapiro and Varian 1999, Yoo, Henfridsson et al. 2010). A technology can thus be disassembled into its constituent parts, separate components can be changed while maintaining stability of the overall system and components can be added and exchanged with other systems. As a result, digital technology is easily editable and transferrable (Kallinikos, Aaltonen et al. 2013) and it is hard to put a 'natural' end point to technological development (Nambisan 2017). Hence many digital technologies can be put to different uses, in combination with different technologies (Teece 2018). Moreover, since components can be switched out and altered, inventing around is relatively easier and the value of patenting decreases. For this reason, it is e.g. relatively hard to protect software through traditional means.

As a result of these technological characteristics, the innovation process looks different as well. In a systems technology, components may come from various different sources. The role of IP in that sort of process is more about enabling technology to be exchanged and combined than about appropriating value per se (Yoo, Boland Jr et al. 2012). However, some of these components may find their origin in user innovation communities or other types of open innovation efforts where the traditional use of IP rights can be a detriment rather than an enabler of innovation (von Hippel 2005, Baldwin and von Hippel 2011). The general purpose, open-ended nature of technology likewise poses a dilemma in the sense that the way technology can be deconstructed allows not only inventing around, but the generation of derivative technologies (Yoo, Boland Jr et al. 2012). This in turn makes it harder for upstream inventors especially to capture value over their IP, as it is easy for owners of derivative inventions, complementary technologies and substitutes to appropriate a larger share of the value generated (Teece 1986, Teece 2018).

In this manner, digital technology has enabled a multitude of new opportunities for both value creation and value capture, spurring an emergent literature on business models and business model innovation (Chesbrough 2010, Bharadwaj, El Sawy et al. 2013, Massa, Tucci et al. 2017). While IP typically played a straightforward role in firm's business models in the industrial age in enabling value capture (Teece 2010), the nature of digital technology and digital innovation have spurred new models for the role of IP. Prominently, constructs like selective revealing and IP modularity advance IP strategies that enable a balancing of value capture and value creation by separating open value creation modules from IP-protected value capture modules along technological tearing lines (Henkel 2006, Hurmelinna, Kyläheiko et al. 2007, Henkel, Baldwin et al. 2013).

The way startups develop in new venture creation processes typically fits well with the characteristics of (the development of) digital technologies, although IP decisions don't feature prominently in the current state of the research. It is argued that ventures and new markets develop through a process of

effectuation. That is, decisions are made on a basis of available means rather than set goals, and commitments from stakeholders increase these means while constraining options over time (Sarasvathy 2001, Sarasvathy and Dew 2005). As a result, the venture as well as its technology grow through small additions. The system is internally stable while retaining flexibility by allowing elements of the business to be switched and changed (Sarasvathy 2003). The way IP strategy emerges in tandem with technology and the business can similarly be understood in these terms.

In order to address these developments and the open question they pose for IP strategy, this thesis consists of a literature review on the current state of IP management research, in addition to an empirical study of IP strategy in digital technology-based startups. The purpose is to explain how the nature and development of digital technologies and business models impact the development of IP strategy formation in these ventures. More specifically, what is the role of IP strategy in the development of digital technology-based ventures in terms of the decisions made and the process by which they are enacted? This licentiate thesis consists of three papers that each address a different aspect of this question. The first paper, 'The Business of Intellectual Property: A Literature Review of IP Management Research' looks back at the research on intellectual property and addresses ongoing and emerging issues in the field, providing a background for the rest of the research. The second paper, 'Business model change and intellectual property strategy: Strategizing for dynamic consistency in digital innovation' addresses the IP decisions made by digital technology-based startups to enable dynamic consistency between the value creation and value capture components of their business models. Lastly, the third paper 'The role of intellectual property decisions in the new venture creation process' focuses on the dynamics of new venture creation and the role played by IP not only in preventing imitation of competitive advantage, but in creating competitive advantage under conditions of uncertainty.

In the next section, the literature used in this thesis is explained in more depth, leading in to a discussion on the methods used in the papers, a summary of the papers and ending in a discussion of the implications so far and opportunities for future research.

2. Literature review

2.1 IP strategy

IP strategy is increasingly being pushed to the forefront of firms' strategic agendas as a source of competitive advantage (Reitzig 2004). Consequently, research on IP management and strategy is growing by the year, although the field is still in an early stage of development (Appio, Cesaroni et al. 2014, Holgersson and van Santen 2018). Much of the existing literature focuses exclusively on the use of IP to appropriate value (Wang, Chai et al. 2015), many studies define IP in a narrow sense with a focus on patents (Somaya 2012), and there is limited use of theoretical constructs (Candelin-Palmqvist, Sandberg et al. 2012).

Due to the growing recognition of the importance of IP as a source of competitive advantage however, research increasingly focuses on delineating the strategic function of IP. For example, many studies have pointed out that although patents are typically seen as relatively ineffective in enabling appropriation (Levin, Klevorick et al. 1987), patenting rates are rising. Instead of being used to appropriate value, patenting is used as a strategic tool to e.g. enable cross-licensing and improve a company's defensive bargaining position (Macdonald 2004, Hanel 2006). In addition, new ways of managing intellectual assets are being advanced, such as strategic disclosure (Peters, Thiel et al. 2013), that focus more on enabling freedom to operate than on statically appropriating value and advance a more dynamic view on IP strategy (Holgersson and Wallin 2017).

Hence the role of IP is changing, from a means of appropriating value (Teece 1986, Teece 2010), to a strategic asset to be incorporated with business model and business strategy design (Al-Aali and Teece 2013). This change is in large part driven by the onset of digital technologies, which increase the importance of IP by changing (opportunities for innovation of) business models, the nature of innovation and the nature of technology itself (Teece 2010, Baldwin and von Hippel 2011, Nambisan, Wright et al. 2019).

2.2 Digital technology

A prevalent force driving changes in the prevalence and use of IP, is digitalization or digital innovation. Digital innovation can be defined as the exploitation of opportunities afforded by digital technology, or more specifically, the use of digital technologies in creating new market offerings, business models and business processes (Nambisan, Lyytinen et al. 2017, Rachinger, Rauter et al. 2018). Digitalization has hence been credited with driving the literature on business models, since the options and opportunities for innovation within value creation and value capture models is now bigger than ever (Massa, Tucci et al. 2017).

The transformative impact of digitalization can be found in the characteristics of digital technologies which are distinct from the physical technologies of the industrial era. As was observed and forecast in light of the 'information age', digital technologies have a higher level of intangibility and are harder to codify than physical technologies (Samuelson 1990, Samuelson 1996). Moreover, digital technologies are systems technologies, made up of different components and hence possible to disassemble (Shapiro and Varian 1999, Yoo, Henfridsson et al. 2010). On account of both of these characteristics, digital technologies are easy to transfer (i.e. consider the ease of sending a file from one location to another over transporting physical goods and technologies), easy to edit and in this sense in theory indefinitely reprogrammable, or open-ended (Kallinikos, Aaltonen et al. 2013, Nambisan 2017, Nambisan, Wright et al. 2019).

The implications for innovation, strategy and, in a related vein, IP, are manifold. For instance, being able to edit a technology at low cost and in small increments makes inventing around easier, and tactics such as patenting relatively less effective. Two of the most salient implications from an IP point of view are the management of boundary-spanning innovation and the importance of emergent IP strategies to facilitate ongoing technology development.

2.3 Boundary-spanning innovation

Since digital technologies are made up of different components, more and more often it is the case that these components come from distributed sources outside the company's boundaries. Either the firm itself doesn't have all the necessary technological components to assemble a technology, or the firm willfully decides not to develop everything itself. As a result, the importance of innovation that is distributed in terms of its actors and combinatorial in terms of its components is a lot higher for digital technologies (Yoo, Boland Jr et al. 2012).

This has spurred a lively literature on open innovation, with some maintaining that open collaborative and user innovation models will come to largely displace producer innovation (Chesbrough 2003, Baldwin and von Hippel 2011). Due to the low threshold for transferability and editability of digital technology, it is relatively easy for these technologies to spread and for distributed actors to bring in their competence (Nambisan 2017). Moreover, these characteristics spur so-called generativity. Generativity means that a single innovation can generate a number of derivative innovations in its wake, a process aided by the fact that some digital technologies are general purpose, able to be adapted to many different purposes in combination with many different complementary, or enabling technologies (Bresnahan and Trajtenberg 1995, Yoo, Boland Jr et al. 2012, Teece 2018). This in turn too raises the importance of user innovation in finding new applications, combinations and meanings for the same technology.

In addition to these types of distributed open and user innovation, the importance of collaboration across technological and industry boundaries is increasing. The reason for this is that digital technology allows for convergence, which entails a merging of experiences and industries by combining technological components across boundaries, e.g. adding digital technology to previously physical technologies such as cars, watches and running shoes (Yoo, Boland Jr et al. 2012). Many industries are seeing their value propositions change as a result of the opportunities offered by digital technologies, and the new players entering their market. As a result, a single firm may no longer have all the required competence in-house to produce a technology, spurring additional boundary-spanning innovation.

2.4 Strategy emergence through effectuation

In addition, an increasingly important priority of IP strategy is the design of strategies that allow for differential accessibility and adaptability of the technology (Holgersson, Granstrand et al. 2018). This in turn requires a process-view of IP strategy that considers not only the conditions under which certain decisions are taken, but the impact that separate IP decisions have over time, how these decisions influence subsequent decision-making and enable or restrict options.

While research has been steadily broadening its scope in terms of which appropriability mechanisms and strategic motives are considered, the lion's share of studies on IP strategy has advanced a mostly static view. That is, few studies have considered the impact of IP decisions over time, the interdependence between successive decisions and the context in which decisions are made. As a result, much research has traditionally advanced a view of IP strategy based on planning under conditions of perfect information and limited constraints (c.f. Somaya, Teece et al. 2011, Eppinger and Vladova 2013).

While this is a poor reflector of decision-making processes in general, it is especially so for startups, which are based around limited resources and characterized by uncertainty. Hence to contrast planning models of decision-making, effectuation was developed through think-aloud protocols with entrepreneurs to describe the way decisions are actually made rather than the rational manner in which they are modelled within entrepreneurship research. The construct refers to a mode of decision-making where decision-makers use available means and partnerships to find goals, instead of pursuing pre-established goals through planning and competitive analysis, i.e. causation (Sarasvathy 2001).

At the intersection of digital innovation and entrepreneurship, effectuation has been raised as a particularly useful way of describing the process by which digital technologies and the ventures based around them develop (c.f. Nambisan 2017). Due to the nascence of many digital technologies, their entrance into markets and industries is in large part driven by new ventures. Moreover, due to the disruptive effect of digital technologies, i.e. their effect in creating new markets, products and business models (Massa, Tucci et al. 2017, Rachinger, Rauter et al. 2018), ventures using digital technologies are faced with particular uncertainty, a context in which effectuation is especially effective (Sarasvathy 2003, Sarasvathy and Dew 2005, Jiang and Rüling 2019).

While research on IP has been lacking in its consideration of the decision-making process research, research taking an effectuation perspective has at times assumed that the content of a decision determines the process by which it was taken and the intent it has. For instance both Alvarez and Barney (2007) and Reymen, Andries et al. (2015) use patenting decisions as a proxy for planned, competitive behavior. This enforces an image of IP strategy formation as a planned, goal-driven endeavor.

However, in light of the nature of digital technology and the subsequent uncertainty in the development of technologies and ventures, it is more likely that IP strategies are flexible and emergent (as a result of effectuation). It is therefore helpful to take a process perspective to the development of IP strategies, which implies considering how ventures strategize around IP on a basis of available means and found goals. Here the concept of effectuation can help to explain how IP decisions are made to manage and develop digital technologies, from a perspective of change readiness as well as actual change and unanticipated development (Jiang and Tornikoski 2019).

2.5 Implications for IP

Based on the developments described above, we can expect the role of IP in digital technology-based ventures to be in many ways different from its role in large established firms based on predominantly physical technologies.

On the one hand, the importance of boundary-spanning innovation reinforces the importance of IP as a currency for enabling exchange and collaboration in open innovation settings (Chesbrough 2003, Hagedoorn and Zobel 2015). IP can be used to protect knowledge in settings where knowledge is exchanged (Olander, Hurmelinna-Laukkanen et al. 2009, Bogers 2010, Hurmelinna-Laukkanen 2011), where collaboration poses a risk of knowledge spillover, e.g. coopetition (Ritala and Hurmelinna-Laukkanen 2009, Ritala and Hurmelinna-Laukkanen 2013), and to enable assembly of intangible assets through codification in IP rights. In user innovation contexts on the other hand, where contributors cannot be easily identified a priori and outcomes are intentionally open-ended, an absence of IP rights can instead facilitate the involvement of diverse actors (von Hippel 2005, von Hippel and von Krogh 2006, Baldwin and von Hippel 2011).

The nature of digital technology hence increases the importance of IP strategies that allow for differential accessibility and control of technologies (Holgersson, Granstrand et al. 2018). One way of

regulating this access is by spatially separating technological modules with different levels of accessibility, i.e. IP modularity. This separation is accomplished by assigning distinct IP statuses to different technological modules. The IP status constitutes a module's legal status and de facto accessibility (Henkel, Baldwin et al. 2013), hence allowing an innovator to decide the accessibility and governance of his technology (Holgersson, Granstrand et al. 2018).

Decomposability of IP strategies similarly facilitates the editability, i.e. ongoing development, of digital technologies while maintaining stability of the venture (Sarasvathy 2003). By allowing certain components to change while keeping a fixed alignment between other parts of the system, the technology can keep developing as digital technology is wont to do (Nambisan 2017). IP strategy then is increasingly required to take a dynamic perspective that considers the conditions under which certain decisions are taken, their interdependence, their impact over time and how these decisions influence subsequent decision-making, simultaneously increasing the available resources and putting constraints on future decision-making (Sarasvathy and Dew 2005).

Recent years have indeed seen an increasing number of studies that do take a more dynamic view on IP strategy, incorporating context, time and interdependence in strategic decisions. For instance, Thomä and Bizer (2013) consider not only the efficacy of different appropriation mechanisms, but the way these mechanisms are combined by different types of small enterprises, finding that formal IP rights and informal mechanisms can be combined to reach firm goals. Manzini and Lazzarotti (2016) study the use of IP mechanisms in collaborative new product development and find differential intensity and usage of mechanisms at different stages of the process. Olander, Hurmelinna-Laukkanen et al. (2009) consider tradeoffs in sharing and protecting knowledge in the small firm context and Holgersson, Granstrand et al. (2018) consider changes in appropriability regimes across development of technologies.

While these examples are part of a first effort to incorporate aspects of dynamism into IP strategy, as of yet there is a lack of congruence and theoretical development in the field. An exception can be found in Holgersson and Wallin (2017), who advance a conceptual framework for single invention technologies in which not only static, but dynamic freedom to operate and indirect on top of direct appropriability are considered, thereby extending our knowledge on appropriability (regimes). Arguably, the concept of IP modularity has a dynamic component, since technological modularity and IP statuses can be adapted to fit the current state of the technology and the company's goals (Henkel, Baldwin et al. 2013, Baldwin and Henkel 2015).

Moreover, while research on IP management has considered aspects of firm size in terms of e.g. resource constraints and patenting propensity (Hanel 2006, Jensen and Webster 2006), most don't explicitly consider the characteristics of entrepreneurial ventures as a separate phenomenon (Shane and Venkataraman 2000). That is, firm size does not fully cover the characteristics of startups, and SMEs and small firm samples are not fully representative of the considerations and dynamics within entrepreneurial ventures. As such, research on the use of IP in entrepreneurial ventures is limited to a consideration of size and resource constraints, not taking uncertainty or the dynamics of their development into account.

Hence there is still a need for frameworks more explicitly aimed at studying dynamic, emergent IP strategies in new ventures based on digital technologies, using frameworks such as effectuation as a basis. This thesis aims to contribute to a development of these frameworks.

3. Methodology

To reiterate, the purpose of this thesis is to explain how the nature and development of digital technologies and business models impact the development of IP strategy formation in ventures based on these technologies. Hence the studies executed as part of this thesis and the papers appended within aim to contribute to this purpose. In what follows, I first explain what has been included in the definition of an IP decision and consequently an IP strategy. Next the method behind the studies conducted as part of this thesis is explained.

3.1 Defining IP decisions

IP is a difficult concept to define if one goes beyond the confines of formal IP rights. I argue however, that many decisions are made with regard to IP that do not involve these rights, for instance using informal appropriability mechanisms to protect intellectual assets. Hence in this thesis I take the position that the definition of IP decisions includes all those decisions concerning the management of a firm's intellectual assets in terms of access and ownership, i.e. the governance of potentially or actually proprietary intellectual resources. While IP decisions or IP strategy is not typically defined as such, many studies intuitively take this perspective. That is, if patenting is an IP decision, any alternative mechanism or business configuration that addresses the same knowledge or technology for similar strategic purposes is an IP decision also, e.g. secrecy, since it pertains to management of the same proprietary intellectual asset. Choosing to make a proprietary asset accessible in a non-proprietary manner hence similarly constitutes a decision regarding IP because the term 'IP' refers to the underlying asset rather than the means by which it is managed.

3.2 Paper I

Research design

The research design for this paper was a descriptive and summative literature review of research on IP and IP rights. In order to do so, three sub-studies were conducted using three different approaches towards the literature search. That is, the first study targeted previous literature reviews on the field of IP, the second study covered special issues on IP management and the third sub-study concerned a systemic search of IP management terms.

Data collection

Papers were found by using search terms relevant to IP management and, depending on the substudy, literature reviews, special issues and specific IP rights such as patents and trademarks. Papers were selected by reading abstracts for relevance. Searches were conducted on Google scholar and Web of Science in order not to miss any particularly relevant or highly cited papers in the search. The third study was conducted twice, once all publications up to 2016 and once from 2016 to 2018. By doing so, literature could be analyzed concerning the overall field of IP management as well as recent trends and current discussions in the field.

Data analysis

Analysis in the case of this paper consisted of a reading and comparison of papers identified through the literature search. Due to the nature of the paper, analysis and findings were mostly of a descriptive nature, outlining the previous writing, arguments and findings from the literature to allow for a summary of the state of the art.

3.3 Paper II and III

Paper I and paper II were written as part of the same research project with the same research design. Hence data collection will be described jointly, before describing the data analysis for each of the papers.

Research design

The research design for papers II and III was a multiple case study based on seven digital technology-based startups. Startups were selected whose business models were based on digital technology and digital innovation which can be defined as "the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology" (Nambisan et al. 2017, p.224). Sampling was theoretical, seeking to encompass the range of different business models enabled by digital innovation (Eisenhardt and Graebner 2007, Eisenhardt 1989). An initial sample was established and successive cases were selected to fill the criteria of this sampling frame, resulting in selection of seven startups in Sweden and the US based on accessibility and suitability until additional cases no longer brought additional variation to the sampling frame.

Data collection

Data was collected between the summer of 2017 and the spring of 2019 therefore allowing some retrospection on the part of respondents while introducing the risk of hindsight bias. This bias was (in part) addressed by using multiple respondents for each case to triangulate accounts and interviewing some respondents again. Data collection was mostly done by two researchers, myself and my co-author, jointly present at each interview, taking notes and asking questions. About one third of interviews were conducted with only done with one researcher present, either myself or my co-author.

Primary data consisted of 35 semi-structured interviews which we triangulated where possible with secondary data in the form of available publications such as websites, white papers, blog posts and, where access was granted, internal communications in the startup. Respondents were selected that were so-called elite informants, meaning they were knowledgeable about the subject matter and in a position to influence decision-making (Aguinis and Solarino 2019). In selecting respondents, we started by interviewing the startup's founders and from there on snowball-sampling was used to identify the relevant respondents regardless of role. That is, at the end of each interview, respondents were asked who else had been involved in decision-making or was otherwise particularly knowledgeable about the topics discussed and data collection continued until respondents no longer identified relevant interview participants. Interviews lasted on average 60 minutes, with a range of 45 – 90 minutes. Interviews were recorded where permission was given (29 recorded) and transcribed. For the other interviews, careful notetaking was used to record the contents of the conversation.

The interview protocol focused on describing the decisions taken in the development of the startup with regard to technology, business models and IP. Specifically, respondents were asked to describe the development of their venture, the decisions taken, the considerations that played a role in making the decision and the parties involved. I analyzed the data by coding using Nvivo software. In this step of the research, paper II and paper III diverge, as a different coding strategy was used for each paper in accordance with the respective research questions.

Data analysis paper II

Paper II was analyzed using a theory-building, three-stage coding strategy (Gioia, Corley et al. 2013). Based on the interview protocol, I used first-stage open coding to identify decisions taken during the

development of the venture and their driving motives. This was initially done at the within-case level to be able to draw up case narratives and analyze the development of each startup separately.

Next, coding was aggregated to a cross-case level by comparing decision events and motivations in their similarity and consolidating codes referring to similar decisions and motives. During second-order coding these first-order cross-case codes were aggregated to arrive at categories of decisions taken for similar motives (e.g. patenting to prevent imitation or employing inbound openness for the sake of technology development). This resulted in an overview of common decisions and associated motives on a cross-case level. Finally, for third-order coding these decisions were ordered based on their function in the venture's business model and linked IP strategy. This resulted in an overview of IP decisions taken to enable value capture and value creation, and the directives guiding decision-making to enable a dynamic balance between the two.

Data analysis paper III

For paper III, I followed a more structured coding scheme. In accordance with the goal of the research, which sought to identify the decision-logics involved in different stages of venture development for different types of IP decisions, coding was structured along a set number of categories. For each case, decision events were coded using open coding (e.g. the decision to patent or open source was identified and coded in an open-ended manner). Next, decision events were coded according to the indicators of effectuation and causation-based decision logics. That is, for each case a coding scheme involving all the dimensions of effectuation and causation was used to identify the considerations cited by respondents in making the decision.

Finally, identifying the decision logics used for each decision was done using one of the features of Nvivo software, coding stripes, to see where coding of logics overlapped with coding for decision events. This information was summarized in table format at the within-case and at the cross-case level, with a consideration of the development of cases over time by developing case narratives where decisions were chronologically ordered.

4. Summary of papers

4.1 Paper I: The Business of Intellectual Property: A Literature Review of IP Management Research

The aim of this review was to provide a roadmap into the field of IP management for practitioners and academics with legal and management backgrounds respectively. The paper posits that in theory and in practice IP has been dealt with in a fragmented manner. Traditionally, the management of IP has been the purview of the legal field, while management sciences are increasingly emphasizing the strategic importance of IP for management.

In order to provide insight into the current state of the field and guidance for its advancement, the current state of the art is summarized through a search of literature reviews and special issues, as well as a structured search across IP management terms. By covering these three areas, the paper aims to provide a comprehensive overview of past, current and future developments in the field.

What is found is that there is an increasing amount of research done on IP. Comparing the amount of publications over time, it can be seen that IP management and strategy is a rapidly growing field. However, much of this research considers only single IP rights instead of taking a view of the entire IP strategy. Among these rights, most attention is being paid to patents, while few publications especially consider the use of for instance trademarks or copyrights.

Moreover, the paper argues for the need to integrate the IP function with the rest of the organization, mainly in terms of business strategy. Recent years have seen an increase in research tackling this issue, in part thanks to specific special issues, but there is still limited understanding of the role of IP and the IP organization in the wider organization structure. Related to this is the issue of how to consider wider organizational, but also specifically human factors in the management of IP, which is gaining traction in the field but still leaves a lot of room for future research.

The paper also raises the enduring importance of finding proper IP strategies for facilitating open innovation. This has been an especially relevant topic in IP management research in the last years, which we find is being dealt with in an increasingly nuanced manner. The debate has moved on from a consideration of whether IP helps or hinders open innovation, to figure out how exactly IP can be used to facilitate innovation of all kinds, open and closed in different forms and to different degrees.

Finally, the paper highlights the increasing importance of IP in new industries, especially those created through digitalization. The impact of convergence, the merging of industries and technologies, as a result of technological change is raised as an especially salient trend inviting future development of the field.

4.2 Paper II: Business model change and intellectual property strategy: Strategizing for dynamic consistency in digital innovation

The second paper was aimed at uncovering what role is played by IP in creating and capturing value for firms using digital technology. Due to the different characteristics of digital technologies as opposed to physical ones, value creation and value capture modules are changing, as is the way IP is used to enable these. The paper departs from this notion in seeking to explore exactly what types of IP decisions are made by digital technology-based startups to enable value capture and value creation.

Startups are chosen as an appropriate setting for three reasons. Firstly, due to their economic importance and secondly on account of the observability of decisions and technologies. Thirdly and most importantly though, startups are selected because they are in many ways the drivers of digitalization, at

the forefront of creating new digital technologies and industries. In order to observe the phenomenon of interest then, i.e. digital technology and the value creation and value capture models it enables, startups are a highly relevant research context.

The decisions made around IP over the development of ventures' technologies and business models are described through semi-structured interviews with elite informants and three-stage coding. The result is a comparative overview of the types of decisions made to create and capture value in digital technology-based startups.

Moreover, data analysis uncovered the importance of not only value capture and value creation decisions, but directives used by decision-makers to achieve present and future balance between value creation and value capture. That is, decision-makers balance value creation and value capture in the design of their business model but changing circumstances may shift the appropriateness of this balance over time. Given the nature of digital technology, which is editable and as a consequence, prone to constant, small but rapid change, any balance struck cannot be too static.

To reflect this concern, the paper advances the concept of dynamic consistency, borrowed from the business model literature. Dynamic consistency refers to a firm's ability to keep up present performance while allowing for change within and between its balanced components (Demil and Lecocq 2010). Within an IP strategy context, this concept is used to denote a firm's ability to balance value creation and value capture through IP decisions, and do so dynamically.

That is, not only is the IP strategy able to change reactively, it is designed for flexibility by virtue of the aforementioned directives. These directives provide tangible guiding principles to balance value creation and value capture across a number of dimensions: the firm boundary (internal versus external), stakeholders and time. Dynamic consistency is achieved by using IP to balance access and control of technologies across the firm boundary, across different stakeholders and across time, incorporating present and future.

4.3 Paper III: The role of intellectual property decisions in the new venture creation process

The final paper sought to uncover not so much what IP decisions are taken, but how they are taken. The research on IP has traditionally paid little attention to the process by which decisions are taken and a strategy is formed, resulting in a somewhat static and simplified picture of decision motives and strategic intent. In this paper therefore, decisions are mapped over time and coded on the logics driving them.

The aim of this paper was to determine by which decision-making logics IP decisions come about, and more importantly, how this impacts our knowledge on the role of IP in the creation of new ventures. On account of our limited knowledge on the process driving IP strategy formation, this role has been similarly assumed to be rather straightforward, i.e. focused on preventing imitation and executing a planned strategy.

In order to map the decision-making logics driving IP decisions and hence IP strategy formation in new ventures, the concepts effectuation and causation are used. These concepts represent emergent respectively planned perspectives on venture creation. Causation implies decision-making through goal-driven planning, avoiding uncertainty, expected returns and competitive analysis. Effectuation encompasses decision-making through using available means, affordable loss, leveraging contingencies and making use of commitments through partnerships (Sarasvathy 2001).

Research has established that these modes of decision-making are used at different stages of venture creation to achieve different ends. For instance, effectuation is used when uncertainty is high and to

broaden the venture scope. Causation in contrast is used when successive commitments create path-dependency and the venture scope narrows down to a set of fixed goals (Sarasvathy and Dew 2005, Reymen, Andries et al. 2015). Likewise, IP decisions made using different logics at different stages have a different role in creating ventures, hence different motives.

What is found is that IP decisions are taken continuously, both during effectuation episodes and during causation episodes in the venture's development. Hence IP decisions of all kinds serve both to widen and narrow the venture scope, to increase and decrease options, to find goals to pursue based on available means and to pursue found goals by acquiring the necessary means. The implication is that any type of IP decision is in essence neutral and doesn't have any given use, motive, meaning or role. The role of an IP decision is determined by its implementation and the stage of venture creation in which it is taken.

Hence the implementation of different IP decisions makes a great difference both in understanding complementarities between decisions in the formation of strategy and in understanding the diversity of motives driving these decisions. That is, the same decision can be implemented in such different ways that just studying the decision itself is less relevant, even though this is exactly what IP management research has often done so far. The implementation should lend itself to the stage of venture creation. That is, using IP effectively in creating new ventures requires IP decisions that are fine-tuned to the development of the venture, and the specific requirements for IP at this stage, be it widening or narrowing the venture scope and finding or pursuing goals.

5. Discussion

This thesis opened by positing that, given the nature of digital technology as compared to physical technology, the role of IP in digital technology-based ventures is different from established knowledge on incumbents using physical technologies. To figure out exactly how the role of IP has changed and what this means for its use as well as the future of the field, two studies were carried out resulting in three papers. In this section, I discuss and build upon the findings from these papers to address these issues.

5.1 Structure and dynamics of technology development: the role of IP modularity and dynamic consistency

The most direct impact from digital technology on IP strategy stems from the characteristics of digital technologies, their structure and their development pattern. Digital technologies are systems technologies, made up of many different components and complementary technologies that can be combined and recombined along more or less exclusive interfaces (Shapiro and Varian 1999, Yoo, Henfridsson et al. 2010). As a result, combining and recombining technological components allows innovators to redefine the use and meaning of technologies, in theory indefinitely (albeit typically not in practice) (Yoo, Boland Jr et al. 2012, Nambisan 2017).

Since the traditional function of IP has been to grant temporary monopolies to inventors on commercialization of their invention (Granstrand 1999), the combinatorial, changeable nature of digital technology counteracts this logic somewhat. Enforcing a monopoly is hard when small changes on a component-level can allow an imitator to invent around, as in the case of e.g. software. If technology changes quickly through adding and changing components, the long-time duration on for instance patent protection is less important for an innovator.

As described in paper II, this challenge requires IP statuses to be adapted to the component-level, i.e. IP modularity (Henkel, Baldwin et al. 2013), and for managers to make decisions with a certain level of flexibility, capable of current stability and future change, which we describe using the concept of dynamic consistency (Demil and Lecocq 2010). The challenge is for IP strategies to be similarly decomposable and changeable as the technologies they refer to. In some cases, this implies making a different IP decision, and in some cases, this implies making the same decision differently. I suggest here that this consideration can be described in terms of the future options (or paths) that different decisions made in the development of IP strategy leave for future decision-making in terms of technologies, business models, partnerships and IP.

5.2 Path-dependency and the process of IP strategy formation

An easily acknowledged but equally easily overlooked aspect of many IP decisions is the type of path-dependency they imply for a venture. For example, patenting forecloses and unlocks options, secrecy allows present flexibility but greatly limits flexibility upon disclosure, open source creates options in terms of technology development while limiting options in terms of IP and business models. Summarizing the differential flexibility respectively path-dependency of different decisions goes beyond the scope of this thesis, but an implication can be drawn from their identification.

That is, IP decisions are context- and process-dependent. Decisions are interdependent on past decisions and future options. Hence their motives and effects are but poorly understood when studied or decided on in a detached manner. In the literature on patenting motives for instance, there is a large plurality of somewhat complementary motives and outcomes. Based on the results from paper III, I argue that the

plurality of motives behind different IP decisions can be at least in part explained by the way these decisions are typically divorced from their context when they are studied. Decisions taken at different stages of firm development, embedded in different paths of prior decisions and future options, have different motives, meanings and outcomes even though the decision content seems uniform.

What this emphasizes is the importance of a process-perspective for understanding not only the motive behind a decision, but its role in the overall business model and business strategy (Al-Aali and Teece 2013). For example, since building open source communities can be time intensive, early open source decisions can be motivated by a desire to market and legitimize the software rather than to develop it. At a stage where the firm and its software are more firmly established, open source can be a way to develop the software in an open-ended, collaborative fashion. Of course, these meanings and the 'stage' at which they are relevant are themselves dependent on characteristics of the technology and the company, e.g. its partnerships and centrality in industries, markets and communities.

Based on the research in this thesis however, I argue that an important part of understanding the 'strategic' function of IP as the literature has taken to calling it (e.g. Macdonald 2004, Blind, Edler et al. 2006, Hanel 2006), is in understanding the context of a decision. A decision may have different meanings on account of its position in various technology, business model and strategy development processes. Hence, we can better understand the increasing range of uses identified for different IP decisions and IP strategy as a whole.

5.3 Near-decomposable systems: stability and change through effectuation

While I believe there is no one right method or theoretical framework to represent the process-perspective I advocate, in paper III I use the concepts of effectuation and causation. This is not only due to the fact my research focuses on startups, but also due to its fit with the dynamics described in paper II. Dynamic consistency implies present stability and future change as a current priority (we can understand this trade-off even if seen statically at one point in time). Taking the dynamics of stability and change into account in a process perspective, effectuation and causation lend themselves well to describe the evolution of business models, strategy and IP (Chesbrough 2010, Nambisan 2017).

The way a modular system can remain stable and yet change through effectuation is described by Sarasvathy (2003) in a paper on the relationship between the evolution of near-decomposable systems. In this paper she describes the relationships between system components as 'near-decomposable', implying stability between components with the possibility to detach and change parts of the system. That is, the system cannot be fully decomposed, prevented by stability in the alignment between components. However, change in components on the outskirts of the system is possible which facilitates change and development of the system as a whole. Effectuation is raised as a good way of describing how the 'patchwork' of components evolves, through small changes based on available means rather than a planned design. The design of the new system emerges rather than being designed a priori, which would imply stability and the ability to plan all future developments.

Based on the discussion so far, I argue the concept of a near-decomposable system fits very well with the development of digital technologies and more importantly, the design of IP strategy. The importance of dynamic consistency implies the need for stability between system components in the present with the ability to change. Within near-decomposable systems, this flexibility is facilitated since subsets of the system can be detached and changed. At any point in time, part of the IP strategy will therefore be 'stable' or path-dependent, while a large part is open to be changed or otherwise awards options for the system to be altered. This change is enacted through a process of effectuation, in which available means are used to alter parts of the system and 'find' new meanings, rather than plan for them.

Using this framework, I hence combine the concepts of modularity, dynamic consistency and effectuation to highlight the design of IP strategy for digital technologies. Nevertheless, the research in this thesis doesn't go much beyond the identification of this perspective and its use for explaining the phenomena described. An important next step would be to use the framework(s) described to extend theory, derive propositions, test assumptions and/or derive implications. In the next section I build on this discussion to identify opportunities for future research and subsequent theory development.

6. Conclusions

To wrap up the discussion so far, this thesis began by describing the need to understand how IP is used in the development of digital technology-based ventures. Due to the characteristics of digital technologies, our current knowledge on the management of IP may no longer be representative of the way it is used and the role it plays. The papers in this thesis addressed respectively the current state of our knowledge, the way IP decisions are made in digital technology-based ventures to support the business model, and the way IP strategy emerges in these ventures as a consequence of successive decision-making and venture development. As such, these studies addressed the current state of the field, decision-making content and decision-making process in IP strategy development in digital technology-based ventures.

The discussion combined the most important insights from these studies to develop a preliminary framework for how ventures, technologies and IP strategies develop in tandem in a digital economy. That is, digital technology consists of a system that can be decomposed into its constituents and keep developing over a long time by changing small parts of the overall system while retaining system stability. IP strategies that facilitate this development need to avail themselves of dynamic consistency, i.e. stable alignment between different decisions with the flexibility to either change a decision that was made or retain options for changing course later on. The venture, its technology and its IP can be seen as a near-decomposable system that is internally stable in terms of alignment between technology, business model elements and IP, i.e. not fully decomposable. Change can be achieved by altering decomposable components on the outskirts of the 'patchwork' through a process of effectuation, based on the means of the organization rather than its goals, so that the design of the new system is emergent.

7. Future research

Given the conclusions outlined above, I next reflect on steps for future research. For one, I believe an important avenue for future research would be to much more explicitly study the concurrent development of IP strategy and digital technologies. This would require a longitudinal perspective to follow the development of the system in terms of stability, change and the decisions driving this. The interdependence between components can be better described when the system is studied in more depth and over a longer time period, elucidating the effect of technology decisions on IP and vice versa.

In addition, the frameworks advanced in this thesis (dynamic consistency, near-decomposable systems, effectuation) fit well into the development of ventures using digital technology, but it is not clear how they would work for established firms. New ventures are at the forefront of the development and commercialization of digital technology, hence they are a suitable research context. However, incumbents are likewise attempting to develop and integrate digital technologies into product offerings and business models. Their challenges and experiences are significantly different from new ventures. Describing the developments in large firms, linking these to the characteristics of digital technologies and subsequently comparing IP strategy design between new ventures and incumbents would be an important priority for future research.

Lastly, a caveat in the research so far is the lack of performance measures in the description of IP decision-making. This is due to constraints in the research design which did not allow for such outcomes to be measured. However, given what has been argued in this thesis, it would be expected that certain types of decisions, certain modes or processes of decision-making would yield different outcomes. This in turn can inform the findings on the development of IP strategy in terms of effectiveness and suitability.

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