CHALMERS

Prerequisites for Successful Technology Commercialization through Licensing

An Empirical Study of Five Technology Licensing Pioneers

Master of Science Thesis in the Master Degree Program,
Entrepreneurship and Business Design

JOHANNA JUHL

Department of Technology Management and Economics
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ABSTRACT

Market transactions for technologies and knowledge have become more common in today's intellectualized economy. These markets have changed the traditional mindset of that organizations need to own downstream manufacturing assets in order to commercialize their assets. Manufacturing organizations to a larger extent commercialize technologies through licensing as a mean to optimize the return on their research investment, and certain organizations use licensing as a sole mean to obtain revenue. Licensing is an example of the innovative division of labor that has lead to organizations that offer R&D as a stand-alone value proposition.

Organizations such as Texas Instruments, IBM, and Dow Chemicals pioneered the licensing trend and have collected hundreds of millions of dollars in annual licensing revenues. The success of these companies have inspired others to follow, however authors such as Ulrich Lichtenthaler have indicated that many organizations have found it hard to replicate the success of these companies. Ulrich Lichtenthaler, Russel Parr, and Patrick Sullivan, amongst others, have investigated the area and provided readers with factors and models for optimizing licensing return. However, prior studies have focused on pure organizational structures or directed their studies to organizations that are thinking about including licensing in their business model, compared to organizations already active in the field.

This thesis is the result of an empirical study of five licensing organizations that are proclaimed pioneers in the technology licensing space: IBM, Rambus, PARC, WARF and MIT TLO. The study was set out to investigate what organizations that perform well in the technology licensing field have in common and consisted of a set of interviews with individuals in managerial positions at the organizations.

The found factors were in many cases interdependent, and often the found factors could not be accomplished easily but required time and persistency. The factors could be broken down into four major factors that enabled the others: sufficient resources, credibility, organizational culture, and lastly and most importantly, the successful organizations had individual licensing strategies tailored to their specific assets, mission, objectives and challenges. An example of this was how the organizations that had more fundamental research results used the start up community to incubate technologies and bridge the gap between them and the commercial market.

The findings supported theories provided by Petrusson (2004), Arora, Fosfuri and Gambardella (2001), and Megantz (2002), yet expanding the theories by deconstructing the reasoning behind the success factors as well as providing intelligence on how organizations may adopt and execute against them.

Keywords: *intellectual property, commercialization, research, development, licensing, strategy, management*

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Johanna Juhl

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Nomenclature

KBB	Knowledge-Based Business
IA	Intellectual Asset
IP	Intellectual Property
IPR	Intellectual Property Right
TLO	Technology Licensing Office
SME	Small to Medium Enterprise

Glossary

Intellectual Assets	Intangible assets, such as experience, knowledge and skills
Technology Market	Market that refers to transactions for the use, diffusion and creation of technologies
Knowledge-Based Business	An organization that apply knowledge to differentiate itself from others
Ex Ante Licensing	The enablement of the use of a technology, typically know-how, designs, processes and consulting hours are transferred as well as the right to use patented technologies
Ex Post Licensing	The licensing of the right to use a patented technology, typically does not include any knowledge-transfer
Deal Sourcing	The activity of identifying, marketing, pursuing and managing deal opportunities

1 INTRODUCTION

This study focused on deconstructing the activity of licensing technology in order to distinguish differentiators for successful actors and how they face challenges in the industry, as the licensing of technology has become increasingly common and important in today's knowledge economy. The purpose of the introductory chapter is twofold; firstly, the chapter aims to set the stage of the thesis by describing the background to the theoretical concepts and prior research in the area, secondly, the chapter sets the scope of the study by framing the purpose and formulating research questions.

1.1 Background

Knowledge has always been important in all societies - the ability to make fire was transmitted throughout different tribes and the knowledge about our surroundings was crucial to our survival. The codification of knowledge, being the main driver of the intellectualization of the economy, has created bridges between areas of competence and this has lead to an acceleration of the rate of growth of accessible knowledge, which in turn has lead to economic growth (Houghton & Sheehan, 2000). By moving further into the knowledge economy we move away from manufacturing and into an economy that highly consist of services - industries that do not have any collateral, from the traditional industry-perspective, and where the value of the actual assets are social constructions[1]. The change in the economy can be observed by the increase of production of services value added in GDP[2] which since the middle of 1900s has increased steadily whilst the share of production value added (tangible assets) in GDP has decreased, visualized in Figure 1.

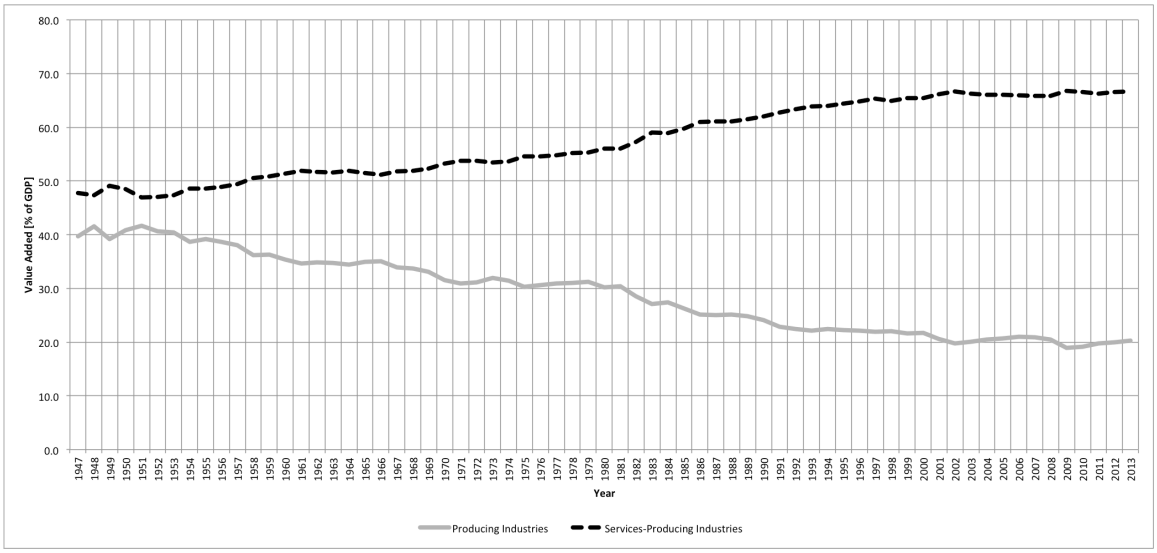

Figure 1, Private-Sector Value Added as Percent of Real GDP, 1948-2010, source: Bureau of Economic Analysis, National Income and Product Accounts.

The intellectualization of the economy becomes very apparent when studying the change in farming. Not to long ago more than 90% of the population were involved in farming, mostly

[1] A phenomenon created and developed by society; a perception of an individual, group, or idea that is constructed through cultural or social practice.

[2] The contribution of a private industry to the overall GDP, value added equals the difference between an industry's gross output and the cost of its intermediated inputs.

due to constraints on productivity and value extraction. Due to the industrialization productivity was increased through the introduction of chemicals and machinery (Petrusson & Heiden, Assets, Property, and Capital in a Globalized Intellectual Value Chain, 2009). More stakeholders were introduced into the value chain, and the possibility to extract value upstream emerged. The rise of knowledge economy enabled more actors and different business models to enter the value chain, a phenomena referred to as the innovative division of labor. This allowed specialization of each of the actors - actors could focus on one aspect of production, yielding higher expertise in this area, thus allowing for higher productivity. The division of labor originates partly from the industrial revolution where the factory principal was introduced - each worker had one specific task. Allowing workers to focus on a single or limited amount of tasks eliminates the long training period required to train craftsmen, increasing concentration and specialization. The workers could focus on their single subtasks, which lead to greater skill and productivity on their particular subtasks than would be achieved by the same number of workers each carrying out the original broad task (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of Innovation and Corporate Strategy, 2001). Open innovation, which exploits the division of labor by leveraging more ideas and value capturing methods, has become increasingly common, as organizations cannot solely rely on their own capabilities. Knowledge, or Intellectual Assets (IAs) have become the most important assets in these types of collaborations and an organization's stock of IAs is the key contributor to obtain and secure sustainable competitive advantage. The importance of IAs can also be observed on a macro economical level – between 1994 and 2002 the annual growth rates in IAs were higher than in machinery and equipment and the U.S. investments in unmeasured intellectual capital were ~10-11% of GDP (roughly equal to that in tangible assets). Furthermore, investments in IAs contributed as much as tangible capital to labor productivity during the same period (Organization for Economic Co-operation and Development, 2006). Due to the growth in knowledge investments, open innovation collaborations and globalized economy, Intellectual Property (IP) has become more important for innovating firms, as the main vehicle for knowledge transfer and protection, and facilitator of disintegration of knowledge-based industries. Patents are today a central business assets and the demand for patents have increased. The increased demand can be illustrated by the increase in patent applications - in the early 1980s 800 000 applications were processed worldwide, and in 2010 about 2 million patents were applied for. The increased interest in patents can also be visualized in the increased activity in licensing and IP-based collaborations; the IP-based markets have allowed for trade in ideas and enabled organizations to capture ideas from both inside and outside the organizational structures. Furthermore, it has enabled organizations to capture value from ideas that are not being utilized internally. In Figure 2 the increase in cross-border licensing trade in the world economy is visualized.

Further indicating the increasing trend of licensing technology, the U.S. RLF revenues have increased from $35 billion in 1994 to $153 billion in 2007 (WIPO, 2011). This emerging markets for technology have not only encouraged manufacturing organizations to leverage their IP portfolios through licensing but it has also enabled new type of actors that thrive on

the creation and management of IP assets, enabling R&D as a stand-alone value proposition. Further, the success of Texas Instruments, Dow Chemicals and IBM in technology licensing have inspired others to follow, however many organizations have found it hard to replicate the success of these companies (Lichtenthaler, Implementation Steps for Successful Out-Licensing, 2011). This study includes five different types of organizations that are proclaimed pioneers in the technology licensing space: IBM, Rambus, PARC, WARF, and MIT TLO; and aims to derive the recipe of success in technology licensing.

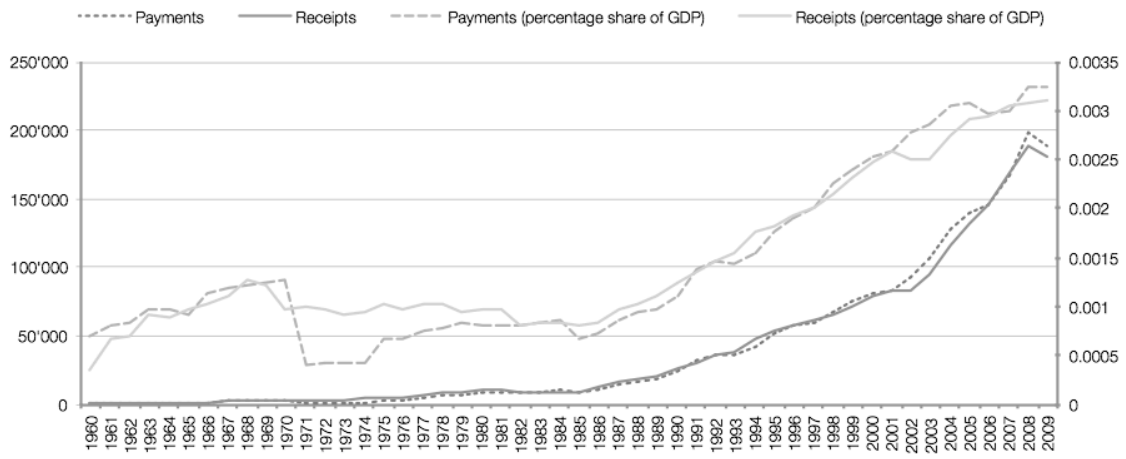

Figure 2, RFL Payments and Receipts, in US dollars (left), and as a Percentage Share of GDP (right), 1960-2009 (WIPO, 2011)

1.2 Prior Research

There have been extensive studies of strategies, strategic management, and licensing in regards to technology in the past. Megantz (2012) provided a guide on how to implement a successful licensing program. The book provides the reader with different elements of licensing and gives important thoughts on what organizations should consider before they determine if they should license. The book does not sufficiently dig into details of an overarching licensing strategy but focuses on specific deals. The book is mostly directed to organizations that have not licensed before but intend to move in that direction. Thus, for organizations that have been in the licensing business for a while and want to improve upon their licensing programs the book provides little guidance.

Harrison and Sullivan (2011) provided an extensive study that is directed to all types of organizations, both new and old to licensing, with information on how organizations may leverage their IP portfolios. The book *Edison in in the Boardroom, Revisited* provides the reader with important facts on why IP and IP management is important, taking real world cases as examples as well as recent changes in the environment for IP. However, this book is highly focused on IP management, not as much on licensing, even if aspects of the book are highly applicable (especially since IP typically drives technology licensing deals).

Lichtenthaler, Ernst, and Conley (2011) did an extensive study where they interviewed 35 experienced professionals in 25 companies to obtain an understanding of how organizations organize for technology licensing. They used a questionnaire that was sent out to 412

companies, where 33% answered. After receiving the results they conducted interviews in ten more companies to discuss the findings of the study. From the study they deducted six essential success factors and four different types of companies. Key findings included the fact that organizations need to organize efficiently for licensing. In their top rated category a common denominator was that the successful organizations had a large number of dedicated employees whose main task was to identify licensing opportunities. The study was limited in the scope as it only focused on the organizational structures, and not so much on strategy, position, and the leveraging of capabilities. The study did however emphasize the need to actively pursue deal opportunities internally and have a team dedicated to this task.

Lichtenthaler (2011), published what he considered major challenges facing organizations implementing a licensing programs and the reasons why organizations fail to replicate the success of Texas Instruments, IBM and Dow Chemicals. He concluded that the main reason for failure was organizations inability to identify licensing opportunities and suitable licensees, i.e. deal sourcing. Lichtenthaler (2011) did not go into detail on *how* successful organizations source deals.

This thesis aims to bridge the gap in existing theory as to how to manage the entire organization for licensing by connecting research management, IP management, licensing management, and deal sourcing. Thus, provide new insights on how organizations successfully manage licensing programs and how they can leverage internal capabilities, emphasizing the connection between research management, IP management and licensing management. Further, the study will highlight challenges noted by the participating organizations and how they strategically face them. Finally, prior studies have indicated deal sourcing as a major dependency for licensing, thus the study will aim to provide the reader with information on how successful organizations source deals.

1.3 Purpose of the Study

The study is set out to research an area that forms the basis of value extraction from technology in the knowledge economy - commercialization of technology and specifically technology licensing. The greater majority of prior researches and studies done in the area have failed to provide practical insights on successful technology licensing.

The primary concern of the study was to create an understanding of how organizations develop and manage technology licensing programs, through a study of different organizations and their licensing strategies. The study aims to provide readers with information on success factors and challenges in technology licensing.

The study will provide top executives, technology licensing managers, and academia with comprehensive factors that successful technology licensing organizations have in common. It also aims to support reflections of the impact of strategic choices; in addition the study can be used to evaluate the robustness of an organization's licensing strategy. The main contribution of the study will be an increased academic and practical understanding of

success factors in technology licensing. Furthermore, the study aims to provide interesting and accessible information to the public interested in the topic.

1.4 Research Questions

To fulfill the purpose of this study the research was focused on answering one main research question, which was broken down into sub-questions.

1.4.1 Main Question

The main question aims to fulfill the purpose of the research by providing insights in an area that has thus far not been addressed in a satisfactory way.

What distinguishes organizations that are successful in managing their licensing programs?

1.4.2 Sub-Questions

The main question was divided into sub-questions. The first sub-question was formulated in order to discover the strategic behavior of each of the organizations. It aimed to map out how each individual organization achieves and executes licensing opportunities. The question did not only focus on the organizational structures that are in place to achieve the mission of the organization but also distinguished how each organization managed assets and capabilities.

- How do organizations leverage organizational capabilities to enable licensing?

Secondly, the flexibility of the organizations was determined by researching how organizations face challenges and adapt to fit current market trends and internal needs. This enabled an exploration on what each of the organizations see as challenges and how they manage the organization in order to face the challenges successfully. A well-performing organization must have a consistency and sustainability in their performance, thus their ability to adapt and strategize based on current event is important.

- How do these organizations face challenges and adapt based on environmental changes and internal needs?

Lastly, the gathered intelligence on the organizations was compared and denominators were derived. In order to determine what distinguishes successful actors both the behavior and factors that were organization-specific as well as the behavior and factors they had in common were of interest. The organization-specific factors and behavior enabled analysis on how and why the specific organizations were different, and the common denominators were used to form a licensing pattern that may be adopted by a variety of organizations as it was not specific for one type of organization.

- What denominators and common behavior can be derived? How do the organizations diverge and why?

1.5 Scope and Limitations

The scope of the study was limited to the study of Knowledge-Based Businesses (KBBs) that are active in the technology market where they out-license technology either as the sole mean of obtaining revenue or as a supporting activity to increase their return on research investments. Further, the study was limited to the U.S. market thus limited to the U.S. legislation and norm of business conduct.

1.6 The Disposition of the Study

This thesis is divided into eight chapters excluding bibliography and appendices.

In the first chapter, Introduction, the background to the topic is presented, the purpose of the study, the research questions and the scope and delimitations. The chapter aims to set the stage and scope of the study.

In the second chapter, Methodology, the strategy and method to answer the research questions are presented.

In the third chapter, Theoretical Framework, the literature review is presented and a theoretical framework is formulated.

In the fourth chapter, Empirical Investigation, the empirical research conducted by the author is presented.

In the fifth chapter, Analysis, the theoretical framework is used to analyze the findings in the empirical research.

In the sixth chapter, Conclusion, conclusions are drawn and the thesis is concluded.

In the seventh chapter, Discussion, the results of the study are discussed and suggestions for further research are presented.

2 METHODOLOGY

This chapter provides the reader with the methodology and strategy used to answer the research questions.

2.1 Research Strategy

The study was, to a large extent, a qualitative study where the "data" was observations gathered through interviews. A qualitative study typically aims to understand behavior and the reasons for such behavior; translated to this study this means the decisions and focus successful organizations have in order to successfully license technology and the reasoning behind this. The study started off as a deductive study with an extensive literature study that aimed to map out the area in which the study would take place. The main contributions were highlighted and used to guide the empirical study to areas where gaps in the theory would allow for new theory to be formed. The empirical study focused on justifying and providing more findings that would strengthen existing theory - a deductive approach, and creating new insights in areas that have not been studied before - an inductive approach. Some quantitative data was used in order to support qualitative findings, such as licensing revenue and number of published patents. However, this data was only used in order to support discussions regarding the qualitative study. The study concerned a subject and area that is ontologically subjective as the subject is a social construction, however, in order to obtain insights an epistemologically positivistic approach was taken - information was put into context but the study did not question the existence of the phenomena discussed (Bryman & Bell, 2011).

2.2 Research Design

The research design used in this study was of comparative design. Comparative design is an extension of a case study design where two or more cases are studied using the same method. This study revolved around five cases - five different organizations. A case study is typically focused on "a bounded situation or system" and emphasis is put on extensive examination of the setting (Bryman & Bell, 2011). Case studies are one of the most challenging of social science endeavors but it remains most appropriate when interested in learning how or why something occurs. The purposes of case studies are not to generalize the result in order to apply to an entire group but rather to expand theories and provide insights (Yin, 2009), which was the purpose of this study.

2.3 Research Process

This section highlights the major steps used throughout the research. It is important to note that that the research was an iterative process, where some of the steps were revisited more than once.

2.3.1 Literature Study

The first step in the process was a literature study, which aimed to form the basis for a study that contributes insight with the potential to form new theory and expands upon prior theories. The literature review was used to build a theoretical framework that would direct the empirical research and provide a basis for the analysis.

2.3.2 Formulation of Research Questions

The research question was based on personal interest and prior theory with the intent to guide the research to new areas or subsets of areas, which needed expansion.

2.3.3 Empirical Selection of Interviewees

Due to time constraints and the nature of this study a *stratified empirical* selection was used as a selection method for the cases/organizations. Stratification is the process of dividing members of the population into homogeneous subgroups, *stratums*, before sampling (Bryman & Bell, 2011). The *strata* should be mutually exclusive: every element in the population must be assigned to only one stratum. The strata should also be collectively exhaustive: no population element can be excluded. The study was limited to KBBs active and successful in the technology market according to the scope of the study. This group has been stratified according to Figure 3, the stratification was based on technology licensing behavior

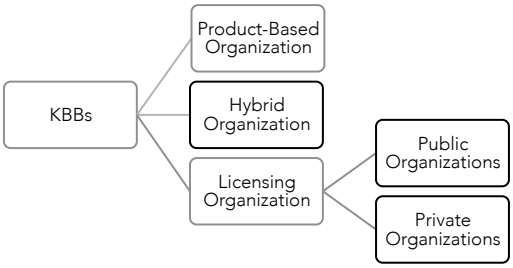

Figure 3, KBBs Stratification Selection.

2.3.3.1 Product-Based Organization

The study focused on technology licensing thus this set of organizations was excluded from the study.

2.3.3.2 Hybrid Organization

A hybrid organization is an organization that obtains revenues derived from technology both incorporated in a product as well as through licensing.

2.3.3.3 Licensing Organization

A licensing organization is an organization that does not produce any tangible products but commercialize technology through third parties.

Private Organizations are organizations that do not have the government as a stakeholder. They may still have government affiliation through contracts, but the government does not fund the major part of the research.

Public Organizations are organizations that commercialize technology that to a large extent has been funded by the government. The category includes public and universities and the affiliated Technology Licensing Offices (TLOs) and governmental research facilities.

2.3.4 Formulation of Interview Questions

The interview questions were formulated as semi-structured open-ended questions leaving much room for interpretation, which enabled unbiased answers. Each set of interview questions for each individual organization were based on the same intent but reflected the type of organization and information that was available through other sources, therefore they in some cases differed.

2.3.5 Data Collection

The data was collected through interviews with individuals in managerial positions at the organizations. The interviews were, for the most part, recorded, however due to personal preferences and confidentiality issues this was not the case for all interviews.

2.3.6 Interpretation of Data

The data gathered in the empirical study was collected through interviews and as such they come from individuals. The individual in question made a conscious decision to answer questions in a certain way. To enable critical eye external data was used together with the data collected through the interviews.

2.3.7 Analysis of Data and Conclusion of Thesis

The analysis of the data was to a large extent based on the theoretical framework and aimed to provide further proof of theory or expansions of existing theory to fill in gaps or broaden the scope. Lastly the findings were concluded and the thesis was formed.

2.4 Quality of Research

Bryman, and Bell (2011) suggest that the quality of qualitative research should be established and assessed through the following criteria: *reliability*, *validity*, *transferability, dependability, confirmability* and *authenticity*.

Reliability can be divided into external and internal reliability, which refer to the degree to which the study can be replicated and to which degree different observers agree about what they see (Bryman & Bell, 2011). In order to create an externally reliable study a clear strategy that would enable future replication of the study was determined. Further, interview questions and interviews were documented thus creating a clear framework that would enable replication. However, it is impossible to freeze a social setting and the circumstances of this study thus it may prove difficult to obtain the exact same result. In regards to internal reliability the theoretical framework was used as a strategy to enable different types of observers to observe in a similar manner, but each individual observe based on their own private experiences. Thus, this thesis is based on the observations by the author.

Validity can also be divided into external and internal validity and refers to which degree observations can be generalized across social settings and the match between the researcher's observations and the theoretical ideas they develop (Bryman & Bell, 2011). Concerns about case design research are often focused on external validity of the research - the result from one or a limited number of cases does not apply to the larger group. In regards to the

external validity of the study it is important to note that the purpose of this study is not to provide general theory but rather provide new insights to the field, which may be used to guide future research and perhaps inspire new theory. The internal validity of the research is ensured through the engagement of the researcher whom not only researched the area through observations but also applied the findings practically in her every-day work.

The *transferability* of qualitative research is often difficult as it is highly dependent on its set mileu and thus does not apply to all other settings (Bryman & Bell, 2011). In order to visualize for which context this study was focused on a rich description of the field and background to the study was included. This allows readers to make their own judgment of the potential transferability of the study to a new context or mileu.

Dependability is a parallel to reliability, and is part of establishing the trustworthiness of the research. In order to address this issue the interview questions, notes and when possible recorded interviews sessions were saved, as this enables each reader to act as an auditor (Bryman & Bell, 2011).

Confirmability refers to the recognition that complete objectivity is impossible but that the researcher should strive to be as objective as possible (Bryman & Bell, 2011). Throughout this study the researcher strived to be as objective as possible by using quantitative data if possible to strengthen qualitative findings.

Authenticity is typically determined based four criteria: *fairness, sensitivity to context, ontological authenticity, educative authenticity, catalytic authenticity*, and *tactical authenticity* (Bryman & Bell, 2011). *Fairness* refers to which degree of fairness the research represents different viewpoints among members of the social setting (Bryman & Bell, 2011). As this study focused on the managerial perspective the interviewees all were individuals that held an executive position in the organization, therefore the result of the study is from a managerial perspective and does not apply to all individuals within the organization. *Ontological authenticity* refers to the interviewees understanding of their social mileu and if the research enabled the interviewees to deepen their understanding of it (Bryman & Bell, 2011). The interview questions were open-ended, thus the discussions throughout the interview enabled the interviewees to speculate and think outside of their typical scope and explore areas that they perhaps had not thought about before. *Educative authenticity*, which refers to the interviewees increased understanding of other members of their social setting (Bryman & Bell, 2011), this was enabled by the complete study as it enabled interviewees to compare their organization to other organizations that strive for similar objectives but in different set ups. *Catalytic authenticity* refers to the ability of the research to encourage interviewees to engage in action that may change their circumstance, but as the interviewees were chosen based on their proclaimed proficiency in licensing it is most probably that this was not achieved. *Tactical authenticity* refers to the ability of the research to empower interviewees to act (Bryman & Bell, 2011), but due to the same reasoning as the catalytic authenticity this was probably not achieved.

3 THEORETICAL FRAMEWORK

This chapter provides the reader with a literature review that forms the foundation of the theoretical framework. The purpose of the framework is threefold; firstly the reader is put into context and the scene for the study is set. This is accomplished by presenting historical events, academic contributions, and changes in the industry, economy and law, that have helped shaped the subject and area of technology licensing. Secondly, the two focus areas; success factors for licensing and challenges in licensing will be explored. Thirdly and lastly, the chapter aims to highlight gaps in theory where contributions can be made.

3.1 Key Concepts

In this section the key concepts related to the research questions are presented.

3.1.1 The Intellectualization of the Economy

During the beginning of the 20th century most of the world lived in economies based on extractive industries – farming, mining, fishing, timber (Bell, 1973). With the creation of the steam engine, new factors of production, and the development of modern chemistry a new understanding of the economies arose – the division of labor and the principle of production. One of the major effects of this change was an increase in productivity – greater output of goods or lesser input of labor. The change in the economy is commonly referred to as the industrial revolution. The industrial revolution was made possible due to "a new understanding of technology and the organization of production" (Bell, 1973). Knowledge was applied to work that set of the productivity explosion, which have developed economies throughout the last hundred years, often referred to as the *Productivity Revolution* (Drucker, 1993). Today, knowledge is applied to knowledge – knowledge is used as means to obtain social and economic results, referred to by Drucker (1993) as the *Management Revolution*. Knowledge has become the essential resource.

3.1.1.1 The Codification of Knowledge and Knowledge-Based Businesses

The main driver of the industrial revolution was the codification of knowledge and the introduction of science and technology (Bell, 1973). The codification of knowledge is best visualized through a comparison with knowledge that has not been codified, *tacit knowledge*. *Tacit knowledge* is knowledge that is complex to articulate and often is embedded in the way things are done (Sullivan, 1998), examples of this is lore, experience and skills developed within a group. Tacit knowledge is hard to value and the holder is rarely aware of the value that he/she possesses. What distinguishes tacit knowledge is that it is owned by the holder and is difficult to transfer or copy. *Codified knowledge* is written down which makes it easier to transfer and control.

Drucker (1993) means that the new social leading groups in the knowledge economy are the *knowledge workers* – the individuals that allocate knowledge to productive use. The difference between these workers and the *manufacturing workers* is that they own the means of production, which means that they can take it and bring it where they want to, emphasizing a challenge of the knowledge economy – control. KBBs do not only have much vested in the knowledge that lies with their employees but their profit is also dependent on extracting value from it (defined by Sullivan (1998) as intellectual capital). *Intellectual capital* can be

divided in three categories: human capital, IAs, and IPRs, each of which constitutes of knowledge in different forms with different levels of control (Sullivan, 1998). *Human capital* constitutes of experience, know-how, skills, and creativity. IAs can refer to documents, drawings, programs, data, inventions, and processes. IPRs are IAs with legal protection such as patents, copyrights, trademarks, trade secrets, and semiconductor masks (further discussed in 3.1.2.1).

3.1.1.2 Markets for Technology

Today "it has long been recognized that economic prosperity rests upon knowledge and its useful application" (Teece, 1998). Market transactions for technologies and knowledge have become more common, and these markets have changed the traditional mindset of that organizations need to own downstream manufacturing assets in order to commercialize their technology[3] (Arora, Fosfuri, & Gambardella, Market for Technology and Their Implications for Corporate Strategy, 2000). Technology and knowledge are today definable, tradable commodities and stand-alone value propositions. The markets for technologies have enabled more specialized business models, lower barriers to enter and increased competition. Arora, Fosfuri and Gambardella (2001) suggest that the innovative division of labor is a consequence of the markets for technology. In order for organizations to successfully partake in the markets for technology Arora, Fosfuri and Gambardella (2000) suggest that organizations must introduce more proactive management of intellectual property, greater attention to external monitoring of technologies and organizational changes to support technology licensing, joint ventures and acquisition of external technology. The U.S. Department of Justice and the Federal Trade Commission provided the following definition for the markets for technologies: "markets for intellectual property that is licensed (the "licensed technology") and its close substitutes – that is, the technologies or goods that are close enough substitutes significantly to constrain the exercise of market power with respect to the intellectual property that is licensed" (U.S. Department of Justice and the Federal Trade Commision, 1995). Arora, Fosfuri and Gambardella (2000) expanded this definition to also include markets for innovation leading to the following expanded definition for markets for technologies: "a market for technology refers to transactions for the use, diffusion and creation of technology. This includes transactions involving technology packages (patents and other intellectual property and know) and patent licensing. It also includes transactions involving knowledge that is not patentable or not patented (e.g. software, or the many non-patented designs and innovations)". For the purpose of this study market for technologies shall be defined as follows: market that refers to transactions for the use, diffusion and creation of technologies.

3.1.1.3 Innovative Division of Labor

Chesbrough (2006) describes the innovative division of labor as: "a system where one party develops a novel idea but does not carry this idea to market itself. Instead, that party

[3] Technology will be treated "as an imprecise term for useful knowledge rooted in engineering and scientific disciplines, but also drawing from practical experience from production" (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of Innovation and Corporate Strategy, 2001).

partners with or sells the idea to another party, and this latter party carries the idea to market". The increased complexity of technology has increased the number of actors that specialize in one specific technology and move further up the value chain, where they offer R&D as stand alone value proposition. Teece (1998) emphasized one of the risks an organization will face when they become an organization that only focus on R&D as a stand-alone value proposition, as such an organization will not directly be involved in the production market, thus they will operate increasingly remote from the manufacture and design of the product itself, thereby generating a gap between them and the commercial market.

3.1.1.4 Managing Intellectual Assets for Competitive Advantage in Research and Innovation

Wiener (1994) uses the term invention to describe the process, typically described by innovation, of bringing novelty to market. In *The Management of Technological Innovation: Strategy and Practice* the term innovation is used to describe "the creation of a new idea and its reduction to practice" (Dogson, Gann, & Salter, 2008). For the purpose of this study the definition provided by Dogson, Gann, and Salter (2008) will be used. This yields a meaning of the phrase that includes the process of commercialization - bringing the product to market. Thus, the activity of innovation thereby includes activities such as: scientific, technological, organizational, financial, marketing and more (ibid). It is a multi-disciplinary activity that requires extensive effort from the entire organization. Innovation further plays a central role in providing organizations with comparative[4] and absolute[5] advantages. This emphasizes the need for organizations to have a holistic view of innovation, where different disciplines are cross-managed to leverage the organization's capabilities. Unsuccessful management of innovation will take shape as failed exploitation of new ideas (Dogson, Gann, & Salter, 2008). The challenges in managing innovation include managing decisions regarding strategy, organization, marketing, finance and technology. The organization must further make effective decisions in each of the areas and often at the same time. "It is the very difficulty of managing technological innovation that makes it such a source of competitive advantage" (Dogson, Gann, & Salter, 2008).

Typically the tendency to innovate is highly dependent on the internal resources for R&D but it has also become increasingly hard for firms to innovate due to the increasing complexity of technology and the fact that technological developments often are incremental. Thus, technologies or technological products often consist of a combination of different technologies, they are multi-technological (Tietze, 2012). (ibid) further illustrates the increasing complexity of technical products in today's market by empirical statistics: "complex technologies comprised 43% of the 30 most valuable world goods exports in

[4] The ability of an individual or group to carry out a particular economic activity (such as making a specific product) more efficiently than another activity (Oxford Dictionaries 2014).

[5] The ability of an individual or group to carry out a particular economic activity more efficiently than another individual or group (Oxford Dictionaries 2014).

1970, however by 1996, complex technologies represented 84% of those goods". The market is often highly populated with competition making innovation a race against competitors. The race aspect yields an increased need to accelerate the processes from ideas to the actual launch on the market. Tietze (2012) mean that the effect of these trends yields that supporting activities – to conceptualize, develop and promote the product becomes more complex. Additionally the capabilities to develop new technology "are functionally and spatially dislocated". Organizations need a variation of skills, capabilities, and competencies over organizational and geographical boundaries, not only in the research phase but also throughout the entire process of bringing novel ideas to market. The need for organizations that help accelerate time-to-market is also emphasized by the complexity of technical products, promoting the innovative division of labor.

Managing innovation, from idea to market, is important for all organizations if they aim to maintain their competitive advantage, grow, be profitable and ultimately survive. Due to the increased complexity in both the market and the technology itself there has been a rapid growth in the variety of arrangements that exist for exchanging technologies or technological services, including but not limited to joint ventures, contracted R&D, licensing and cross-licensing. Tietze (2012) describes a change in the behavior of firms of today as: "firms increasingly innovate openly, sourcing, and exploiting technologies outside the boundaries of their own firm" (Tietze, 2012). The R&D activity has increasingly become a joint effort, where the phenomena of open innovation has become a more common concept, for example when NEC saw their expertise in semiconductors as being a key strategic technology central to their competiveness, they decided to develop their expertise in semiconductors, which required over a hundred technological alliances (Dogson, Gann, & Salter, 2008). Open innovation, labeled by Henry Chesbrough in 2003, introduces new types of business models. The open business model exploits the division of labor by leveraging more ideas and value capturing means and arrangements by using a certain asset, resource or position in numerous businesses. The concept of open innovation builds on the fact that organizations cannot solely rely on their own capabilities.

> Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology.
>
> *- Henry Chesbrough, 2003*

The effectiveness and quality of the commercialization determine the outcome of innovation - if the invention in fact can be regarded as an innovation (Dogson, Gann, & Salter, 2008).

3.1.2 Control of Technology

In order to commercialize technology through third parties organizations must control the technology and knowledge they transfer. IPRs constitute the most robust system for organizations to control these assets.

3.1.2.1 Intellectual Property Rights

IPRs refer to the means organizations have in order to protect intangible assets generated within the organizations, i.e. transform technology into property. The rights resemble other rights as they allow creators, or owners to benefit from the work or investment. Megantz (2002) suggests the following about the importance of IP: "development, protection and proper utilization of IP are of fundamental importance to companies active in technology licensing".

IPRs form the basis of technology licensing and include copyright, trademarks, patents, and in some jurisdictions trade secrets (Megantz, 2002). A patent is intended to protect the property rights of the inventor or owner while still allowing the benefits of the invention to be utilized by the public. The protection is designed to give the holder the right to exclude others from making, using, or selling the invention for a fixed period of time. In the U.S. there are three different types of patents; *utility patents*, *design patents* and *plant patents*.

Utility patents have a term for 20 years from the date of application and cover functional inventions, new compositions, drugs, engineered plants and animals, and software[6]. The patent application is published 18 months after U.S. patent application, unless the applicant files a document at the time of the application that states that the application will not be subject to foreign filings. The applicant can also apply for a provisional patent application that yields a patent pending status for 12 months; during these 12 months the patent must be converted into a utility patent or discontinued. The provisional patent application is useful if the inventor needs more time for proof of concept as it is less espensive than a utility patent application, and it also yields the inventor an extra year of patent protection. There are four requirements in the U.S. patent system to obtain patent protection (Megantz, 2002):

1. Novelty: the invention must be original and not previously known to anyone.
2. Non-obviousness: the invention must not be an obvious development from prior art.
3. Utility: the invention must be capable of being operated to achieve some useful purpose.
4. Enabling disclosure: the disclosure of the invention must be so that a person with ordinary skill in the art would be able to make or use the claimed invention without undue experimentation.

Design patents protect non-functional aspects of manufactured products and have a term of 14 years, in addition certain parts of them can sometimes be additionally protected as trademarks.

Plant patents can be sought after for new varieties of asexually reproduced plants, the term for these is 17 years (Megantz, 2002).

[6] Highly controversial as the U.S. system is the only IP system in the world that allows patents on software further the view upon software as patentable has changed throughout years.

Trademarks are symbols or words that identify the source or a certain aspect of products or services, it is used to preserve the owners good will. Either the trademark can be established through commercial use or it may be registered. The term for registered marks is ten years, after which the owner may choose to renew for an additional ten years. Typically trademarks are not thought of as part of technology licensing but Megantz (2002) believes that licensing trademark together with other IP can yield certain advantages; the use of the trademark can yield a higher license fee as well as increase the value of the licensed trademark through the marketing of the licensee, also trademarks have a never-ending term.

Copyright protects books, compositions, performances, movies, software, firmware, manuals, and alike. To obtain copyright protections the work must be original, the author must have created the work, and it must be fixed in a tangible medium of expression. The copyright yields the author the exclusive right to reproduce, distribute, and commercially exploit the work. The protection lasts for the lifetime of the author plus 50 years, the term for work made for hire is 75 years from the date of publication or 100 years from the date of creation, depending of which comes first. After the term the work enters the public domain (Megantz, 2002).

Know-how can also be a form of an IPR through trade secrets. It includes all information that is particular and essential to the operation of the business. Know-how is protected by keeping it secret, and is thus maintained through instituting policies about disclosures and use of know-how (Megantz, 2002).

There is also a right called *mask works* which are topological drawings used to manufacture circuits, these can be registered and protect the work for two years after first commercial exploitation.

Until recently the coveted and most interesting sales items have been U.S. patents, this mainly due to the combination of the big commercial market in the U.S. and the expense and potential awards available through litigation. However, recently there has been an increase of interest in European patents, especially German, as they are considered to be high quality patents and the fact that it is less expensive to litigate in Germany (Wild J. b., 2014).

3.1.2.2 Intellectual Property Management

Petrusson (2004) conceptualizes three keys for constructing "business and create wealth in an increasingly intellectualized economy". Each of the three keys represents the normative conceptualization of an insight of the real cognitive character of IPRs (and other intellectual institutions. The keys are as follows:

1. Understanding of IPRs as communicative actions in three arenas: judicial, administrative, and business.
2. Understanding of IPRs as regulative and consequential norm experiences.

3. Understanding of IPRs as value visions, value propositions, value experiences and self-assertive interests.

The first and second key governs intellectual value creation where as the third key governs value extraction (Petrusson, Intellectual Property & Entrepreneurship, 2004). The first key relates to the fact that the organization must monitor IPRs as communicative actions on the three arenas: judicial, administrative, and business. Each of the arenas should be regarded as structural platforms that must be used in the construction of IPRs. In the administrative arena Petrusson (2004) suggests that the communicative actions to a large extent are governed with formalistic procedures, of for example patent filings with the patent office. The judicial arena forms the structural fundament of states where legislation and earlier court cases forms informative sources for organizations. The administrative and judicial arenas are to large extent national structural platforms. This forms a problem with the last arena, the business arena – which is, for the most part, an international arena. Petrusson (2004) describes the administrative and judicial arenas as supportive, structural platforms for the business arena. By these three arenas Petrusson (2004) aims to highlight the fact that decisions regarding IPRs must be considered in the three arenas thus the organization must have competencies in these three arenas. The first key emphasizes that the organization "needs the operational skills to recognize how intellectual claims of structural control interact with other intellectual claims", i.e. how a strategic decision will affect the organization in all the three arenas. The organization may then map how different claims in the business arena have to interact with communicative actions in the judicial and administrative arena. The second key relates to the norm-based reification process that constitutes the basis of value extraction – the organization must establish a sophisticated network of norm relationships that work to capitalize the intellectual creativity. The third key unveils the financial dimension in IPRs – Petrusson (2004) presents the different means an organization may use to turn their IPRs into financial returns.

To innovate successfully organizations need not only to manage the R&D but also their IP assets, not only to eliminate the risk of litigation but also for "more efficient creation of innovations" (Tietze, 2012). Megantz (2002) emphasizes the importance of IP in licensing deals, as it is the foundation on which a licensing program is built. Thus, "effective management of IP is critical to the success of any licensing strategy" (Megantz, 2002). The objective of an IP management program should be to optimize the use of IAs. Typically the activity includes:

1. Identification of IP assets.
2. Determination of level and type of protection of IP assets.
3. Development of complementary assets, determine what is needed in order to reach the business objective for the IP asset and how this is to be obtained.
4. Utilization of IP asset, determine of the use of the IP asset can be optimized in order to maximize revenue that is in line with the overarching strategy.

Teece (1998) suggested several critical dimensions for the potential of returns of an organization's IP: the nature of the technology, the strength of property rights,

complementary assets, the ease of replication and the ease of imitation. The success of licensing is increased when there exists a substantial gap between replication and imitation costs according to Teece (1998). Arora, Fosfuri and Gambardella (2000) agree with Teece (1998) and suggest that if the technology is easy to replicate and transfer but difficult to imitate, the licensing organization may capture a large part of the rents simply by licensing. When the underlying knowledge base is sufficiently codified and not context specific, and IPRs are well defined and protected, licensing may work well (Arora, Fosfuri, & Gambardella, Market for Technology and Their Implications for Corporate Strategy, 2000).

The strategic importance and value of IP has increased over the past years, and it is an area that is still, to a large extent, developing (Harrison & Sullivan, 2011). Harrison and Sullivan (2011) mention six factors for the increase in value of IP, or rather the recognition of value of IPRs. The first factor is the recent increase in IP litigation and the increased size of the judgments. During the 1980s the average patent judgment was $6.2 million, 1990s the average was $13.2 million, and between 2000-2008 the average patent judgment was $17.8 million. Harrison and Sullivan (2011) suggest that those numbers do not reflect the huge damages in some cases, such as Abbott Laboratories by Centocor $1.67 billion or Microsoft by Lucent $1.52 billion. The judgments have increased but also the sheer number of patents filed further indicating the expanding field; in the U.S. 2000 295926 patents were filed, compared to 2010 when 490226 patents were filed (ibid).

The second factor for the increase in value of IP is the shift to knowledge-based products and the new collaborative product design, open innovation. A "WIPO report indicated that between 1982 and 2000, the physical assets of U.S. corporations declined from 62% to 30% of their value" (Harrison & Sullivan, 2011).

The third factor they mention is the rise of the Internet. Internet enables mass infringement on an enormous scale. For example, whenever a person attaches an article in an email it is technically copyright infringement unless licensed by the copyright owner (Harrison & Sullivan, 2011).

The fourth factor mentioned by Harrison and Sullivan (2011) is the reform of the patent law. The U.S. patent system has moved from *first-to-invent*[7] to *first-to-file*[8], and to remedies on how to calculate damages and the ability to obtain *injunctive relief*[9].

The fifth factor is the rise of software. Software has become expanded for its potential applications, no longer only used for accounting and word processing but now ubiquitous

[7] The right to the grant of the patent is given to the entity that is the first to conceice the invention and then reduced it to practice by filing a patent application. Only the U.S., Canada, and the Philippines had this type of system, however all of them have switched to *first-to-file* in 2013, 1989, and 1998.
[8] The right to the grant of the patent is given to the entity that is the first to file a patent application.
[9] Court-ordered act of prohibition against an act or condition, which has been requested in a petition to the court for an injunction.

and incorporated in almost everything. Software poses difficult challenges for IP law as both patents and copyright can protect it. However, neither of the systems have developed with the development of software and as such each of the systems face significant challenges. The major challenges of copyright law is the functional nature of software, traditional copyrightable work offers the author wide range of freedom but for software the developer is limited by the need to work with other software. Hence, copyright is difficult to apply for software. Patent protection for software is a highly controversial subject. The European Patent Convention does not even include computer programs in patent protection. However, in the U.S. software is patentable. The issue has been revisited since 1963 when AT&T:s Bell Laboratories sought a patent for converting between two binary forms a couple of times. The patent application was rejected claiming the invention to be "a logical list of mental steps". The case reached the Supreme Court in 1972 and then IBM filed a brief opposing the patent. They not only opposed that specific patent but software patents in general. IBM argued that copyright protection was better suited to protect software. Lee (2014) argues that copyright allows someone else to develop software that achieves the same result as existing copyrighted software, patent law does not. In 1981 the Supreme Court allowed the first computer-related patent. This patent was allowed as it sought to protect a process for curing synthetic rubber and was not, as the prior Bell patent application, a pure mathematical formula. This meant that pure software patents were still illegal but inventions that tied software to tangible applications were permissible. In 1982 Congress created the U.S. Court of Appeals for the Federal Circuit and gave it jurisdiction over all patent appeals, the new court had a noticeable pro-patent bias. In 1998 a patent protecting a strategy for managing mutual funds by the State Street bank was allowed. The number of software patents increased in the 1990s, and not only the number of patents but also in the number of lawsuits involving software patents. In 2012 the high court rejected patents of medical diagnostic techniques and in 2013 they rejected patents on human genes.

The last factor Harrison and Sullivan (2011) mention is the rapid technology development and obsolescence we experience today. IP position is one of the ways an organization can fend of competitors.

3.1.2.3 The Patent Marketplace

During recent years the marketplace for patents have grown, patens can be bought, sold, and traded. This has led to an increase in strategic management of patents, liquidity, transactions and business models for buyers and sellers as well as intermediaries. Today the market for patents include among others: patent assertion entities, patent aggregators, IP development companies, licensing agents, litigations investment firms, patent brokers, IP auction houses, and online IP exchanges (Millien & Laurie, 2007).

3.1.2.4 The Intellectual Property Portfolio as a Competitive Tool

Harrison, and Sullivan (2011) describes different levels of IP management:

1. *Defend Level* translates into an organization that make sure that their business is protected by having IP identification procedures, facilitating patent generation and

maintenance, enforce patents, and have educational programs regarding IP and how it links to business.

2. *Managing Cost Level* translates into an organization that relates the IP portfolio to the business of the organization, establishes screening criterions, manages the cost of IP, and considers in licensing as means to manage costs.
3. *Value Capture Level* translates into an organization that identifies what value they intend to extract from their IP, develops a value extraction strategy, organizes for the strategy and develops IP reporting metrics.
4. *Synthesize Opportunities Level* translates into an organization that understands and capitalizes upon the relationships between invention and innovation for the enterprise, and quantifies the IP risk/reward trade-offs from the ownership of the IP portfolio.
5. *Shaping the Future Level* translates into an organization that manages IP as business assets that should generate value, use "patent applications as *technology options,* investments to place bets and hedges on alternative business and technology future", continuously refine and update their IP strategy depending on the changing business and technology conditions, and define and influence their future.

3.1.3 Commercialization of Technology – the Final Stage of Innovation

Commercialization of technology is a complex endeavor that involves a variety of processes. It is commonly defined to "reflect the transition from discovery to public use" (DeGeeter, 2004). However, this definition is too broad as it is equivalent to the meaning of innovation. (ibid) mentions a variety of different definitions but the definition that is the most suitable for this study is "the business transaction or processes by which innovations are moved from one place, development stage or application to another place" (ibid). For manufacturing companies this would mean selling the technology incorporated within a product and transferring the product into the market through sales. The definition provided by (ibid) is the definition that will be used throughout this study.

The act of commercializing technology is a multidisciplinary action where the strategy will vary with the technology and transferee. DeGeeter (2004) introduces challenges for commercializing technology such as; capital limitations, rapid technology change, short product life cycles, and complex regulatory environment. The likelihood of successfully commercializing technology "may be greater if: the technology produces an operative cost-effective benefit significant to at least some people; and thorough patent/literature reveals strong claims that are likely to be patentable and enforceable". DeGeeter (2004) further emphasizes that the most important activity in technology commercialization is the technology marketing, i.e. finding and attracting a demand for the technology.

Petrusson (2004) conceptualizes the intellectual value chain (innovation process) into an intellectual value star, Figure 4, which illustrates the activities in value creation, specifically that the activities are parallel, dependent, and interacting. This star emphasizes the capabilities an organization needs in order to succeed at becoming a structural platform in extracting value from IAs.

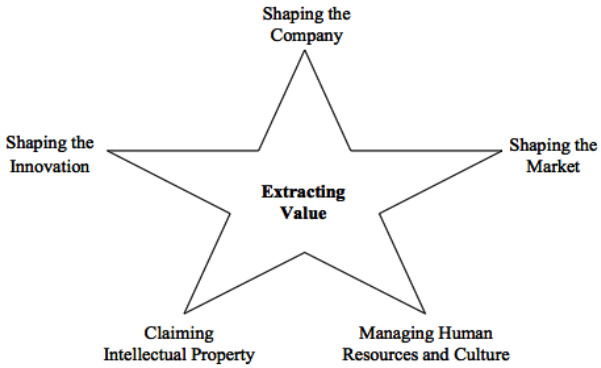

Figure 4, The CIP Intellectual Value Star (Petrusson, Intellectual Property & Entrepreneurship, 2004).

Licensing technology is one way to commercialize technology, but there are other means such as; traditionally manufacturing products, initiating a new venture, establishing a joint venture, forming a strategic alliance, and selling the technology to a third part. Each organization should consider alternatives to licensing and determine what suits each technology and situation best (Megantz, 2002). Megantz (2002) proposes a mapping of the technology against complimentary assets; assets needed in order to successfully commercialize the technology (such as capital, marketing, development, facilities, complimentary IP asset).

3.1.3.1 Licensing Technology

Organizations are often focused on maximizing revenues from their developed technologies and licensing has become a commercialization channel that may complement traditional product development. Organizations such as Texas Instruments, IBM, and Dow Chemicals pioneered the trend of out-licensing. IBM and Dow Chemicals collected hundreds of millions of dollars in annual licensing revenues and 50% of Texas Instruments net income stems from licensing activities. The success of these companies have inspired others to follow, however many organizations have found it hard to replicate their success (Lichtenthaler, Implementation Steps for Successful Out-Licensing, 2011). In the U.S. 99% of patent licensing revenues stems from 40% of the patent holders, leaving the remaining 60% of patent holders with only 1% of the licensing revenues (Lichtenthaler, Implementation Steps for Successful Out-Licensing, 2011).

IBM expanded their licensing practice in 1988, and between 1993 and 1994 they increased the revenues from technology licensing from $345 million to $640 million. In 1998 their revenues from licensing constituted $1 billion (almost $750 000 per patent), and over 10% of their net profits (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of

Innovation and Corporate Strategy, 2001). Texas Instruments initiated their licensing strategy in 1985 through a successful assertion play, and between 1986 and 1993 they earned $1.8 billion in cumulative royalties (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of Innovation and Corporate Strategy, 2001). Dow Chemicals formed a licensing group in 1995 with the purpose to generate more revenues from their technology. Before the formation of the group the annual revenues summed up to about $25 million per year. In 2000 they expected to earn around $125 million per year (Lichtenthaler, Implementation Steps for Successful Out-Licensing, 2011). IBM, Texas Instruments, and Dow Chemicals did not choose to license their technology due to inability to commercialize it by themselves but rather they saw licensing as a beneficial and profitable side-activity. Reasons for licensing technology can include (according to Lichtenthaler (2011)):

- The technology has applications in markets where the organization is not active.
- Licensing can be used to control prices, create and control *de facto standards* .
- Enhance demand by creating a second source of supply.
- Cross-licensing purpose.
- To control competition and limit entry.

Reason for licensing is traditionally explained by organizations being less efficient at exploiting the technology than the licensee (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of Innovation and Corporate Strategy, 2001). However, licensing is often beneficial for all types of technology organizations as organizations often develop technologies that are valuable to numerous organizations. Even if they are used by the owner for specific purposes they could be licensed to other firms for other purposes which in turn increases the return on the investment to the owner. Further, firms often have technologies and patents they have not, nor intend to, commercialize. These types of technologies can be licensed to actors that have a need for that specific technology. Arora, Fosfuri, and Gambardella (2001) specifically separate between the market for technology and the market for products and present challenges and synergies in and between the two. Amongst challenges found in the product market they emphasize the competition in the product market as a strong strategic incentive to license. Decisions to license involve, according to Arora, Fosfuri and Gambardella (2001), factors such as; the nature of demand, transaction costs, bargaining power of the licensor and patent protection. The two main forces driving licensing decisions for manufacturing organizations are the *revenue effect*[10] and the *rent dissipation effect*[11] (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of Innovation and Corporate Strategy, 2001).

There are a number of strategic concerns that must be taken into consideration in order for the organization to form an implementable and suitable licensing strategy (Megantz, 2002). The strategy must support the overall business plan, the revenues from the licensing activity

[10] Arora, Fosfuri, and Gambardella (2001) refers to the revenue effect as rents earned through licensing revenues.

[11] Arora, Fosfuri, and Gambardella (2001) refers to the rent dissipation effect as given by the erosion of profits due to another competitor competing in the product market.

need to be adequate to support the licensing strategy, the strategy should reflect whether it is a long-term or short-term strategy, and lastly if it is a long-term strategy the relationships between the licensor and licensees must reflect this (Megantz, 2002). (ibid) introduces the subject of strategic fit – the licensing strategy and program must fit with the overarching business strategy of the organization. These considerations will be different depending on what type of organization it is. If the revenue of the organization solely comes from licensing the challenges are different compared to a hybrid organization that both license technology as well as incorporate the technology in their products. For the hybrid organization they must make sure that the licensing strategy complements and enhance their product lines. If they are licensing to a competitor the individual strategy must reflect the fact that they are licensing to a competitor and be developed as to prevent future problems. The success factor is further complicated by the individual objectives of each organization, where private actors primarily focuses on return on the investment in R&D and public organizations have objectives of technology impact (Megantz, 2002).

When forming a licensing program the revenues forecasted for the program must be sufficient to justify the effort of actually implementing the strategy. Implementing a licensing program requires extensive effort and capital, and Megantz (2002) emphasizes the need to allocate sufficient resources in order for the licensing program to succeed by stating: "Inadequate allocation of resources to these efforts can delay or even prevent the program's success." (Megantz, 2002).

There are different types of licensing that primarily depend on what is being transferred, how it is being transferred and the strategic reasoning behind the decision to license. The types of licensing can be divided into *ex ante licensing* and *ex post licensing*, this refers to what is being granted to the licensee (the subject is further discussed in 3.1.3.2). There are also different consideration depending on if it is a decision to license-out or license-in, further discussed in 3.1.3.3 and 3.1.3.4.

3.1.3.2 Ax Ante and Ex Post Licensing

There exists different ways to categorize technology licensing depending on what is being transferred and how it is being transferred. The most illustrative way is perhaps *carrot* and *stick licensing*. *Carrot licensing* is when an organization offers an attractive patent on its own merits to a potential buyer or licensee and convinces the buyer/licensee to take the offer based on potential profitability (Goldscheider & Gordon, 2006). *Stick licensing* is when an organization offers a patent to an infringer and unless the prospect agrees with the terms the holder of the patent sues (ibid). Goldscheider and Gordeon (2006) suggest that the term stick licensing is negative connotation that is undeserved, but rather a necessary process for all licensing organizations. Arora, Fosfuri, and Gamradella differentiate between licensing existing technology or future technology (or component for future technology) and WIPO (2004) differentiates between three different types of licenses; pure IP license, product or technology license, or standards license.

For the purpose of this study *ex ante* and *ex post licensing* will be used to differentiate the different types of licensing activities. *Ex ante licensing* is to be defined as the licensing of a future technology - more than just the right to use the technology described in the patents is granted. *Ex ante licensing* is a solution license where know-how, designs, processes, patents, and sometimes consulting hours are typically transferred. *Ex post licensing* will be used in this study referring to licensing an existing technology that only gives the taker of a license the right to use the technology described in the claims of the patents, a new capability is not enabled.

Licensing patents on a technology that is already used by the licensee can sometimes be referred to as ex post licensing. This has created new types of business models, organizations that buy patents and license them without developing the technology further nor producing any goods based on the technology, often referred to as Non-Practicing Entities (NPEs) or the inherently negative term *trolls*. This type of business model is a highly controversial subject that during the past couple of years have been given much attention. One side claims that they "improve markets for technology and increase incentives for small inventors", and the other side claims that NPEs "exploit weaknesses in the patents system" (Bessen, Ford, & Meurer, 2011). The NPEs that have this type of business model lies outside the scope of this study and will thus not be discussed further.

3.1.3.3 Licensing-Out

Licensing-out is what the licensor does when the organization transfers rights to the technology. Reasons for licensing-out include; generating revenue from existing IP portfolio, providing a second source of supply, gain side benefits, minimize legal expenses, and exploit new markets. Megantz (2002) emphasizes the challenges in out-licensing; it is not simple, nor inexpensive. This illustrates the need of the activity of out-licensing to be a long-term commitment.

Parr and Sullivan (2006) divide out-licensing organizations into two types; strategic out-licensors – organizations that seek to generate income from their developed strategic technology and IP, and opportunistic out-licensors – organizations that are interested in receiving income from their non-strategic technology and IP.

3.1.3.4 Licensing-In

Licensing-in is what the licensee does when the organization takes a license from another party. Taking a license to an existing technology, instead of developing it in-house often reduces the time to market and saves resources (Megantz, 2002). Thus it is a way to acquire new technologies, it enables an organization to manufacture standardized products, and legalizes infringement.

Parr and Sullivan (2006) divide the in-licensing organizations, into two categories as well; seekers of technology – organizations that wish to accelerate their time to market by using

already developed technology rather than investing in their own research, and infringers – organizations that have been found to use existing technology without right.

3.1.3.5 Cross-Licensing

Cross-license is a license between two or more parties were each of the parties grant a license to each other for the exploitation of the subject-matter claimed in specific patents (Megantz, 2002). It is occasionally used to settle IP conflicts and is often used by organizations to avoid litigation and to obtain rights to IP they need for their business.

3.1.3.6 Different Types of Licenses

As there are different methods and different types of arrangements between licensor and licensee each license needs to be exclusively tailored in order to reflect the technology, market, and the relationship between the licensee and licensor. The license must reflect upon exclusivity – should the license be exclusive or non-exclusive, in which market should the licensee be allowed to operate – both in regards to territorial and field of use (Megantz, 2002). A non-exclusive license typically means less risk for both the licensee and the licensor, and enables more control for the licensee. Market and territorial consideration allows the licensor to actually license to a competitor as long as the license constricts in where the licensee is allowed to act. Other considerations include but are not limited to: right to improvements and continuity, financial terms, rights to sub-license, and warranties.

3.1.3.7 Vertical and Horizontal Licensing

Licensing can further be classified depending on where in the value chain it occurs. *Vertical licensing* involves organizations that do not compete but rather specialize in one particular aspect of development. *Horizontal licensing* is between two similar organizations that are active on the same level in the value chain. Vertical markets have become increasingly important and common in high-tech industries (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of Innovation and Corporate Strategy, 2001). The "vertical markets are a division of labor in the innovation process itself and thus is closely linked to a much older and more powerful set of economic ideas" (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of Innovation and Corporate Strategy, 2001). In theory specialized upstream suppliers that serve many firms yield output that is produced under increasing returns, thus more effective (Arora, Fosfuri, & Gambardella, Markets for Technology the Economics of Innovation and Corporate Strategy, 2001). This has lead to an increase in organizations that only focus on upstream R&D as a stand-alone value proposition. Having organizations with R&D as a stand-alone value proposition increases the demands on enabling profitable business models for these types of organizations. "The licensing of technology has become an area of increasing profitability for knowledge-based companies" (Parr & Sullivan, 2006).

3.1.3.8 Universities as Licensors

The type of licensor will also lead to different licensing strategies. A university as a licensor creates new challenges (Megantz, 2002). Firstly, the government funds the major part of research results produced. Further, the technology is often far away from the market,

yielding a greater risk for the licensee. But the most important difference is the objective of the different types of organizations; universities strive for impact – making inventions available to the public, and not as typical business actors - income.

3.1.3.9 Success Factors and Challenges in Licensing Technology

Managerial challenges facing organizations active in the technology-licensing field include the difficulty in sourcing deals, and the management of actual transfer of the technology (Lichtenthaler, Ernst, & Conley, How to Develop a Successful Technology Licensning Program, 2010). (ibid) identified success factors for technology licensing through a benchmarking study in medium-sized and large European companies. They conducted interviews with 35 experts in 25 companies to gain an understanding of organizing for technology licensing. After the interviews they conducted a questionnaire-based benchmarking study among licensing and intellectual property managers. For the questionnaire they received a response rate of 33% (136 companies responded from 412 companies asked). After the questionnaire they conducted interviews in 10 companies to discuss the findings. They concluded their findings in six success factors:

1. Assigning dedicated employees.
2. Leverage external networks, organizations often rely on their existing networks to identify licensing opportunities.
3. Set up multidisciplinary teams to identify deal opportunities.
4. Create transfer project teams, when deal opportunities emerge set up specific transfer teams dedicated to the specific deal.
5. Use executives to promote licensing throughout the organization.
6. Enlist employee participation, draw participation from a variety of employees to assist in identifying deal opportunities and manage the deals.

Of the sample they studied they divided them into four categories depending on the proficiency in technology licensing:

- Traditionalist, organizations that primarily focuses on their product business.
- Hesitators, organizations that are actively aware of the benefits from licensing but are not actively pursuing them.
- Activists, companies that have relatively proficient licensing programs where they actively attempt to identify potential licensing opportunities rather then just waiting for inquiries from licensees.
- Outperformers, the organizations that have pioneered the trend towards active licensing.

Lichtenthaler, Ernst and Conley (2010) emphasized the need to not oversimplify the realization of licensing opportunities, and the need to organize effectively for licensing. Goldscheider and Gordon (2006) suggest that the most successful high-technology companies have entire departments focused on enforcing the companies' intellectual property. They emphasize the need to do the *homework*. By *homework* they mean both internal and external analysis of the portfolio, determining the extent of the portfolio and then

mapping the portfolio towards potential licensees' products. Doing the homework moves the licensing process at a reasonable pace (Goldscheider & Gordon, 2006).

Megantz (2002) states that: "accurate and reliable market information is perhaps the single most important component of a successful licensing strategy". An organization needs the most current information in order to implement a successful business strategy(ibid). (ibid) divides the type of information needed into four categories; general information, companies currently active in the market, ongoing research and unexploited technologies, and current technology licensing activities in the market place. Having this information enables the organization to see where their technology fits in the ecosystem and further it enables organization to project potential revenues, and develop strategy.

3.1.3.10 Deal Sourcing

The noun *source* is defined as "a place, person, or thing from which something comes of can be obtained" (Oxford Dictionaries, 2014). The verb *source* is defined as "obtain from a particular source" (ibid). The noun *deal* is defined as "an agreement entered into by two or more parties for their mutual benefit, esp. in business or political context" (ibid). For the purpose of this study *deal sourcing* shall refer the activity of identifying, marketing, pursuing and managing deal opportunities.

Many organizations find it difficult to source deals (Lichtenthaler (2011) and Harrison and Sullivan (2011)). Lichtenthaler (2011) believes that the major challenges facing organizations implementing a licensing program and the reasons why they fail to replicate the success of Texas Instruments, IBM and Dow Chemicals, is their inability to identify licensing opportunities and suitable licensees. Insufficient understanding of potential applications for their technology constitutes the major reason for failing to identify licensing opportunities (Lichtenthaler, Implementation Steps for Successful Out-Licensing, 2011). Arora, Fosfuri, and Ronde (2014) found that nearly 75% of the IP managers that participated in a survey were under the impression that they could increase licensing revenues. This means that there are many deal opportunities that were foregone (ibid). (ibid) claim that decentralized licensing yields under-licensing, i.e. foregone licensing opportunities. Further they introduce what type of error may occur due to centralization, some potentially good deals will be rejected and some value-destroying deals will be accepted (Arora, Fosfuri, & Ronde, Managing Licensing in a Market for Technology, 2014).

Megantz (2001) claims that marketing technology is far more challenging than marketing products, this mainly due to the intangible nature of the technology – it becomes more difficult to explain features, forms, functions and value when the technology is not incorporated in a tangible products.

Research presented by Ford, and Saren (2001) showed that, in most licensing deals, it is the buyer of the technology that is most likely to take the initiative. Hence leading to the conclusion organizations tend to be better at identifying inadequacies in their own

technology rather than organization with a marketable technology identifying this and seeking potential customers. 2/12 organization investigated by Ford and Saren (2001) had a formal process for identifying licensees. Comments from the organizations were that organized searches never worked. One company concluded their entire deal sourcing strategy as basically announcing the availability of a technology and then let licensees approach them. Other companies emphasized the need for information as a preparation for a deal. They cited one of their interviewees saying: "Once we have determined the best method for utilization, we use all available approaches to find a licensee, such as trade publications, contacts with trade associations, Chambers of Commerce etc. In connection with our overseas licensing program, we work very closely with commercial attaches of various foreign consulates and the various overseas association, such as the British Board of Trade, to secure information on companies interested in expanding their product lines. Another fertile source of prospective licensees is our own internal-purchasing vendor lists. We work very closely with out purchasing departments, and as matter of policy give our vendors first opportunity to qualify for a license relating to products they are now manufacturing for us. " (Ford & Michael, 2001).

Macwright, and Ritter (2007) propose a method of systematic marketing for sourcing deals for technology. The method is divided into four activities:

1. Gather internal information (if the technology is invented in-house) – this step is focused on gathering information from the inventors, and turn it into information. Questions to answer in this step include: mapping potential applications (products and services that would benefit from the invention), mapping competitive landscape (similar offerings, substitutions etc.), mapping potential licensees, mapping value propositions (what is our offering, i.e. the utility of the invention), mapping the market (what is the market and market segment the invention falls under, size and growth of market, key players, competition, market stage, regulatory obstacles, investment needed to reach market, i.e. baseline cost), lastly map what internal contacts could be used to reach the market (does the inventor have contacts at the licensee or knows anyone who has contacts there). This step is used to gather all internal knowledge that may be leveraged in order for the technology to reach the market.
2. Gather external information about the potential licensees; use the web, newspapers etc., consider subscribing to services that enables searches for potential licensees.
3. Summarize and review information in order to generate a prospect list. Prioritize the prospect list and rank them according to how their focus maps to the technology in question.
4. Finally, make contact with the potential licensees. This step includes locating the right person to talk to. Call the person and make sure to record potential useful information throughout the call. After the initial contact have been made follow up with a letter and start building the relationship.

The organization can also use intermediates to source deal opportunities for technologies. One potential way is an IP broker. The broker mediates between the buyers and sellers of the IP and can manage the deal sourcing process. The broker helps at setting expectations for the seller and helps provide a neutral ground for both parties. The broker can also assist a buyer in finding a specific technology. When the engagement is done the broker takes a percentage of the sale. There are also licensing agents, that are very similar to brokers, but focus solely on the sellers/licensors side, i.e. they assist in finding licensees for the for the licensor. These types of engagements are often more long-term than the broker engagement (Millien & Laurie, 2007).

There are also parties that facilitate live auctions for IP. The auction house facilitates an exchange for historically illiquid assets. The auction house allows sellers to offer one or more patents for predetermined set of terms and conditions. The auction house then charge listing fees, attendance fees and commission. This is typically only in regards to sale of patents and not so much for licensing (Millien & Laurie, 2007).

There are many emerging business models to fill the need found by many in sourcing deals for technology. A new type of model has been implemented by Canadian organization Snowflake Inc., - a global Technology Reserve. The organization works as an accelerator for the transfer and commercialization of technology. They aim to lower the access barriers for Small to Medium Enterprises (SMEs) to obtain technology, and by this accelerate innovation. They are targeted at three main actors: depositors, borrowers, and SMEs. The organization acts like a bank in which IP developers, depositors, can deposit rights to use their IP on which they receive annual interest payments. Governments, borrowers, will loan these IPRs and pay annual interests in order to receive options to license the technologies. The governments may then pass on these rights to SMEs in their region. The SMEs may then test and try out the technologies with the possibility to convert the option to a license at preset prices and terms (IFA Network, 2012).

When a potential licensee has been found and interest to partner up has been sparked some obstacles still lie in the way in order to close the deal. What type of license was discussed briefly in 3.1.3.5 and 3.1.3.6, and strategic considerations were touched upon in 3.1.3.7. Other aspect that must be taken into consideration is valuing the technology. "Accurate technology valuation provides the foundation for the development of a logical and defensible royalty structure and can ameliorate many royalty-related problems encountered in license negotiations" (Megantz, 2002). As valuation lies outside of the scope of this study the methods for valuing technology will not be discussed in detail.

The relationship between the licensor and licensee is reflected in the license agreement. The negotiation of the terms set in an agreement is a sensitive process in the licensing activity (Megantz, 2002). Megantz (2002) claims that in order to successfully negotiate the terms of an agreement flexibility, open-mindedness, and receptiveness are needed. A detailed discussion of negotiations strategies and tactics is an interesting and huge area of research

but lies outside of the scope of this study and will thus not be discussed further; neither will the drafting of the agreement.

3.2 Towards a Conceptual Framework

Due to the intellectualized economy we live in today new types of businesses have emerged - businesses focused on generating knowledge. The innovative division of labor, a result of the knowledge economy, and a development to Adam Smith's theory about division of labor has generated a group of organizations that not only generate knowledge but also monetize solely on this intangible asset. The IP system facilitates control over knowledge and is in fact what makes these types of business models possible, further it opens up innovation as organizations can work together yet control their own assets that leads to higher creativity and accelerates research, a business model and theory first labeled by Chesbrough (2006).

An organizations level of understanding of their IAs and IPRs differs thus also their performance in activities that revolves around IAs and IPRs. Sullivan and Harrison (2011) provides a model for analyzing an organizations level of performance in regards to IP management where the top level includes actors that use their IP portfolio as a competitive tool to shape the future.

Petrusson (2004) provided the reader with three keys in order to open the door to realize financial value from intellectual value where IPRs formed the foundation:

1. Understanding of IPRs as communicative actions in three arenas: judicial, administrative, and business.
2. Understanding of IPRs as regulative and consequential norm experiences.
3. Understanding of IPRs as value visions, value propositions, value experiences and self-assertive interests.

Further Petrusson (2004) introduced the Intellectual Value Star where crucial organizational capabilities were introduced in order to succeed in creating financial value, the star can be used in order to assess an organizations capabilities in each of the areas.

Lichtenthaler, Ernst and Conley (2010) found 6 organizational success factors for licensing organizations:

1. Assigning dedicated employees.
2. Leverage external networks, organizations often rely on their existing networks to identify licensing opportunities.
3. Set up multidisciplinary teams to identify deal opportunities.
4. Create transfer project teams, when deal opportunities emerge set up specific transfer teams dedicated to the specific deal.
5. Use executives to promote licensing throughout the organization.
6. Enlist employee participation, draw participation from a variety of employees to assist in identifying deal opportunities and manage the deals.

Goldscheider and Gordon (2006) suggested that the most successful high-technology companies have entire departments focused on enforcing the companies' intellectual property. Megantz (2002) emphasizes the need to allocate sufficient resources in order for the licensing program to succeed by stating: "Inadequate allocation of resources to these efforts can delay or even prevent the program's success." (Megantz, 2002). "Effective management of IP is critical to the success of any licensing strategy" (Megantz, 2002).

Lichtenthaler (2011) and Harrison and Sullivan (2011) suggested that many organizations find it difficult to source deals and research presented by Ford, and Saren (2001) showed that, in most licensing deals, it is the buyer of the technology that is most likely to take the initiative in license deals. Megantz (2002) further claims that marketing technology is far more challenging that marketing products.

DeGeeter (2004) introduce challenges for commercializing technology such as; capital limitations, rapid technology change, short product life cycles, and complex regulatory environment. The success of likelihood of successfully commercializing technology "may be greater if: the technology produces an operative cost-effective benefit significant to at least some people; and thorough patent/literature reveals strong claims that are likely to be patentable and enforceable" (DeGeeter, 2004). (ibid) further emphasizes that the most important activity in technology commercialization is the technology marketing, i.e. finding and attracting a demand for the technology.

Prior research regarding technology licensing provides little practical insight for operating organizations looking to optimize their licensing strategy. Further it only touches upon challenges facing organizations, neither considering causes nor solutions. The theoretical framework is summarized in Table 1.

Table 1, Summary of Theoretical Framework.

Element	Definition	Factors
Organizational Structures	*Refers to the tools used to implement the strategy in the organization*	Petrusson (2004): • Organizational model through which the licensing capabilities of an organization could be measured: Shaping the Company, Shaping the Innovation, Shaping the Market, Claiming IP, Managing Human Resources Lichtenthaler, Ernst and Conley (2010): • Assigning dedicated employees • Set up multidisciplinary teams to identify deal opportunities • Create transfer project teams, when deal opportunities emerge set up specific transfer teams dedicated to the specific deal Arora, Fosfuri and Ronde (2014): • Decentralized licensing yields under-licensing, i.e. foregone licensing opportunities. Gordon (2006) • The most successful high-technology companies have entire departments focused on enforcing the companies' intellectual property Arora, Fosfuri and Gambardella (2000): • Organizations must introduce organizational changes to support technology licensing, joint ventures and acquisition of external technology
Management	*Refers the function that coordinates strategy, assets, and resources in order to accomplish the objective*	Megantz (2002): • Development, protection and proper utilization of IP are of fundamental importance to companies active in technology licensing Tietze (2012): • Organizations must manage their IP assets for more efficient innovation Harrison, and Sullivan (2011): • Organization that manages IP as business assets that should generate value Harrison, and Sullivan (2011): • Continuously refine and update their IP strategy depending on the changing business and technology conditions, and define and influence their future Arora, Fosfuri and Gambardella (2000): • Organizations must introduce more proactive management of intellectual property, greater attention to external monitoring of technologies Goldscheider and Gordeon (2006): • Ex post licensing is a necessary process for all licensing organizations.
Competencies	*Refers to the abilities to perform specific tasks successfully*	Petrusson (2004): • Decisions regarding IPRs must be considered in three different arenas: judicial, administrative and business. Specifically how they tie together, thus organizations must have competencies available in the organization that span through these areas of expertise
Culture	*Refers to the customs and beliefs of a particular group*	Lichtenthaler, Ernst and Conley (2010): • Enlist employee participation, draw participation from a variety of employees to assist in identifying deal opportunities and manage the deals • Use executives to promote licensing throughout the organization
Position	*Refers to the perceived strength of the organization*	Arora, Fosfuri and Gambardella (2001): • Bargaining power of the licensor
Assets	*Refers to the technology and IP*	Teece (1998) and Arora, Fosfuri and Gambardella (2000): • The success of licensing is increased when there exists a substantial

	controlled by the organization	gap between replication and imitation costs
Resources	*Refers to the monetary and human capital within an organization*	Megantz (2002): • Emphasized the need to allocate sufficient resources in order for the licensing program to succeed
Theoretical Understanding of the Field	*Refers to the understanding of theoretical concepts and social constructions within the field*	Petrusson (2004): • Understanding of IPRs as communicative actions in three arenas: judicial, administrative, and business • Understanding of IPRs as regulative and consequential norm experiences • Understanding of IPRs as value visions, value propositions, value experiences and self-assertive interests
Challenges	*Refers particular events or facts that may affect the performance of an organization in a negative way*	Megantz (2002): • Marketing technology is far more challenging that marketing products DeGeeter (2004): • Capital limitations • Rapid technology change • Short product life cycles • Complex regulatory environment Lichtenthaler (2011) and Harrison and Sullivan (2011): • Many organizations find it difficult to source deals

3.3 Summary

The literature review consisted of three major parts; Intellectualization of the Economy, Control of Technology, and Technology Commercialization – the Final Stage of Innovation. The review was followed by a compilation of the literature where the key contributions and gaps were highlighted. The resulting theoretical framework will form the basis for the empirical study.

4 EMPIRICAL INVESTIGATION

This chapter is used to present the empirical investigation; each of the organizations will be described with the interviews as the main source of information.

The empirical investigation was performed using the theoretical framework. The elements and findings were converted into questions. Firstly an attempt to answer the questions using existing theory and electronic sources was made, after this first attempt the questions were restructured to individually fit each organization and the findings from the first attempt. The individually structured questions were asked at an interview with an individual in a managerial position at each of the organizations. Table 2 visualizes a summary of the organizations in regards to what type of organization as well as the name and title of the interviewee.

Table 2, Summary of the Organizations and Interviewees that Represents the Cases Included in the Study.

Organization	Type of Organization	Interviewee	Position of Interviewee
IBM	Hybrid Organization	Jim Schreiber	Program Director Intellectual Property
Rambus	Private Licensing Organization	Stefan Tamme	VP of IP Strategy
PARC	Private Licensing Organization	Michael Waltrip	Senior Director ICM
MIT TLO	Public Licensing Organization	Lita Nelsen	Director
WARF	Public Licensing Organization	Leigh Cagan	Chief Technology Commercialization Officer

4.1 IBM

This section describes the history and development of IBM[12] as an organization, brand, their technologies, and licensing activities. A summary about the organization can be seen in Table 3.

Table 3, Short Facts about the IBM.

The Organization	
	IBM
Employees (2013)	431212
Revenue in $US (2013)	$104.51 billion
Origin	U.S. 1911
Scope of Study	
R&D	IBM spends around $6 billion in research every year and employs about 170000 researchers.
IP	IBM published, on average, 12944 patent applications annually between 2009-2013. Today they hold 55587 active granted patents.
Licensing	IBM reported $822 million licensing revenue in 2013, where $150 million were patent licensing and royalty fees.
Main source for study	Interview with Jim Schreiber (Program Director Intellectual Property)

4.1.1 Background

IBM was founded in 1911 through the merger of three companies: the Tabulating Machine Company, the International Time Recording Company, and the Computing Scale Company. The company was initially named Computing Tabulating Record Company, which turned into International Business Machines Corporation (IBM) in 1924 (Madrigal, 2011). IBM develops and manufactures hardware and software, and sells infrastructure, hosting, consulting, and license technology in areas ranging from mainframe computers to

[12] www.ibm.com

nanotechnology. IBM had revenue of $104.51 billion in 2014 (Forbes, 2013) and spends $6 million in research and development annually (Frier, 2013). Famous inventions by the organization include: the ATM, floppy disk, hard disk drive, electronic keypunch, magnetic stripe card, virtual machine, scanning tunneling microscope, DRAM, UPC, and Watson AI. The organization holds 12 research laboratories and holds the record for the most patents generated by a company for 20 consecutive years (Frier, 2013), further the organization employs about 170000 researchers (Ma, 2008). Between 1994 and 2013 IBM published about 152000[13] patents.

The corporation is ranked as the No. 4 largest U.S. firm in terms of employees (Fortune 500 a, 2012), and the No. 9 most profitable (Fortune 500 b, 2012). Furthermore, the organization was ranked No.4 Most Valuable Brands (Forbes, 2013), and No. 6 Most Innovative Company (Nisen, 2013).

In 1993 IBM posted the biggest loss (at the time) in the history of corporate America - $8 billion. IBM suggested the cause of this loss to be that they had missed a number of key technology shifts and that they had become "insular and marginalized in a changing technology landscape" (Lefever, Pesanello, Fraser, & Taurman, 2011). In order to battle this difficulty the management chose to expand upon their offerings to include services and solutions. To enable this change they had to change the way they did research, developed products, marketed and sold new offerings, as well as how they acquired talent and in general operated in a global economy. The change was led by Louis V. Gerstner, Jr., who was the first CEO recruited outside of IBM's ranks (he was a former McKinsey consultant and had spent 11 years as a top executive at American Express). He recommitted to the main frame and drove cost reductions. The effects of his actions gave results as the organization turned profits of $3 billion by 1994. Gerstner's end-goal was to restore the once great reputation IBM had, and in order to do this he shed commodity business and focused on high-margin opportunities. The organization divested in low margin industries such as DRAM, IBM Network, personal printers and hard drives. They started a global services business that became a leading technology integrator. Further, IBM became brand agnostic in their services – they integrated whatever technologies the client desired even if parts came from a competitor to IBM. Their software strategy focused on middleware – the software that connects operating system to applications and IBM invested heavily into it. However, their effort in developing their operating system, OS/2, which was technically superior to Microsoft's Windows 95, never penetrated stand-alone desktop PC market segments sufficiently. To compete with Microsoft IBM bought Lotus Development who's Lotus SmartSuite would compete with Microsoft Office. Due to stalled negotiations with Microsoft IBM received their Windows license later than their competitors, which ended up hurting the sales of the IBM PCs. In 1996 Microsoft's market value passed IBM's as personal computing exploded, largely led by Dell and Compaq, which ran Microsoft's Windows (Madrigal, 2011).

[13] Source: Thomson Innovation

IBM has a successful history of changing the computer industry and developing and delivering outstanding machines. In 1997 the IBM Deep Blue beat Garry Karparaov in Chess, which was the first time a computer defeated a reigning world champion in a match (Garry Karparaov resigned after 19 moves) (Madrigal, 2011). In 1998 the first microprocessor (CMOS) that ran at 1 billion cycles per second was unveiled. The breakthrough generated new circuit designs and product groups. IBM then started a research project with Lawrence Livermore National Laboratory, the United States Department of Energy and academia, that was focused on building new supercomputers capable of one quadrillion operations per second. The project was nicknamed "Blue Gene". The new type of computers would perform 500 times faster than other supercomputers and could be used to simulate folding complex proteins. In 2000 IBM delivered the world's most powerful computer to the United States Department of Energy. The computer would test the safety and effectiveness of the nuclear weapon stockpile. In 2008 IBM took the No. 1 rank for world's most powerful supercomputers, the computer could operate at speeds faster than one quadrillion calculations per second and used half the electricity the supercomputer ranked as No. 2 used. In 2011 the IBM supercomputer "Watson" competed and won on TV show Jeopardy and on September 29th, in 2011 IBM also surpassed Microsoft closing price.

IBM has been involved in various large, strategic acquisitions, both on the buy-, and sale-side. In 2005 they sold the personal computing division (ThinkPad) to Lenovo, marking a transition into a service company (Madrigal, 2011) and in 2012 they bought Kenexa, which provides employment and retention solutions to assist organizations in hiring and keeping workers, for $1.3 billion. Most recently in June 2013 they acquired SoftLayer Technology, which provides cloud infrastructure, for about $2 billion and Trusteer, which provides web fraud detection services, for about $1 billion.

Other recent engagements include the OpenPOWER Consortium. In 2013 IBM joined Google, NVIDIA, Mellanox and Tyan to create an OpenPOWER Consortium, where the goal is to build advanced servers, networking, storage, and GPU-accelerated technology based on the IBM POWER microprocessor architecture.

The organization has moved increasingly to become a service-based organization and on February 27th 2014 the organization announced that they would layoff 25% of the hardware division.

They have also gone through rougher times more recently as in 2013 when they struggled, due to the controversial cooperation with the National Security Agency (NSA), which caused stock prices to decline after the NSA mass espionage revelation.

IBM has historically had a strong brand and has delivered many outstanding innovations to society. They occasionally make risky investments in R&D and many of these investments have shaped how the world looks at technology today. They have not only helped shaped

the technology industry but have also been one of the pioneers in shaping the IP community by "demonstrating that patents need not be blunt instruments of litigation, but an effective tool for supporting and encouraging collaboration, pen standards and innovation" (Ma, 2008). IBMs track record, and their reputation throughout the history yields credibility not only in policy matters but also in their own business negotiations.

4.1.2 Assets

IBM makes sure that they always have a continuous flow of assets to license through different ways, for example many organizations cut research funding in times of trouble – IBM does not. They also allocate funds to pure speculative projects such as the Watson Computer and IBM works hard on incentivizing inventors to file patents on their discoveries (Kurman, 2011). IBM's portfolio of assets is vast and broad, and they always assess newly issued patents to ensure quality in their portfolio. IBM has published, on average, 12944[14] patent applications annually between 2009-2013 and today they hold 55587[15] active granted patents.

In 2011 Manny W. Schecter, Chief Patent Counsel, said the following about the success of IBMs IP strategy: "I suspect our business executives are more in tune with our IP strategy than some of our competitors. We also outspend our competitors in terms of research & development" (Quinn, 2012). IBM has engineers and lawyers within each business unit that look for potential infringers and if an engineer discovers a potential infringement they put pressure on the infringer to pay a license fee. This behavior is frown upon by many as it is suggested that it may halt innovation and that it is a form of a bullying behavior as the accused infringer often ends up paying the license fee due to inability of pay for litigation (Kurman, 2011). Louis Galambos, professor of economic and business history, Johns Hopkins University, Baltimore emphasizes the need for a strategic approach to technology licensing which IBM's performance dramatizes, "They have learned how to use licensing as a strong positioning factor in global markets." Furthermore, IBM donates some patents to open source and certain IBM technologies are put into the public domain, generating a substantial amount of good will. Other than generating good will it is also a clever tactic sometimes referred to as *picket fence defense*, which means that when the invention becomes prior art, as it does when placed in the public domain, competitors may be less incentivized to patent incremental inventions (Kurman, 2011).

4.1.3 Licensing Management and Deal Sourcing

IBM has always had an open licensing policy, which has evolved together with the market (Schreiber, 2014). It started with the mainframe, evolving to the personal computer, and has changed with the IP climate. About five to six years ago the organization also started to sell patents. The organization has a centralized IP division that is multidisciplinary and involves individuals from different backgrounds: business, technology, and legal. Schreiber (2014) emphasizes the need to do "the homework" - one must know exactly what a patent covers

[14] Thomson Innovation
[15] Innography

and if it is being used. IBM never approaches potential licensees unless they are completely sure of the fact that the patented technology is being used. Extensive effort is put into understanding the patents and exactly what they apply to, yielding very targeted and indemnified sourcing of deals. This type of commitment requires extensive bandwidth within the organization, which IBM has. IBM highly rely on their reputation and existing relationships for sourcing deals, which means that existing relationships must be managed in a good manner to encourage continuous relationships.

In 2013 IBM reported $822 million in *intellectual property and custom development* income. This number can be broken down accordingly:

- $352m Sales and other transfers of IP
- $320m Custom development
- $150m Licensing/royalty based fees

The first category consists of pure sales of IP or IP that has been spun off. The second category is not related to IP nor to technology licensing. The third category includes technology and patent licensing. Patent licensing and technology licensing differ according to IBM, as the latter often involves the transfer of trade-secrets, technical know-how, etc. Joff Wild claims that 40% of the third category is ex post licensing where as 60% is ex ante licensing (Wild J. , 2008).

4.1.4 Challenges

Schreiber (2014) points out the fast-paced and ever-changing technology industry as the main challenge for the organization. Organizations active in the technology industry must try to predict where the market is heading as technology development and research is a time-consuming effort that is hard to shift fast. Therefore the licensing teams at IBM that are very active in the technology market strive to feed back information of potential emerging markets to the research teams (Schreiber, 2014).

4.2 Rambus

This section will provide the history and development of Rambus[16] as an organization, brand, their technologies, and licensing activities. A summary about the organization can be seen in Table 4.

Table 4, Short Facts about the Rambus.

The Organization	
	Rambus
Employees (2013)	450
Revenue in $US (2013)	$281.6 million
Origin	U.S. 1990
Scope of Study	
R&D	Rambus spent $118.0 million on research and development in 2013.
IP	Rambus published, on average, 270 patent applications annually between 2009-2013. Today they hold 1648 active granted patents.
Licensing	Rambus is an organization that solely commercializes technology through different types of licensing arrangement thus the entire revenue comes from licensing.
Main source for study	Interview with Stefan Tamme (VP of IP Strategy)

4.2.1 Background

Rambus was founded in 1990, and is a research organization focused on technology licensing. Their offering spans from the seeds of new technologies to fully developed products. They historically have had their strength in technologies related to memory architectures and hardware-based security solutions, but today they also develop products and services in adjacent markets such as advanced LED lighting.

In an article by Erin Fuchs regarding 'Tech's 8 Most Fearsome 'Patent Trolls" Erin ranked Rambus as the sixth most fearsome troll, citing tech blogger Joel Hruska claiming that Rambus is not only a troll but rather *the troll* (Hruska, 2012). Other organizations mentioned were: Acacia Technologies (ranked eighth), Tessera Technologies (ranked seventh), Wisconsin Alumni Research Foundation, WARF (ranked fifth), Interdigital (ranked fourth), Rockstar Consortium LLC (ranked third), Round Rock Research LLC (ranked second), and Intellectual Ventures (ranked first). Erin uses a definition for Non-Practicing Entity (NPE) from PatentFreedom as: "any company that derives the majority of its income from licensing patents", a definition too broad in order to say that "patent troll" is equivalent to that meaning. Further the definition fails to explain the term it is directed to, namely NPE. A better definition of what a patent troll does was provided by Jessica Karmasek (2014) "a patent troll purchases groups of patents without an intent to market or develop a product. In some cases, but not all, the non-practicing entity or patent assertion entity then targets other businesses with lawsuits alleging infringement of the patents it bought." (Karmasek, 2014) Efforts are currently being made by large corporations such as Google to push Congress and the U.S. Supreme Court to curb abusive litigation (Decker, 2014), which has lead to a rather infected subject where unnecessary name-calling has been used to diminish organizations and what they are trying to accomplish. Rambus creates the technology they patent, and the majority of their employees are engineers and inventors (Fuchs, 2012), thus they should not be labeled as a troll but rather a research organization that commercializes technology

[16] www.rambus.com

through licensing or as an accelerator of technology as these types of organizations often help speed up time-to-market for clients.

Cannady (2013) described the licensing strategy used by Rambus in the 1990s as *Moat Building*. Moat building means that a fortress is built as a collection of technologies and related patents owned by numerous parties – forming a technology standard. An organization then claims related technologies that organizations that implement the standard are likely to use – "anyone that wants to visit the fortress must cross the moat" (Cannady, 2013). The strategy described by Cannady (2013) is challenging, as it requires large investments. The investment is not always recovered, as predicting the way standards and markets evolve is not always possible. Further, implementation of this strategy can sometimes violate antitrust laws and yield bad press, as the members of the Standard Setting Organizations most often do not appreciate the behavior. Cannady (2013) mentions Rambus as an example of this strategy due to their history. In 1992 Rambus joined a Standards Setting Organization, the Joint Electron Devices Engineering Council (JEDEC). The organization participated in a committee that was to define DRAM standards, which they later withdrew from before JEDEC approved a standard for DDR SDRAM. Right after their withdrawal they started a licensing program based on their DDR SDRAM patents. This was made possible due to the fact that the SSO policy did not require its members to broadly disclose patent applications (Cannady, 2013).

4.2.2 Assets

Rambus has published, on average, 270[17] patent applications annually between 2009-2013 and today holds 1648[18] active granted patents. Their portfolio is not as diverse as many other organizations, as their focus for a long time was memory systems their portfolio reflects this. This leads to the advantage that by pure numbers they are very likely to have many patents covering technologies related to memory systems (Tamme, 2014). Regarding IP management, Rambus has an internal prosecution team that manages the filing procedure.

4.2.3 Licensing Management and Deal Sourcing

Rambus started out as a licensing business mainly due to the cost of building a DRAM factory (Tamme, 2014), they realized from the start that building a DRAM factory was not an option hence out of necessity they formed a licensing business model.

In 1996 the organization experienced great success starting with licensing the RDRAM to the Nintendo 64. Shortly after they entered into a development and license contract with Intel. These early successes helped build trust and credibility in the organization. In 2000 the relationship with Intel started to cool of, this leading to a need for the organization to change. Therefore Rambus found it necessary to work and strive for an ex post license with Intel.

[17] Thomson Innovation
[18] Innography

Success stories after 2000 include the Sony PlayStation 2 that incorporates the RDRAM, and the PlayStation 3 with the XDR DRAM, the successor to RDRAM. These types of deals were based on long-term relationships that had developed over time

Rambus has been very successful throughout the latest couple of years. In 2010 the organization signed agreements with Samsung and Elpida (Rambus a, 2014). During 2011 Rambus signed license agreements with NVIDIA Corporation, Broadcom, Panasonic and Freescale during the year (Rambus a, 2014). Major highlights of 2012 included patent license deals with Fujitsu and Mediatek (Rambus a, 2014). During 2013 the organization signed license agreements with SK Hynix, Micron Technology, ST Microelectronics, and LSI Corporation (Rambus a, 2014). The CEO, Director Ronald D. Black Ph.D commented about their recent success in 2013: "2013 was certainly a year of transition as we implemented our strategy of personalizing broad licensing options based on consumer needs; approach the market in a more open and collaborative manner and focus investments to achieve optimal shareholder value creation." (Financial Trend, 2014). In 2013 Rambus reported licensing revenue of $281.6 million, an increase of 14% compared to 2012 results (non-GAAP results)[19] (Rambus a, 2014).

Rambus has a unique mix of ex ante and ex post licensing. Over the years they have modulated these two different business models and gone back and forth between the two in order to obtain the right mixture. On the revenue side for 2013 the number $282 million can be divided accordingly (Rambus c, 2014):

- Patent License Royalties: $249 million
- Solutions License Royalties: $15 million
- Contract Revenue: $7 million
- Other Patent Royalties Received: $10 million

Only comparing patent and solution royalties (ex post and ex ante), it yields a distribution of 94.3% and 5.7%.

Rambus' biggest ex post deal is with Samsung, which is worth $900 million over five years. Solely in 2013 they signed ex post licensing deals worth more than $1 billion. Ex post licensing has for long time been a big part of Rambus' business model, as it is a business model that offers high return, and often necessary in order to maintain rights and control over assets. However, aggressive efforts in ex post licensing yields bad press, and too big efforts in ex post licensing can prove damaging to ex ante licensing activities. In cases where infringement is clear the organization must be aggressive and in worst case assert in order to establish credibility for potential future partners (Tamme, 2014).

[19] In computing each of these non-GAAP financial measures, the following items were considered: other patent royalties received but not recognized as revenue, gain from settlement, proceeds from sale of intellectual property, stock-based compensation expenses, acquisition-related transaction costs and retention bonus expense, amortization expenses, costs of restatement and related legal activities, restructuring charges, impairment charges, severance costs, non-cash interest expense and certain other one-time adjustments. (Rambus 2014)

Today, the organization focuses on ex ante licensing (Tamme, 2014), and they are investing heavily to revitalize this business. This strategic change was initiated due to internal needs such as achieving closeness to the market and means to develop new technology that fit with the needs of the market, thus capitalizing on the effects of open innovation. External environment regarding legislation was also a factor in the change of strategic direction. Other recent strategic changes include their focus on having more, but smaller deals.

Rambus often source deals through existing relationships, thus the organization strives to establish long-term relationships. The exact strategy and tactic when sourcing a deal depend on what type of deal they are looking for. Ex ante licensing typically start with technology professionals, since the design elements require extensive discussions, as they typically do not offer complete solutions but rather provide the licensee with technical elements. These types of discussions can go on for three months to three years before closing – typically they go on for about a year. For ex post licensing the deal is sourced with the licensing group within the licensee organization rather than technical people.

Rambus' strategy has changed throughout the years responding to internal changes and external factors. The organization is constantly thinking about how to improve. In regards to changing the licensing strategy Tamme (2014) said the following: "there are no quick fixes for strategies, you want to move fast but *it is impossible to un-ring a bell* therefore you do not want to move too fast".

4.2.4 Challenges

Tamme (2014) emphasizes the need for licensing organizations to be credible in the eyes of the licensees; the organization must have control of the technology (enforce) and be able to deliver what is being promised, the licensees must be ensured that they have obtained sustainable rights to the technology they are licensing.

Other challenges for Rambus as an organization include managing the friction between ex post and ex ante licensing. Tamme (2014) also mentioned the concern that the market for IP licensing might not be sufficiently big to enable further growth of these types of businesses in the future.

4.3 PARC

This section describes the history and development of PARC[20] as an organization and brand, their technologies, and licensing activities. A summary about the organization can be seen in Table 5.

Table 5, Short Facts about the PARC.

The Organization	
	PARC
Employees (2013)	250
Revenue in $US (2013)	$50-75 million[21]
Origin	U.S. 1970
Scope of Study	
R&D	PARC operates as a research institute, which funds R&D at an annual level equivalent to its annual revenue.
IP	PARC published, on average, 270 patent applications annually between 2009-2013, and today holds 1265 active granted patents.
Licensing	PARC is research institute, which earns revenue from several channels, such as: research and innovation consulting; technology transfer; patent sales; and, technology licensing. PARC's annual licensing revenue typically constitutes approximately 15-20% of it total annual revenue.
Main source for study	Interview with Michael Waltrip (Senior Director ICM) and Jonathan Walter (Vice President and Chief Financial Officer)

4.3.1 Background

Xerox founded PARC in 1970s as a research center that in the beginning consisted of a team of experts in information and physical sciences. The organization became a wholly owned subsidiary of Xerox in 2002, and has since developed into an open innovation organization that provide R&D services, technology, and IP to Fortune 500 and Global 1000 companies, startups, and government agencies. Furthermore, PARC has produced nearly 30 new companies. The organization specializes in the following technology areas; big data, contextual intelligence, design and digital manufacturing, content-centric networking, printed and flexible electronics, optoelectronics and optics, cleantech and energy.

PARC has an extensive history of delivering ground-breaking innovation. For example, in 1971 PARC modulated a laser to create a bit-mapped electronic image on a xerographic drum. Between 1971 and 1980 multiple inventions were discovered including but not limited to; the Ethernet, the first gallium-arsenide, distributed-feedback lasers, and the graphic-user interface. Between 1981 and 1990 inventions such as multi-beam lasers, ubiquitous computing, and amorphous silicon displays were discovered. During the 1990s the organization developed technologies for single touch-screen input, and blue lasers. After 2000 the organization have developed electronic reusable paper, and fiber array scanning technology cytometer.

During the 1970s PARC was considered to be the U.S's most successful corporate research lab. Historically PARC invented many great technologies but were often unsuccessful in commercializing them; Rao and Scaruffi (2011) mentioned four reasons for this. Firstly, the decision-making was often not about new technologies and opportunities but rather about

[20] www.parc.com

[21] PARC is wholly owned subsidiary of Xerox and as such financial information is confidential, thus an approiate range was provided by the organization.

personalities, politics, and short-term incentives. Second, Xerox managers saw Xerox as a copier company and were fixed on their business and business model, unable to grasp or capture the opportunities given in the computer market. Thirdly, entrepreneurial scientists were not allowed to do spinouts for a long time, which lead to the fact that Xerox lost a lot of talent. Finally, PARC often acted as a pure research center where the researchers were acting far away from the market (Rao & Scaruffi, 2011).

After PARC was spun out their licensing efforts and different type of engagements with clients have increased and today they successfully monetize on their technologies.

4.3.2 Assets

PARC published, on average, 270[22] patent applications annually between 2009-2013 and today they hold 1265[23] active granted patents. Worth mentioning is the fact that patents filed before PARC was spun out in 2002 still have Xerox as assignee, even if some of them are controlled by PARC. When the organization was spun out PARC had a patent portfolio that had been developed for more than 20 years around one client - Xerox. This affected the content of the portfolio that was available for commercialization from the beginning. Today the portfolio has been developed around many different clients and is thus more diverse even if many core areas still are related to the research prior to 2002. The team that work with licensing at PARC also plays a key part in IP creation decisions, IP maintenance and shaping the overall IP strategy for PARC.

4.3.3 Licensing Management and Deal Sourcing

Licensing started as a focus area for commercialization for PARC after the organization was spun out from Xerox. PARC needed to find a way to monetize on the capabilities that existed within the organization in order for them to carry their own costs. They had an aggressive and diverse commercialization model from the beginning and considered many different commercialization opportunities early. In almost all deals managed by PARC some sort of license is one of the key deliverables. PARC has had the same relationship with licensing since the beginning of the licensing program but that the characteristics of the portfolio have changed (type of assets and level of encumbrance), which in turn affects the nature of deals and licensing - the nature of the portfolio affects the strategy to optimize the monetization of the portfolio (Waltrip, 2014).

Waltrip (2014) mentions the difference in selling research, invention, innovation and opportunity. Where the difference highly depends on the maturity of the assets that are being licensed. The maturity of the asset will put different demands on the licensee in order to achieve successful commercialization. Today, PARC is moving to sell opportunities rather than innovation, i.e. assets that are mature enough to provide the licensee with a clear business opportunity.

[22] Thomson Innovation
[23] Innography

Organizations that want to sustain successful license activities should optimize for return rather than revenue and cash flow, sometimes they need to make choices that yield lower short-term income but a big strategic benefit. An organization must take licensing decisions focused on sustainability (Waltrip, 2014). When optimizing for cash flow an organization risks diluting their portfolio by encumbrances, which may compromise potential future opportunities. For organizations active in research the return should be optimized accordingly with their interests and investments in research. The idea of optimizing by return should also be mirrored in the commercialization routes organizations prioritize, for example working with start-ups can yield important market intelligence which in turn can be used to guide research. PARC has always been good at interacting with the start-up community and use the synergies that these encounters create to build upon their own research capabilities. Organizations that are good at meeting market needs often are fast at identifying trends based on market intelligence and then execute research and strategic direction based on this information. Waltrip (2014) considers this capability important for organizations that wish to succeed in licensing. Further, IP management and licensing management must be in line as synergies between the two may be used to generate high-value and high-return deals.

Waltrip (2014) believes that all organizations need to actively enforce their patents in order to maintain interest from licensees but it is important not over-enforce patents as this could cause other organizations to loose interest to partner with the organization. Ex post licensing and ex ante licensing are interdependent, as one adds value for the other (Waltrip, 2014), enforcement reinforces market position and reduces effort to license. The spectrum of enforcement has a floor and a ceiling and the gap between depends on the business model. The size of the spectra in between the two differs depending on the type of business model of the organization (Waltrip, 2014).

Waltrip (2014) believes that PARC has been successful due to their well-established brand, the diversity and quality of the technology developed at PARC, and their track record of delivering innovation.

4.3.4 Challenges

One challenge identified by Waltrip (2014) is the difficulty in maintaining the strength of the portfolio - it is difficult for an organization to identify the equilibrium (continuous flow of high-value assets) for the portfolio and even harder to achieve it (Waltrip, 2014).

Challenges for PARC has historically been the maturity of the assets developed, as many of them are far ahead of the curve market applications are hard to predict. Waltrip (2014) also mentions the scalability of the business model, as selling opportunities often are one-to-one sales, thus generating a high dependency of sufficient bandwidth within the organization to support it, also emphasizing the cost of acquiring costumers that is very high and this further affects the scalability. The main reason for the cost to be so high is due to the difficulty in selling intangible assets, particularly if you look to optimize for return.

4.4 WARF

Wisconsin Alumni Research Foundation[24] (WARF) is the Technology Licensing Office (TLO) for the UW-Madison and Morgridge Institute for Research. This section describes the history and development of WARF as an organization, brand, their technologies, and licensing activities. A summary about the organization can be seen in Table 6.

Table 6, Short Facts about WARF.

The Organization	
	WARF
Employees (2013)	
Revenue in $US (2013)	$95.0 million
Origin	U.S. 1925
Scope of Study	
R&D	WARF manages a $2.0 billion endowment on behalf of the University of Wisconsin-Madison and makes unrestricted gifts to the University based on annual requests. These annual gifts have in total exceeded $45.0 million.
IP	WARF manages the entire patenting process and patent management for the University and has published, on average, 255 patent applications annually between 2009-2013, and today they hold 1856 active granted patents.
Licensing	WARF is the licensing office for University of Wisconsin-Madison and had a $95.0 million revenue in 2013.
Main source for study	Interview with Leigh Cagan (Chief Technology Commercialization Officer)

4.4.1 Background

Harry Steenbock established WARF in 1925 after he invented the process for adding vitamin D to milk. The result stemmed from university research and he choose a rather, at the time, unorthodox path where he patented the invention and commercialized it together with commercial market actors. The proceeds he fed back to university to fund further research. The management and objective of WARF has not changed since the foundation, as the organization still manages all IP and commercialization activities that stem from the university.

The research results that are patented at WARF are to a large extent, as for most other university research results, funded by public means. What differentiates WARF from most other Technology Licensing Offices (TLOs) is the fact that the organization is a separate legal entity from the university.

Vitamin D has played a big part in the development of WARF and up until 2013 royalties for Vitamin D-related technologies have continued to be a large percentage of the total revenue. Later technologies were based on the vitamin D continuations led by Hector DeLucas. Other success stories include Warfarin, an anticoagulant factor, which today is the basis to one of the most prescribed medicines to prevent stroke and thrombosis, Coumadin. Warfarin was isolated in 1941 by Karl Paul Link. Recent successes include the patents for non-human primate and human embryonic stem cells. WARF has always been innovative in their way to commercialize the technologies and always look for opportunities to improve. To make their stem cells available to the public WARF established WiCell, a non-profit

[24] www.warf.org

subsidiary that is focused on licensing the stem cell lines. The subsidiary was awarded to develop the first National Cell Bank in 2005. WARF has also spun out more than 30 start-ups. The organization has a reputation of being the leader among TLOs in generating proceeds from their patent portfolio.

WARF was mentioned by Fuchs (2012) as a patent troll, ranked 5 in list provided by Business Insider. Janet Kelly, spokeswoman for WARF at the time, responded in the following manner: "our whole purpose for being is to bring inventions from the university into the world into practical use. That is what we are all about".

4.4.2 Assets

WARF has since its establishment processed about 6000 discoveries. The organization has published, on average, 255[25] patent applications annually between 2009-2013, and today they hold 1856[26] active patents. The organization typically patents around 50% of all invention disclosures (Cagan, 2014). Patenting decisions are determined by a multidisciplinary board that overviews and determines patentability and commercial viability of the inventions.

4.4.3 Licensing Management and Deal Sourcing

WARF has since its foundation closed more than 1600 licensing deals around the world, and they have provided more than $1 billion of research funds to the university. In 2013 the organization had a total licensing revenue of $95.3 million (WARF, 2014).

The idea behind licensing at WARF is that the TLO should be a separate organization from the university and that this organization take the commercial responsibility around the inventions developed at the university. The main objective of the TLO is that the organization should not only defend the invention but also support future research at the university. The way they accomplish this is though commercial partners that help bring the invention to market. The objective for their licensing program is, and always has been, for the research to reach the market so that society may benefit from developed technologies. To support their licensing activity they have a strong team within each domain, the people focused on pharma come from the pharma industry, all of whom have industrial experience.

The general idea behind technology licensing at WARF is that the licensee does not pay for the technology unless the technology proves successful in the market place (Cagan, 2014). This results in the fact that most of the deals at WARF are upside deals, where royalties are paid based on commercial or technological success. Exclusivity is determined on a case-by-case basis and typically depends on the technology; pharma and biotech deals are often exclusive due to the large investments required in order for a product to reach market, where as IT is typically licensed non-exclusively.

[25] Thomson Innovation
[26] Innography

The start up path as a commercialization route is highly prioritized, as members of the faculty often are interested in the invention and in commercializing it. Commercializing through start ups constitutes a way to provide proof of concept in order to gain interest from established, large corporations. Cagan (2014) believes that big pharma, for example, continuously requires lower and lower risk projects in order to consider investing. The benefit of engaging start ups is twofold – it serves the purpose of bringing the technology closer to market but it also brings the organization closer to market, yielding synergies that may be used to provide the organization with market intelligence and a network of contacts. This "smaller" investment aims to bridge the gap between university research and industry that poses a big challenge for many universities in the U.S. WARF begins sourcing deals in the invention disclosure and patentability investigation, and typically they consider existing relationships first. Instead of focusing on how many patents they have or how much licensing revenue the organization obtains, they focus on the fact that their technology reaches the public (Cagan, 2014). The only way to for the technology to actually reach the public is however through commercialization. Thus, having an increased focus on commercialization as WARF has increases the potential for the technology to be used.

The largest portion of licensing at WARF is ex ante licensing, but they do actively enforce their portfolio and in some cases the organization has been forced to assert. This has made WARF into a rather controversial organization, as there has been an opposition against asserting patents that to a large extent are financed through tax money. However, Cagan (2014) considers the fact that in order to have commercial partners, you must enforce your rights otherwise you are not a credible partner. Licensees pay for IPRs thus expect the licensor to protect these rights, therefore licensing organizations must actively enforce. WARF does not like to litigate, but if the situation offers no other resolution they will.

Cagan (2014) believes that WARF has been successful due to the fact that they have focused on translating university research to real world market applications, both in regards to their patenting decisions where inventions must have a big commercial potential in order for them to patent and through their engagements in the start up community. They realized early on that if there is no commercial aspect or potential to an invention, patenting the technology is not needed.

4.4.4 Challenges

The main challenge that faces WARF according to Cagan (2014), and UW Madison, is mainly the economic environment in which they exist - they do not have large venture pools around them as for example Stanford has, this further emphasizing the success of the licensing office.

Cagan (2014) mentions the fact that the key patents related to one of their most successful technology regarding vitamin D expired in December 2013; thus yielding a need to fill the gap in revenue that this created. Their solution for this was and is to make sure that the portfolio is diverse.

4.5 MIT TLO

The Massachusetts Institute of Technology Licensing Office[27] (MIT TLO) is the department at Massachusetts Institute of Technology (MIT) that is responsible for enabling the use of research results found at MIT outside of the university. This section describes the history and development of MIT TLO as a department, brand, their technologies, and licensing activities. A summary about the department can be seen in Table 7.

Table 7, Short Facts about MIT TLO.

The Organization	
	MIT TLO
Employees (2013)	
Revenue in $US (2013)	$79.1 million
Origin	U.S. 1925
Scope of Study	
R&D	The TLO at MIT is a department of the university, thus the revenue from the TLO goes directly to the university. MIT spent $2.0 billion on research in 2013.
IP	The TLO manages the entire patenting process and patent management for the university and has published, on average, 612 patent applications annually between 2009-2013. Today they hold 2993 active granted patents.
Licensing	The TLO had a licensing revenue of $79.1 million in 2013
Main source for study	Interview with Lita Nelsen (Director)

4.5.1 Background

The mission of the MIT TLO[28] is: "to benefit the public by moving results of MIT research into societal use via technology licensing, through a process which is consistent with academic principles, demonstrates a concern for the welfare of students and faculty, and conforms to the highest ethical standards". The TLO at MIT is a department of the university and as such they report to the Vice President of Research who reports to the Provost. However, MIT is a private university thus they do not receive state support.

In 2013 MIT reported $2909 million in operating expenses where $692 million is for instruction and unsponsored research, and $1397 sponsored research, yielding a total of about $2089 million spent on research. About 3590 researchers work with MIT research and 2440 graduate students assist as research assistants in the research (MIT, 2014).

4.5.2 Assets

The MIT TLO reviews all technology disclosures from the MIT community and when appropriate the TLO puts efforts into licensing the MIT inventions to the industry for further development and commercialization. The TLO manages the entire patenting process and patent management for the university and has published, on average, 612[29] patent applications annually between 2009-2013. Today they hold 2993[30] active granted patents.

The TLO typically use provisional patent applications for a number of reasons:

- It yields 21 years of protection

[27] web.mit.edu/tlo/www
[28] web.mit.edu/tol/www/
[29] Thomson Innovation
[30] Innography

- There might come in more important data
- Quick - due to publications issues
- The officer does not want to say no to the inventor

When it comes to the ownership of the IP it depends upon the employment status of the creators of the invention. The TLO considers three major aspects; source of the research funds, employment status of the creators, and terms of agreements related to the creation of the IP. In general MIT owns all inventions created by its employees while working under grants or contract at the university, or when using resources provided by MIT.

4.5.3 Licensing Management and Deal Sourcing

In 2013 the MIT TLO had revenue of $79.6 million, 58% of this came from royalties (MIT TLO a, 2014). The MIT TLO constitutes of 12 senior technology licensing officers, 5 associates licensing officers, 7 licensing associates, and other supporting staff (MIT TLO b, 2014). The background of the licensing officers differ but most of them have technical backgrounds, some have worked with product development, marketing or business development, some have legal backgrounds and there are some with Ph.D:s as well as M.B.A's. The majority of the officers have both technical and substantial business experience as the organization typically strive to employ from the industry. One officer is assigned to each case (invention disclosure) and manages this case from patent decision to license negotiations. It is the technology officer, together with the inventor and a patent attorney that decides if the invention should be patented. Even if each case is assigned to one single officer, they are not alone in the case as they have associates. Also the group is very interactive in a more informal way. Each new case is presented at weekly meetings, which further enables collaboration with colleagues. The TLO does not separate invention discovery from licensing, marketing and negotiations but rather see it as a continuous process (Nelsen, 2014). Nelsen (2013) means that by having one officer per case the relationship between the TLO and the faculty is enforced, which is crucial for the success of the TLO. To further incentivize the researchers the royalties obtained from licenses are shared with the inventor and the department to which they belong.

After an invention has been disclosed the assigned technology licensing officer reviews the invention, conducts patent searches, analyzes the market and assesses the invention's commercial potential. In order to encourage potential licensees and if considered appropriate the TLO then applies for a patent. The next phase is marketing, with the help of the inventors; the TLO identifies companies that have the expertise, resources and business networks needed to bring the invention to market. The TLO typically consider two vehicles of commercialization; through a start up, or through licensing to an existing company. As of today 27% of the licensees are start up companies. It is always the case officer that determines how a certain technology best should be commercialized. Technologies better suited for start ups typically are cutting edge technologies in new markets with a broad range of potential applications and often the inventor is interested in founding a company. The TLO assists in venture introductions but does not invest in the start ups; they do however

often take equity in lieu of royalties. The TLO does not license pure know-how as results emerging from research must be publishable.

Deal sourcing at the TLO is to a large extent done using existing relations of the inventors (70% of licensees today were known to the inventors), the TLO, or other researchers affiliated to MIT. In the beginning they typically posted potential licensing opportunities on their website but they very soon discovered that this was a bad use of time as very few licensing deals emerged through this type of sourcing. The TLO capitalizes on the network and knowledge of the inventor as he/she is asked to describe commercial applications in the invention disclosure in order for the TLO to assess economic potential for the invention. The inventor is also asked to add a list of commercial entities that may be interested in the technology in order to help the TLO with a list of potential licensees. Reality is that in the kind of fundamental research that MIT does often is hard to commercialize through operating companies; the technologies are often too early stage for established companies. Thus the TLO is very dependent on start up companies to bridge the gap between the technology and commercial applications. The deal sourcing strategy has not changed much other than the fact that electronic sources are used to a higher extent as they have simplified the search for licensees.

The organization actively enforce their IPRs and specifically if there is a fair amount of money involved, the patents are considered strong, and if the university has "legal high ground". In order for the organization to assert there must be enough potential damages to justify the effort. They do emphasize the importance of enforcing ones rights, Nelsen (2014) says the following: "if you do not enforce your right, then why do you have them?".

There are enormous differences between TLOs and the licensing departments at operating companies. Firstly, the type of research the TLO is trying to commercialize is at a much earlier stage as universities tend to do more fundamental research compared to operating companies that focus more on commercial applications. Secondly, the inventor plays a bigger role in both the patenting and licensing activities. Thirdly, the assets they try to commercialize are often much more diverse and not focused on certain areas. Lastly, they strive for different objectives, the primary objective of a TLO is not income but rather impact – they strive to get the technology available to the public (Nelsen, 2014). Nelsen (2014) believes that in order for TLOs and industry to work in the same space there must a mutual understanding and respect for that the culture, objectives and fundamental principles of the organizations are different, thus they must strive to find solutions that honor both sides and not work against each other to change one another.

Nelsen (2014) believes that the practice at the TLO could be improved by educating the faculty at MIT, this is something that they work actively on in order to reduce issues with patentability and publications. Further areas that could be improved is the agreement managements between the research institutions as they often work together collaborations would be further encouraged and simplified by facilitating standard agreements.

The MIT TLO and Nelsen (2014) states the following as factors for their success:

- Well-established brand.
- The amount of and quality of technology found at MIT.
- The entrepreneurial spirit among the faculty at MIT.
- Well thought-through and clear policies that are consistently applied.
- Support from management.
- Efficient and simple invention disclosures.
- The experience and commitment of their technology officers.
- Simple and efficient licensing procedures and the ability to "commit at the negotiation table". Most agreements can be signed in the TLO without further review.
- The entrepreneurial climate and the infrastructure, both internally at the university and in the Cambridge/Boston area

4.5.4 Challenges

Nelsen (2014) believes that challenges that TLOs in general face are getting an existing industry of venture capitalists to think longer range to enable investments in early stage technologies. She also mentions the early set revenue demands on TLOs as difficult as it takes time to build a consistent and profitable licensing practice - the MIT TLO does not have these demands. Challenges that Nelsen (2014) sees facing the MIT TLO right now relates to the ever-changing nature of U.S. patent law as well as managing the trade-off between attracting industry as well as sticking to the IP policy of the university.

The MIT TLO works actively with the challenges and makes the management at the university aware of the issues such that there is a consistency to their approach. Nelsen (2014) also mentions the importance of hiring flexible and creative people who understands where to draw the line and where they can be more flexible.

5 ANALYSIS

This chapter aims to analyze the factors that have enabled the success of the organizations included in the study. The data gathered through the empirical study will be analyzed in retrospect of the theory found in the area.

5.1 The Organizations and their Mission

In order to determine if an organization is successful and why it is licensing technology the objective/mission was analyzed. As this study includes universities (even if privately held) much of their funding for research originates from public funds. Figure 5 visualizes the different types of organizations and their individual missions. The university TLOs have been mapped as public organizations for the purpose of this study, even if MIT is a privately held university the public is an important stakeholder for the organization. The stakeholders will influence the mission of the organization and for the TLOs this will cause them to have impact as their primary objective - they strive for their technology to reach the public. The privately held organizations typically strive for income - for a return on their investment in R&D. This will affect how the performance of the organization is measured. For the organizations that strive for impact measuring licensing revenue becomes rather contradictory as royalty on products actually limits impact - if an organization higher up in the value chain is entitled to royalty the price of the end-product will reflect this thus creating a more expensive end-product that in turn may cause consumers not to adopt the technology. Other tools of measuring success for technology impact become speculative and based on the qualitative assessment of the observer. Thus, for the purpose of this study licensing revenue will be used as an indicator of the success of the organization in the technology space but it will not be used to compare with organizations whose sole objective is to generate income. Further indicating the success of the organizations is the fact that they all fall under the category of Activists or Outperformers suggested by Lichtenthaler, Ernst and Conley (2010), and level 3-5 described by Harrison, and Sullivan (2011).

The mission and objective of the organization falls hand-in-hand with why the organization actually license technology, and can be used to determine the thought-process behind taking the decision to engage in the activity of licensing. IBM's decision to license most likely stem from the beneficial changes in the IP legislative climate where changes in the end of the 1970s enabled the patenting of software. This change led to the fact that the research

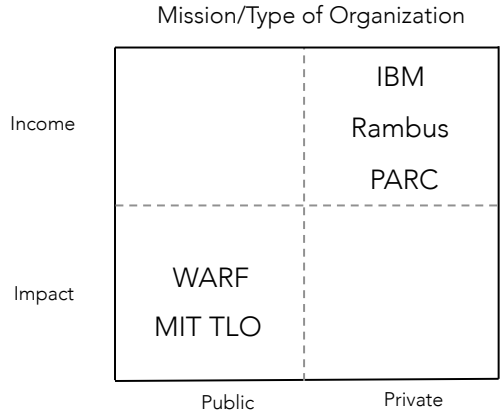

Figure 5, Mission of the Studied Organization.

conducted at IBM had a new end-product – patents, thus generating an asset that the organization could monetize. Another factor that made IBM make licensing part of their business model constitutes of the fact that IBM always has been a research organization and the possibility for an organization such as IBM to monetize all of their inventions through manufacturing would be impossible. Licensing un-core technologies enabled them to obtain a return on their investment in R&D without diverting from their core business. Rambus started licensing technology mainly due to the cost of building a DRAM factory but also due to the profitability the business model promised and their strategic position in the DRAM industry - they found themselves in a very beneficial position where much of their patented technologies had been adopted through their prior engagements in JEDEC. This engagement is not the sole factor for their success but it most probably enabled their fast growth. PARC increased their efforts in licensing after they were spun out from Xerox in 2002, the business model offered a way for them to capitalize on the capabilities of the organization. These capabilities had been developed for more than 30 years together with Xerox, therefore they already had a well-managed portfolio of assets to capitalize on. WARF and the MIT TLO initiated their licensing activity as a way to bridge the gap between university research and industry. Licensing offered them a route for their technologies to reach the public. WARF has successfully adopted many characteristics of industrial actors, and can today almost be perceived as one. This has most likely increased their attractiveness for industrial partners. The MIT TLO has an outstanding reputation of holding invaluable, groundbreaking technologies and this has been a factor to their success.

The strategy exists in order for the organizations to reach their mission and the organizational structures are the tools used to implement the strategy. The organizational structures also put limitations on the strategy as they represents the capabilities of what is possible to achieve. Other limitations include organization size, capital, culture and philosophy. The size and capital differs between the organizations that participated in the study where IBM is the biggest player in regards to employees and total revenue, but in regards to pure IP licensing revenue Rambus exceeds IBM. PARC is smaller in regards to total revenue, number of employees, and pure licensing revenue. WARF and MIT TLO have similar size but historically WARF has generated more revenue from their portfolio.

5.2 Success Factors for Licensing

In this section the observations regarding success factors for licensing organizations will be compiled based on the empirical data as well as personal thoughts and conclusions provided by the interviewees.

5.2.1 Multidisciplinary Collaborative Licensing Teams

IBM, Rambus, PARC, WARF, and MIT TLO have dedicated multidisciplinary teams with backgrounds in legal, business and technology. They all work actively with researchers in the search for licensing opportunities and have executives that have promoted licensing throughout the organization. Furthermore, all employees are encouraged to take part in the licensing activity. IBM, Rambus and PARC strive to feed back market information gathered

through market interactions to the researchers in order to efficiently meet market needs. The two-way communication between R&D and licensing is key in order to both commercialize existing assets as well as guide future research. The TLOs do not have the same need to feed back information to the researchers, as they do not try to affect the research at the universities. However, they work very closely with the researchers to make patenting decisions and throughout the commercialization process. At the university TLOs the researchers have a bigger role in the commercialization process, exemplified by the fact that the inventors at MIT TLO knows about 70% of the licensees.

5.2.2 Marketable Assets and Market Understanding

The type of technologies the organization has will affect the strategy and result of licensing of the organization. Universities and research institutes tend to engage in fundamental research thus generating less mature technologies that lie further away from commercial applications compared to technologies invented by industrial actors. The actors included in the study were mapped based on their research engagement in Figure 6, where research was divided into the different components: fundamental, applied and commercial. Their activity in the "commercial market" was also mapped, where PARC and Rambus obtain a closeness to the market due to their engagements with clients and IBM to a larger extent operates in the commercial market (grey bubble). Their research and closeness to the market will affect the type of patents the organization files for, as the patents then will cover fundamental technologies and not commercial applications. Thus investing in a license to these types of technologies yields a higher risk and the time to market also tends to be longer. Therefore these types of organizations; MIT TLO, WARF and in some sense also PARC, often find success in incubating the technologies in a start ups to bridge the gap between the current stage of the technology to an "industrial friendly" technology. Organizations such as IBM and Rambus do not have the same need to mature their technology, therefore their licensing strategies do not prioritize start ups as much as the others. This observation emphasizes the need for an organization to be aware of the type of assets they are trying to license and generate a strategy based on this.

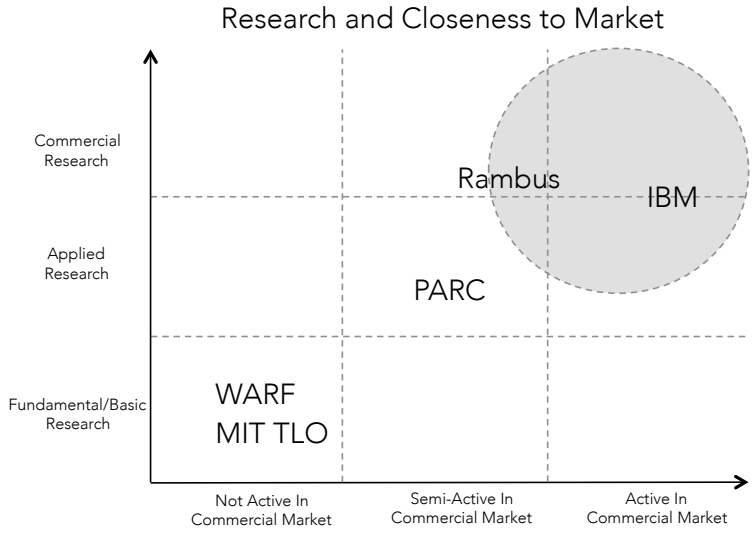

Figure 6, Research and Closeness to Market.

IP management also plays a big part in creating assets that have the focus of being commercialized through licensing. Often it is the inventor that knows who is in the market and who could be potential licensees, therefore it is important that the organization capitalize on this knowledge. A way to do this, used by most of the organizations in the study, is through the invention disclosure. Further, the organization should not patent technologies that have no potential commercial application (mentioned by Cagan (2014)), these inventions could instead be made public knowledge by publishing the results (a strategy used by IBM).

The level of encumbrances in the portfolio is both an indicator of the licensing strategy as well as a limitation to it (Waltrip, 2014). The encumbrances indicate if the organization has had a long-term strategy where deals and exclusivities have been tailored accordingly compared to a portfolio that has been licensed depending on short-term cash flow objectives. This also determines the sustainability of the licensing strategy as the managers must strive to achieve equilibrium in the portfolio - sufficient amount of assets must be generated to replace encumbered assets in order to support the business model in the future. Nelsen (2014) mentioned the challenges in consistent revenue from licensing. Tamme (2014) mentioned that Rambus is moving toward achieving smaller but more deals, perhaps a way to decrease the volatility of the licensing revenue.

Licensing organizations that solely rely on licensing as means of revenue have by doing so separated themselves from the commercial market, thus created a gap between them and the market. Closeness to the market help in providing intelligence on market trends. The licensing team at IBM works actively to feed back intelligence picked up in the field to the research groups. MIT TLO and WARF bridge this gap by taking an active part in the start up community. PARC also works actively with start ups as well as facilitation of different types of platforms for open innovation that offer opportunities to get closer to the market. Rambus has always developed technologies that lie close to the market by using networks and collaborations.

5.2.3 Market and Technology Position

Organizations active in the ex ante licensing field must be considered credible both in regards to commercialization through licensing - track record of successful licensing deals, and have technology advantage – they must offer something the licensee cannot accomplish by themselves. Further, in order for the licensee to take a license the licensee must be able to trust that the licensor delivers and that the rights obtained are sustainable, as noted by Tamme (2014). Figure 7 maps the different organizations licensing credibility based on market (commercialization), and technology credibility. IBM has a long track record of successfully transferring rights to licensees as well as a well-established brand that can help provide credibility to the licensee. Further they have helped shape innovation in hardware and software since the 1970s, thereby their technology position is very strong. PARC has always had a very strong technology position and has since the start in the beginning of the 1970s been at the forefront of hardware and software research. The organization also has a

history of commercializing technology through licensing. PARC, historically, acted more as a research institute and thus their market position is perhaps not as strong as IBM's and Rambus'. Rambus is stronger commercially than PARC but is not perceived as the technology groundbreaking organization that PARC is perceived as. WARF is often described as a TLO that acts like an industrial actor, thus they have higher market credibility than MIT TLO. Both of these organizations have vast amounts of technology resources and as such they have very high technology credibility. The closer an organization lies to the upper right corner in the Figure the more credible the organization is in a licensing deal. As can be seen in Figure 7 all of the industrial organizations, as well as WARF, included in the study fall near this corner.

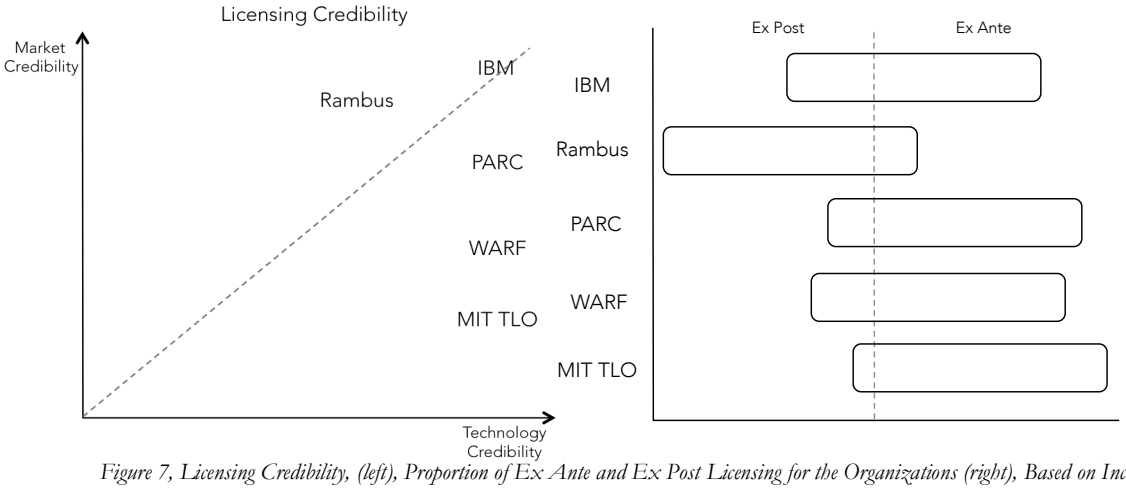

Figure 7, Licensing Credibility, (left), Proportion of Ex Ante and Ex Post Licensing for the Organizations (right), Based on Income as Interpreted by the Author.

Ex post licensing, if the claims of the IPR are excluded from the discussion, is more about the perceived strength of the organization (the licensee's fear of the licensor). Thus, factors such as prior litigation activity and success as well as capital will affect the position of the licensor. In Figure 7 the proportion of ex post and ex ante licensing the organizations take part in is visualized. The activities generate both synergies and friction, as most interviewees have pointed out a licensing organization must enforce their IPRs to be considered a credible licensor. Thus licensing organizations must in some part engage in ex post licensing. However, the distribution between the two can, if weighted in one way or another, generate friction. Further complicating the optimal distribution between the two is the fact that the distribution will differ depending on the type of organization. Waltrip (2014) describes this as a floor and ceiling of enforcement and that the size of the spectrum in between depends on the type of the organization. Tamme (2014) mentioned the difficulty for Rambus in transforming the organization to be more focused on ex ante licensing compared to their historic focus on ex post licensing. Ex post licensing is a very profitable business model where the potential return is high, and it makes the licensor seem credible in regards to enforcing IPRs. However, solely relying on ex post licensing is not sustainable as it separates the organization from the market, generates bad reputation and may harm ex ante licensing activities. Ex ante licensing provides closeness to the market, as the activity is more of a

collaboration that creates synergies, which may be used to direct research in order to generate assets that are in line with current market trends. Typically ex ante licensing involves a higher risk for the licensor but the reward exceeds solely monetary benefits.

5.2.4 Leveraging Relationships to Successfully Source Deals

All of the organizations that participated in the study mentioned the leveraging of internal and external networks as key to successful deal sourcing. Internal networks consists of employees that in some way worked with the technology; researchers, IP attorneys, or business developers. In order to both source and execute a deal all the groups must be on the same page as miscommunications and misunderstandings can lead to delays and bad decisions. As mentioned before the researchers often know of potential licensees. Having structured processes for communication and information enables more efficient deal sourcing. An example of this is to use the invention disclosure as a mean to both gather and store commercialization data, such as many of the above mentioned organizations do. Another critical aspect of the deal sourcing is the leveraging of external networks. All of the participating organizations in the study mentioned existing relationships as the most efficient and most common used mean to license. Managing these relationships in a good way is thus very important. Further the organization needs to have sufficient bandwidth in order to facilitate an efficient deal process.

None of the organizations included in the report mentioned having a structured and communicated deal sourcing strategy but rather used a case-by-case approach that highly depend on the licensing officer of the case. This yields a high dependency on the licensing officers and emphasizes the importance of hiring experienced and well-connected employees. Therefore the organizations must be attractable employers in order to attract these types of individuals.

5.2.5 Working for Long-Term Return

The organizations in this study have all been around and been profitable for a long time, this bares witness to the fact that they work for long-term return. IBM has since the start of their licensing activity had an open licensing policy where they work with the market and use both their position and their portfolio to shape the future. Rambus is moving more towards ex ante licensing as a response to changes in both the IP climate as well as internal needs. PARC is increasingly engaging in open innovation constellations, something that is becoming more and more common in today's market. WARF and MIT TLO have always, and probably always, will work for impact.

As information about specific deal structures typically fall under confidential information it is difficult to assess if their deals typically have short-term cash flow as an objective or long-term return, further complicating the issue is the fact that in order to continue to be a business all organizations must in some way have a focus on cash flow.

5.3 Challenges for Licensing as a Business Model

How organizations respond to challenges is also an aspect that will factor in to their long-term success in the market and is key to a successful licensing strategy. This section analyzes some of the challenges that were mentioned in the interviews and how each of the organizations face them.

5.3.1 Maintaining a Strong Portfolio

Waltrip (2014) considered maintaining the strength of the portfolio as a major challenge. It is difficult for an organization to identify the equilibrium for the portfolio and even harder to achieve it. PARC works actively on portfolio management and always considers long-term value before signing licensing deals.

5.3.2 Ever-Changing Intellectual Property Legislature

The changing legislature regarding IP was a challenge mentioned specifically by Nelsen (2014) and indirectly by Tamme (2014). Tamme (2014) discussed recent proposed changes that will create a more difficult climate for NPEs, specifically NPEs that focus on ex post licensing, as a response to this the organization today focuses on revitalizing their ex ante licensing business, Nelsen (2014) mentioned the importance of communicating potential issues with management.

5.3.3 Fast-Evolving Technologies and Accelerated Change in the Technology Market

Schreiber (2014) considered the fast-paced and ever-changing technology industry as the major challenge for IBM. To meet this challenge the licensing teams at IBM that are very active in the technology market strive to feed back information of potential emerging markets to the research teams (Schreiber, 2014).

5.3.4 Limited Size of the Licensing Market and the Scalability of the Business Model

Tamme (2014) mentioned that the market for IP licensing might not be sufficiently big to enable the growth of these business models in the future, therefore Rambus constantly reviews and assesses their business model. Waltrip (2014) also mentions the scalability of the business model, as ex ante licensing requires broad bandwidth within the organization and the cost of acquiring costumers is very high.

5.3.5 Challenges for University TLOs

The university TLOs both mentioned attracting venture capital as one of the major challenges. Cagan (2014) considered the economic environment in which the university exists in as the major challenge, as they do not have large venture pools around them. WARF actively works to get closer to the venture funds and expand upon their relationships.

5.4 Common Denominators and Differentiators

The common denominators that were found could be divided into the same elements as the findings in the theoretical study, and are as follows.

5.4.1 Organizational Structures

Assigned licensing teams that not only are active in licensing decisions but take an active part in directing research, forming IP strategy, and educating research staff.

Organizations that have a team working with the sole focus of licensing and commercialization yet still takes part in research and IP decisions enables a holistic licensing strategy which is infused in all decisions in the organization. This was suggested by Lichtenthaler, Ernst and Conley (2010), however they did not consider the benefit of having licensing teams that engage in research and IP decisions. An organization that adopts this type of holistic view of licensing and commercialization and infuses it in research and IP decisions holds a better chance of developing assets that may create impact and income. TLOs do not have this opportunity, as they cannot affect research decisions. They can however affect IP decisions as the IP management and licensing management is often vested in the same department at universities.

5.4.2 Management

Research and IP management that provide a pipeline of technologies that enables commercialization at the right time.

Each of the industrial actors in the study made conscious and strategic decisions on how and when to license certain technologies. Thus, the organizations that properly manage their portfolio with the intent of constructing a pipeline, a long-term commercialization plan, are better prepared thereby limiting the risk of each transaction. TLOs can in some sense also create this type of plans, however it is limited to patenting decisions and as TLOs tend to strive for getting their technology out to the public waiting may prove contraindicative. However, making the "right" commercialization decision may prove to increase the impact.

Management and usage of market intelligence to shape the licensing strategy of the organization.

Organizations that have means and tools to use market intelligence to drive both their research and licensing decisions have an advantage compared to others as they have a better chance of forecasting what may become the next big thing. It is very difficult to "jump" on a technology trend when the market is already populated as this generates high entry barriers.

Well-managed relationships with licensees and external networks.

Organizations that are well-connected do not have the same initial hurdle to attract potential licensees as they may use existing relationships, thus the marketing of the technology which was indicated as a challenge by Megantz (2002) becomes easier.

Responsiveness to changes in both the legal climate and market, and the ability to manage the organization in order to adapt quickly to changes and needs.

Organizations that adapt quickly to market needs and are responsive to the legal climate may adapt and stay ahead instead of being taken by surprise, which may harm their business (even if it is only temporary).

5.4.3 Culture

All employees strive to commercialize, i.e. they take an active part in organizing for licensing.

The organizations studied all have been focused on licensing as either part or as their entire mean for revenue for a long time, this has enabled them to create a culture within the organization where licensing is seen as one of their objectives. Having a "pro"-culture for licensing enables a beneficial climate where more licensing opportunities are found as all the different teams throughout the organization work towards licensing. Here TLOs typically struggle as university-employed researchers tend to be more separated from the commercialization. However, the TLOs in this study work hard to facilitate collaboration between themselves and the faculty by providing education and monetary incentives if the technology is licensed.

All employees "own" the value created by licensing and takes an active part in shaping the future of the organization by; striving to generate quality IP with commercial potential and communicating trends and insights observed in the market space back to the research teams.

When organizations strive to create value through licensing it is important that all the different teams take part in the end-value so that they may have a holistic view, which may enable them to see their part, and how their decisions may contribute.

5.4.4 Competencies

Multidisciplinary teams with experience in technology, law, and business.

The technology licensing teams must have sufficient technology understanding to know where the technology applies, what problem it solves, and whom it may help. Further they must have an understanding of the law in order to take consistent decisions that will not hurt them or limit their options in the future. Lastly, they must be able to understand how each decision translates into the business context, for example how the language in a license agreement may affect the organization in the future. The organizations included in the study have teams with these expertise, both of the TLOs emphasize that they tend to hire from the industry in order to obtain the important business perspective. This supports the theory introduced by Petrusson (2004), yet expanding the scope to include technology.

5.4.5 Assets

The ability to maintain high-quality technology portfolios and making smart decisions that do not dilute the value of the portfolio in the future but strive to maintain equilibrium.

Organizations that base licensing decisions on short-term return risk diluting their technology portfolio thereby generating an unsustainable business model. The organizations included in this study invest heavily in R&D and manage their licensing programs with long-term return in mind. They have, because of this, stayed successful for a longer period of time.

The ability to find ways to incubate assets in order to "prepare" them for the commercial market.

Many research institute and TLOs generate assets that are based upon fundamental research. This yield higher barriers to license as the risk for the licensee is bigger. The organizations included in this study have managed this challenge by incubating technology in start ups or, as in the case of one of the TLOs, tailored their licensing deals based on shared risk.

5.4.6 Position

Impressive innovative track record, strong brand, and the reputation of enforcing IPRs, i.e. high technology, market, and enforcement credibility.

It was also found that the position was a major factor, which supported the theory provided by Arora, Fosfuri and Gambardella (2001) when they discussed the bargaining power of the licensor as a factor to success. However, the bargaining power, or in this case – the position, was further broken down into its components; technology, market and enforcement credibility, yielding an expansion of the theory. In order for a licensor to attract licensee they must offer a capability that the licensees cannot accomplish by themselves. They must also be able to successfully transfer this capability and enforce the right to the capability. If other organizations may obtain the capability for free there is no incentive for the licensee to pay for it.

The ability to position themselves closely to the market or bridge the gap that often occurs when an actor moves up the value chain and solely relies on licensing as a source of revenue.

Organizations such as TLOs and research institutes that to some extent act outside of the market can use the start up community and open innovation consortiums to bridge the gap between them and the commercial market.

5.4.7 Resources

Sufficient resources in regards to human capital as well as monetary capital to support the licensing activity as the cost of acquiring costumers is both time-consuming and expensive.

The cost of developing and maintaining a successful licensing program is big and in order for a licensing organization to succeed there must be sufficient resources. The scalability of the business model has been pointed out as a challenge by numerous of the interviewees, as the cost of acquiring costumers is high, also noted in theory by Megantz (2002).

6 CONCLUSIONS

This chapter concludes the thesis and highlights the findings of the study.

The organizations in study were chosen based on their reputation for being successful licensors. The different set-ups in the organizations generated different insights for success factors and challenges thus enabling a wider scope and applicability of the study. By adding university TLOs to the study a different type of comparison, between different set of stakeholders were enabled, yielding the interesting finding of the friction between the industry and universities as well as the challenges in commercializing fundamental research, which resembled the challenges faced by research institutes.

The found factors were in many cases interdependent, and often the found factors could not be accomplished easily but require expertise, time, money and persistency. The first most important factor is sufficient resources – an organization with sufficient resources can attract a multidisciplinary team of experienced, well-connected staff that has the crucial capabilities (technical, judicial, administrative, and business expertise).

The second crucial factor is the organizational culture - licensing is not a stand-alone activity but must be incorporated in the creation and control of the assets. This is perhaps the toughest factor to change but by encouraging, educating, and incentivizing staff throughout the organization licensing can be made more successful. Furthermore, by working on the culture the licensing strategy can holistically be incorporated in research and IP decisions.

Thirdly organizations that wish to be successful in the licensing of technology must credible in the eyes of the licensee. The credibility expands beyond technological expertise and includes the perceived ability to successfully transfer technology and the ability to enforce the rights that are being transferred. Organizations that wish be consistently successful in their licensing endeavor must make a habit of taking strategic decisions that work beneficially both for themselves and the licensee. This emphasizes the importance of managing one's portfolio for sustainable licensing activity and being responsive to changes and challenges in the market and legal environment.

Lastly and most importantly, the successful organizations have individual licensing strategies tailored to their specific assets, missions, objectives and challenges, thus in order to optimize and improve upon one's licensing strategy an organization must first identify their individual needs. An example of this was how the organizations that had more fundamental research results use the start up community to incubate technologies and bridge the gap between them and the commercial market. The findings supported theories provided by Petrusson (2004), Arora, Fosfuri and Gambardella (2001), and Megantz (2002), yet expanding the theories by deconstructing the reasoning behind the success factors as well as providing how organizations may adopt and execute against them.

7 DISCUSSION

This chapter discusses the study and the conclusion.

7.1 General Discussion

The study included five different actors where IBM represents the industry giant which strategically licenses part of their IP portfolio, Rambus represents the actor that relies on R&D as a stand-alone value proposition, PARC represents the private research institute that to a large extent monetize on their research through licensing, WARF represents the technology licensing office that have adapted and moved closer to the industrial actors, and MIT TLO represents the typical technology licensing office at a university. The differences between the organizations enabled a wider scope of the study where the different views of the actors became apparent. However, the differences between the organizations also provided the challenge of comparing and deriving success factors that the organizations had in common as well as factors that were individual for the organizations.

One very interesting aspect of this study is the fact that prior theory indicated that a communicated deal sourcing strategy to a large extent enabled a successful licensing strategy. However, when studying the organization none of them actually seemed to have a communicated strategy regarding this. Rather they trusted the individual officers and existing networks. WARF and MIT TLO communicated the need to identify deal opportunities early and they to a large extent included deal sourcing in their patentability discussion. Further they relied on the researchers for leads regarding potential licensees. This is probably due to the nature of the technology, as a similar trend could be seen when studying PARC, which is a research institute.

Another interesting aspect was the friction between ex ante and ex post licensing as Tamme (2014) introduced. This discussion tied closely together with the spectrum introduced by Waltrip (2014) as the degree of enforcement needed by each organization is highly dependent on the specific organization. All types of licensing activities partly relies on the organization's ability to enforce their IPRs, but the spectrum also entailed a roof as too much enforcement or ex post licensing may harm the ex ante licensing which is key to the sustainability of the business model.

Finally, the major take-away from the study is that each of organizations in the study had individual licensing strategies tailored to their specific assets and missions, thus emphasizing the importance of developing tailored organization-specific strategies.

7.2 Suggestions for Further Research

An interesting continuation for the study would be an in-depth analysis of the different organizations. Due to time limitations this study has but scraped the surface of a very important and interesting subject. An interesting aspect could also be to interview different professionals within the organizations to obtain the different views on challenges for the entities - for example add the perspective of the managers of R&D and IP and their thoughts on licensing. To increase the credibility of the study it would also be desirable to expand the study and add more organizations. Also, to further highlight the challenges in licensing technology an interesting aspect could also be to introduce the intermediate actors (such as brokers and auction houses) to see why they succeed.

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Appendix A, Interview Questions

The interview questions were reviewed after each interview, thus they differed some depending on when the interview took place. Further, the questions were also tailored to the information that was available through external sources.

Rambus and WARF:

- How has the licensing strategy at your Organization evolved?
- How and in what aspects has your Organization been successful in licensing technology?
- Why have your Organization been successful in finding deal opportunities?

IBM:

- How has the licensing strategy at IBM evolved?
- What are the major events that have helped to shape the strategy to become what it is today?
- How and in what aspects have IBM been successful in licensing technology?
- Why have IBM been successful in finding deal opportunities?
- What are the organizational structures to support the IP licensing strategy?
- What commercialization routes do you consider?
    - Are they prioritized in any specific way?
- What is your process and requirements for IPR protection?
- When do you identify recipients for the technology, does it differ between ex ante and ex post licensing?
    - And how do you identify recipients for specific technologies?
- What would you say are the key dependencies and challenges in sourcing a deal?
- What are the major challenges facing IBM regarding IP licensing?
    - And how does IBM face these?

PARC:

- How has the licensing strategy at PARC evolved?
- What are the major events that have helped to shape the strategy to become what it is today?
- How and in what aspects have PARC been successful in licensing technology?
- Why have PARC been successful in finding deal opportunities?
- What are the organizational structures to support the IP licensing strategy?
- What commercialization routes do you consider? Are they prioritized in any specific way?
- What is your process and requirements for IPR protection?
- When do you identify recipients for the technology, does it differ between ex ante and ex post licensing?
    - And how do you identify recipients for specific technologies?
- What would you say are the key dependencies and challenges in sourcing a deal?
- What are the major challenges facing PARC regarding IP licensing?
    - And how does PARC face these?

MIT TLO:

- Negative aspects of having 1 officer assigned to each case, having only one set of eyes throughout the process?
    - Structures supporting this?
- Do you use provisional patents applications?
- Tell me more about how you find potential licensees for technology?
    - Is it a communicated strategy or does it differ depending on the officer?
- What is the TLO view upon enforcement of patents rights, does an organization need an aggressive approach (threat of assertion) in order to convince licensees?
- What are the differences between a TLO at a university and a licensing department at an industrial actor?
- What could the industry learn from TLOs at universities?
- Why do you think the MIT TLO has been successful?
- What are the major challenges in licensing technology, for the MIT TLO, for TLOs at university and in general?
    - And how does the MIT TLO face them?
- How do you think that licensing at MIT could be improved?