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Visualizing Innovation Capital: A case study of Technology Transfer and Biomedical start-up

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"Your problem is in the gene that makes antibodies, but since the Biophase Corp. now has a patent on that gene, I can't do anything for you."

Abstract

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Purpose: The purpose is to present a greater understanding of the progression of innovation capital in a technology transfer and biotech start-up context. The findings offer technology transfer professionals, entrepreneurs and academia an overall perception and mental framework of the technology transfer practice and the embracement of a promising invention, building upon its hidden value.

Methodology: The thesis was conducted using a qualitative case study, executed with the help of interviews, in order to answer the research question: How is an embryo of innovation capital continuously cultivated in a technology transfer and biomedical start-up process?

Conclusions: A technology transfer entity provides the means to establish a platform where an entrepreneur can build its own human capital, structural capital, and relationship capital. The forms of capital interact and thus create value, herein considered as innovation capital. Whilst the interaction is increased, the ability of renewal is improved and results start to amass, thus innovation capital is elevated. The results may be seen as an accumulated mass of explicit knowledge. The mass is in need of safeguarding in order to appropriate the rents from innovation and hence the use of patent protection is put into effect, turning intellectual assets into intellectual property rights. The value from this is derived from two aspects: commercial value of safeguarded explicit knowledge mass and degree of uncertainty. This matches up to the corporate valuing mechanism, market value added, argued to be the most appropriate in the intangible value chain.

Acknowledgements

Firstly, there have been several individuals who willingly devoted some of their time to share their thoughts with us during interviews, and we thank them.

We would also like to express our utmost gratitude to our tutor, Leif Edvinsson. Whilst writing this thesis we have followed his advice as he continuously emphasized the art and value of questioning reality, yet the importance of this matter was said long before;

> "The important thing is not to stop questioning. Curiosity has its own reason for existing. One cannot help but be in awe when he contemplates the mysteries of eternity, of life, of the marvelous structure of reality. It is enough if one tries merely to comprehend a little of this mystery every day. Never lose a holy curiosity."
>
> - Albert Einstein

Last but not least, we would like to express our appreciation to our families and dearly beloved girlfriends for their indispensable support in writing this thesis.

To Johanna

To Helena

Malmö, January 12, 2006.

Alexander, Johan

Contents

1. Introduction

This first chapter is intended to provide the reader with an understanding of the focal areas, the theoretical propositions in the problem discussion and lastly the purpose and scope of this thesis.

1.1. Background

This first section will provide the reader with an understanding of the biotechnology industry, why it is relevant to discuss it in the view of intellectual capital and the role of small ventures in the biotechnology sector.

1.1.1. The biotechnology industry

Fundamental discoveries, such as recombinant DNA and monoclonal antibodies, led to the emergence of biotechnology in the 1970s, something that was followed by several industrial applications (Saviotti et al., 2005). The biotech industry consists of firms operating in various sectors such as health care, environmental, agri-food and aquaculture. For those firms involved in scientific discovery aimed at the creation of new health care products, the process is lengthy and challenging. Discovery and preclinical studies are followed by three phases of clinical trials on humans thereby obtaining required regulatory approval. The development period of biotech products are among the longest of any science- or technology-based product, reportedly taking six to eight years in reaching a regulatory approval (Cumby & Conrod, 2001). The three phases of clinical trials are intended to ensure safety when a substance is applied as human treatment, defining appropriate dosage and the discovery of possible side effects. Naturally, the number of individuals subjected to the trials increase by each phase, normally 20-80 in a phase I study, followed by 100-300 and finally 1000-3000 individuals in phase III (National Institute of Health, 2006).

Sweden has the potential to become one of the world leaders in research and entrepreneurship within the biotech industry. Currently there are approximately 800 active companies with 40 000 employees working with developing new products and services related to biotech (Vinnova, 2005). Although there are numerous hurdles for biotech firms to evade during development of a product, the biotech industry is an archetype of industries with forecasts for astonishing high future sales (Hermans & Kauranen, 2005). As a result of its good future prospects, the biotechnology industry has attracted vast amount of financial support from various venture capitalists and institutions which in turn has spurred a growth within the field (Vinnova, 2005).

As an example of the potential value in the biotech industry we can highlight Esperion Therapeutics, founded in 1998 by a group of researchers, which develops drugs inhibiting progression of atherosclerosis by reducing arterial plaque in certain heart patients. After positive phase II trial results, showing that one of their drug candidates were safe and well tolerated, Esperion Therapeutics was bought by Pfizer

in 2004 for an estimated $1.3 billion. However, a product launch is not expected until 2007, thereby making Esperion Therapeutics profitable by 2008 (Mullin, 2004).

1.1.2. The Intellectual Capital perspective

If we consider the case of Esperion Therapeutics, there is obviously a tremendous gap between book and market value of such a firm. This phenomenon is on the other hand the essence of intellectual capital (IC). IC is in its most basic sense defined as the difference between book value and market value (Edvinsson & Malone, 1997). Edvinsson (2002) further describe IC as the future earning potential of the organization and in short the ability to transform knowledge and intangible assets into value, by multiplying human capital, the knowledge and brains of the people who work for the organisation, with structural capital, the work processes, routines, office design and the like. Thus applying an IC perspective to this industry might help in clarifying how to manage and build the potential, yet hidden, value in these firms.

After all, intangible assets are the primary drivers of wealth and growth in modern economies. Thus, dominant market positions, abnormal profits and even monopolistic advantages are most effectively obtained by the management of these intangible assets (Hand & Lev, 2003).

How may these intangibles be properly managed and safeguarded then? Biotech firms, like any science-based, technological sophisticated industries, need to appropriate the returns on their innovations and therefore must protect their intellectual assets (Cohen et al., 2000). The appropriation regime most widely used by biotech firms is patents. Research shows that patent protection for pharmaceutical and biotech products is unusually strong. This is mainly due to the precise chemical definition of the patented innovation, which is difficult to circumvent by rivals and therefore easier to defend against infringements in court (Calabrese et al., 2000).

The overall idea of managing intellectual and intangible assets also commonly falls under the IC concept. As mentioned, the dominating appropriation regime and protection of intellectual assets used by biotech firms is patenting; naturally we want to understand where and how patenting is a feature in the IC landscape. Edvinsson & Sullivan (1996) discuss a model for managing IC and begin by defining the two components of IC as human resources and structural capital, which include intellectual assets. The distinction of the two is important to company owners. Intellectual assets are pieces of codified knowledge that, unlike human resources, can be owned by the firm. Hence, the transformation of innovations produced by the human resources into intellectual assets is of crucial importance. Intellectual assets of great value or those to be used outside of the firm are likely in need of protection. When intellectual assets receive legal protection, for example by patenting, they become intellectual property.

Granstrand (1999) discusses the rise of IC firms and IC-intensive industries, defining an IC firm with the characteristic of a build-up and exploitation of immaterial resources and the concern of turning these resources into capital for economic purposes. Firms can be classified according to the share of IC and it is

possible to find almost 'pure' IC firms, in which IC is the only productive factor. The numbers and types of these firms are growing; consequently more 'pure' IC industries arise, for example the biotech sector. As a result of this we can see that generating value in the biotech industry is to a great extent about managing the IC.

1.1.3. Small Biotechnology ventures

To elaborate on the role of start-up firms within the biotech sector, Granstrand (1999) also brings up that in almost 'pure' IC industries new start-up firms, both autonomous start-ups firms and corporate ventures, are naturally becoming IC-oriented and that new start-ups play a fundamentally important function of intellectual capitalism.

Zahra (1996) studied start-up biotech firms in the U.S. and compared the performance of autonomous ventures (AV) versus corporate ventures (CV). The results showed that AVs outperform CVs and that there might be many possible explanations. Founders of autonomous ventures are more interested in the fate of the venture, since their wealth depends on its success, and are often closely involved in the operation, which in turn creates an environment where risk-taking is encouraged. Resource advantages of corporate ventures may not always generate competitive advantages. CVs frequently encounter difficulties accessing resources from corporate sponsors; they may become caught up in political and budgetary processes or constrained by existing systems and policies. Altogether, AVs may do better because emerging high technology industries, such as biotech, require radical innovation.

1.2. Problem discussion

In the background we have presented the essential facts to be used in the following problem discussion and theoretical propositions. We can see that the biotech industry is a promising sector that clearly benefits from small autonomous start-up firms. The background also brought a discussion on the benefits of applying an IC perspective on biotech firms.

1.2.1. Value from Intellectual Capital

Harrison & Sullivan (2000) describe how firms profit from their IC. The value of a firm's IC depends on the company's context, which is expressed through the vision of what they wish to become and the strategy of how to achieve it. Different companies will determine different roles for their IC, which in general is divided into offensive and defensive roles. How IC is managed may also be considered regarding its impact on a current or a future time dimension. Extracting value from intellectual assets normally involves thinking of the future and about strategic positioning. Intellectual capital can be a source for either one-time transaction value or an ongoing cash-flow-producing value, although IC assets are often sold individually or in bundling.

As we observed in the Esperion Therapeutics case the value is realized after a number of years, hence in a future time dimension. This brings us to think of a

decision that has to be included in the vision for small biotech companies, i.e. whether to sell the intellectual asset or commercialize it on your own? To commercialize it on your own usually requires additionally resources or capabilities. Edvinsson & Sullivan (1996) refer to this as complementary business assets, such as processing facilities, service forces or distribution networks. The concept of complementary assets was however introduced by Teece (1986), showing the importance of having a complete set of business assets when deploying an innovation. Lacking complementary assets and the ability to obtain them, naturally leaves the firm with the option of selling or licensing the intellectual asset to another firm with the appropriate set of complementary assets. This scenario is also usually displayed in the biotech industry, not least with the example of Esperion Therapeutics, where larger multinational firms purchase small companies having achieved certain promising research results. Making clinical phase III trials as well as launching products commonly requires relatively large amounts of capital, hindering small biotech firms from going all the way on their own.

If the most reasonable future for a small biotech firm is to be purchased by a large corporation, what is the value being derived from the almost 'pure' IC firm? An intangible asset is an abstract concept, yet Ahonen (2000) makes a distinction between generative and commercially exploitable assets in the intangible value chain. The value chain depicts that generative assets, human and structural capital, produce commercially exploitable assets, such as patents, which in turn are valued by the market; claiming that market value added is the preferred measurement of derived value from intangible assets.

This perspective is almost equivalent with the concept of innovation capital, a subunit of structural capital in Skandia's value scheme, reflecting the renewal capability as well as the result of that capability in the form of intellectual property rights (Edvinsson & Malone, 1997). Innovation capital is also proclaimed to be the pivotal link of IC in recent studies, simply stressed by the importance of an ability to innovate for increasing corporate value (Tseng & Goo, 2005; Chen et al., 2004).

Thus we may observe that value in commercially exploitable assets is a product of time. This creates a reason to believe that the management of innovation capital over time, i.e. both the ability to innovate and the result of this effort, is a means of achieving value maximization, in this sense. Having comprehended this logic it leads us to the question of how this is done?

1.2.2. The Technology Transfer process

New biotech start-ups are predominantly founded on the basis of novel inventions generated by academic research. As a result, biotech firms are mainly localized around universities offering high quality and biomedical research. In Sweden, university researchers are granted the intellectual property right of their inventions and inventors can choose if to commercially exploit it, including which route for technology transfer they wish to utilize. In order to improve exploitation of knowledge from universities, and thereby promote regional growth, Teknikbrostiftelsen was established in the mid 1990s at seven universities around Sweden. The purpose of Teknikbrostiftelsen is to help researchers carrying an

invention with preparing a business plan, patenting, licenses and founding (Medicon Valley Academy, 2004).

In addition to the above mentioned technology transfer process, a discussion with Stina Gestrelius (2005), Vice President of Medicon Valley Academy, provided us with the following insight regarding the development of a business and patenting in small biotech ventures. The management of a smaller firm within the biotech industry usually does not have sufficient knowledge or the resources needed to manage and create strategies related to business and patenting. As a result of this, the firm continuously turns to intellectual property bureaus, seeking assistance with for the most part patenting.

1.2.3. Problem summary

Now we may be able to see that exploiting novel inventions and knowledge, with regards to biomedical science, i.e. intangible assets steamed from an academic research environment, is a question of managing IC and in particular innovation capital.

In the problem discussion we can observe two different aspects that are interesting regarding management of IC in small biotech firms. Firstly, there is the intrinsic problem with six to eight year long periods of product development that is to be followed by commercialization. Autonomous ventures seam to create a better environment in emerging high technology industries, where there may be a need for radical innovation. However when products are to be commercialized small firms may lack complementary assets, which can inhibit a successful product launch. A solution is to pursue a strategy where the whole company or just the specific product is sold or licensed to a larger firm with a right set of complementary assets. This in turn needs to be considered early in the process of converting innovations into intellectual assets and safeguarded through patenting in order to maximize the value. By looking at the past discussion on IC, it is evident that managing the build up of innovation capital is a mean of achieving this value maximization.

Secondly, since founders of small biotech firms often lack knowledge and resources to manage their IC, they frequently turn to external agents such as Technology Transfer agents and intellectual property bureaus. The fact that external parties to a large extent are involved in the IC management is also interesting. Not least just to determine their roles in the perspective of IC management.

1.2.4. Research question

The focal subject is the apprehension of how innovation capital is developed and increased. Comparing a novel invention and its inventor with an embryo of innovation capital; how is it managed and safeguarded in order for it to prosper into tremendous value, hoping to achieve similar figures as in the case of Esperion Therapeutics? With regards to the problem discussion, this may be summarized into the following question:

"How is an embryo of innovation capital continuously cultivated in a technology transfer and biomedical start-up process?"

1.2.5. Purpose

The purpose is to present a greater understanding of the progression of innovation capital in a technology transfer and biotech start-up context. The findings offer technology transfer professionals, entrepreneurs and academia an overall perception and mental framework of the technology transfer practice and the embracement of a promising invention, building upon its hidden value.

Our research question incorporates studying biomedical start-up. This is by all means an important and comprehensive part of the biotech industry, yet not covering all the various types of technologies within the concept of biotech. The purpose of selecting a biomedical case is primarily due to wanting to capture the intrinsic time conditions created with product development lasting up till ten years or more, not to focus on a specific area of technology.

2. Methodology

In this chapter we describe the methods that have been used and how we have approached the research questions in a scientific manner.

2.1. Research method

As an introduction to how this thesis came about, the first part will describe the initial phases and the overall approach of the study. The second part emphasizes why we have chosen a qualitative research method.

2.1.1. Approach

Previous experience of studying intellectual property rights, along with the apparent importance of the Intellectual Capital concept in modern economies, brought us to an early decision of writing a thesis on some aspect IC. We also realised that it would perhaps be more interesting to limit the scope of the thesis to a particular industry, one where intellectual assets are of substantial importance. We recalled a guest lecture given by Stina Gestrelius, Vice President of Medicon Valley Academy, on the Biotech industry and a choice was made. After a thorough literature review on the area of IC and its application to the Biotech industry, combined with an interview with Stina Gestrelius (2005, we arrived at the problem formulation and research question you find outlined in chapter one. Thus we have based much of our initial perceptions and propositions on previous studies and theory, yet it is still intertwined with empirically gathered data from a discussion with an industry expert working with firms in the biotech industry.

In research there are generally two approaches whereby theory and empirical data relate to each other, namely the inductive and deductive approach. Using an inductive approach, a researcher gathers data without any preconceived thoughts or hypotheses and from this data new theories are created. With a deductive approach, the researcher creates a theoretical framework, which is then verified using data gathered from field research (Wallén, 1996). Conducting a 'pure' inductive or deductive study is however difficult and both approaches have been criticised for their shortcomings. Therefore, today one rather speaks of the degree of openness in the approach, taking into account the boundaries a researcher has set before the data is to be gathered and how open the researcher is for new and unexpected information which was not considered in advance (Jacobsen, 2000).

If we are to characterize the approach, the process has been to a large extent deductive, drawing upon results from previous studies and using a theoretical analytical framework. However to fill some of the knowledge gaps identified our approach also includes elements of an inductive nature; concerning the role played by external parties, where we found little previous studies related to the area of IC and

small venturing. On the other hand, our mapping of this relatively uncharted matter was to some extent influenced by the notion we had on how small biotech firms start out and develop, which from a 'pure' inductive perspective is less accurate. Summarised, we have set relatively clear boundaries while leaving some room for unanticipated data.

2.1.2. A qualitative study

Conventionally there are two methods of conducting scientific research, quantitatively and qualitatively. The choice of method is governed by the purpose of the research and to some extent by the science itself (Yin, 2003). The strengths of the qualitative method are many but foremost the richness and holism of the data collected, thus enabling a deeper understanding (Miles & Huberman, 1994).

Due to the descriptive nature of our purpose and the need for comprehensive and in-depth empirical data to answer the research questions, we found that a qualitative approach is highly suitable. If we were to conduct a quantitative study, previously uncharted issues embedded in the research propositions, expected and unexpected, would be neglected, not to mention the numerous vague assumptions that would have to be made in order to formulate hypotheses to be tested. Our decision to perform this study with a qualitative toolset has on the other hand implications on the reliability and validity of the results, which we discuss further in section 2.5 Validity & Reliability.

2.2. Case study

The case study is a widespread strategy in qualitative social science research. Yin (2003), describe the methodology which is basically characterised by the in-depth study and analysis of one or a few units.

2.2.1. Design

In its most basic sense a research design is the logical sequence that connects the empirical data to a study's initial research questions and in the end, its conclusions. Five components of a research design are especially important: (1) a study's questions, (2) its propositions, if any, (3) its unit(s) of analysis, (4) the logic linking the data to the propositions, (5) and the criteria for interpreting the findings (Ibid.).

Regarding the first two set of components, the research question and theoretical propositions of this thesis are outlined in chapter one. While addressing the third component, the case definition needs to be clear. In qualitative research one often struggles with a definition of the case, although abstractly it can be defined as a phenomenon of some sort in a bounded context (Miles & Huberman, 1994). The case definition used in this study is, to be more precise, the management of intellectual assets and enhancement of its potential value, during the technology transfer process and continuously in the development of a small Biotech firm. While the case definition refers to the management of IC in fostering the innovation capital,

belonging to a firm, the actual course of action involves several other actors who take part in different decisions and activities. As a consequence, the units of analysis used in the case study are the small biotech firm, the intellectual property agents, the seed capital firm and the business development firm. Yin (2003) labels the usage of multiple units of analysis while still focusing on one case as an embedded single case design. The selection of units of analysis and data collection sources of each unit is discussed in the next part. The fourth and fifth components of the case design are discussed in section 2.2.3 Data analysis.

2.2.2. Gathering of Data

The selection of units of analysis originates in the development of a small biotech firm named Cartela AB. The firm was founded in the year 2000, currently has 13 employees, conducts research in biomedicine and pursues an outspoken strategy to generate revenue by corporate collaborations and by out-licensing its technology. There is also a plan for an exit within 5-7 years by trade-sale to another pharmaceutical or biotech entity (Cartela, 2005). Evidently this is a small company, with a relatively short track record, pursuing a formulated strategy of collaboration and out-licensing as well as a vision of a planned exit. Thus, this firm is a good research candidate and a choice Yin (2003) would describe with a representative or typical case rationale. Cartela AB is naturally one of the units of analysis.

As mentioned, three external firms have significantly contributed to the initial growth of Cartela AB (Innovationsbron Syd, 2005); logically they are also regarded as units of analysis. Teknoseed AB made partial initial investments to support research and development. Essential developments of the business plan as well as the establishment of key contacts where made with the help of Teknopol AB. Forskarpatent i Syd AB provided help in the pre start-up phase of Cartela AB, selling the invention to an industry actor. All three are subsidiaries of the overarching organisation named Innovationsbron Syd AB, formerly known as Teknikbrostiftelsen i Lund, which have a coordinating role. Finally, two of the selected units of analysis are intellectual property bureaus. Awapatent AB was the agent providing assistance when submitting the first two patents in Cartela AB's portfolio. In an effort to reinforce the study's ability to capture the importance of patenting in relation to business strategy, we also selected Wagner Zacco AB, claimed to be the leading IPR bureau in Scandinavia, as a unit of analysis.

Yin (2003) also discusses how to prepare for data collection in a case study. Whilst the data collection may have to rely heavily on information from individual interviewees, conclusions need to be supported by other sources of information, for example organizational outcomes or corporate documentation. Such information is of course used in our case study and is continually presented in the case description found in chapter 4. For example the empirical chapter includes a walkthrough of the patent documents. However, the primary data collection sources in the units of analysis are the individuals listed below. Although each unit of analysis contains very few employees, in order to obtain the best information we stated our area of interest and requested the most appropriate informed interviewee.

Sources of data collection within the units of analysis:

- Evy Lundgren-Åkerlund, inventor, founder and CEO, Cartela AB
- Adam Schatz, former Board Member, Cartela AB, and Managing Director, Teknoseed AB
- Per Antonsson, Business Advisor, Teknopol AB
- John Karlström, Patent Attorney, Awapatent AB
- Sven Trolle, CEO, Forskarpatent i Syd AB
- Sven-Thore Holm, CEO, Innovationsbron Syd AB
- Per Tomas Karlsson, Managing Director, Wagner Zacco AB

The interviews conducted have been relatively unstructured or open in character. Thus the interviewees were given room to answer questions and describe events in great detail (Kvale, 1997). During our interviews, the answers were succeeded by more probing questions for the purpose of elaboration, which led to a dynamic interview process. This is a common characteristic and a strong point of case studies according to Yin (2003). Kvale (1997) recommends the usage of a tape recorder during interviews; it enables the researcher to concentrate on the subject and the dynamics of the interview. On the other hand, the usage of a tape recorder might interrupt the conversation and the work effort afterwards, the process of transcribing the content, can be laborious, something that is often forgotten by researchers (Wallén, 1996). Having performed interviews with a tape recorder previously and considered the advantages and disadvantages, we saw that the benefits outweighed the negative effects.

2.2.3. Data analysis

When we conducted the analysis we used transcriptions from the interviews as working material for coding. The working material comprised of approximately 90 pages in total. A code is a label attached to a piece of collected data, which in turn makes it possible to structure data. The process enables the researcher to gather data referring to certain codes and thereby draw conclusions (Miles & Huberman, 1994). For example we used the labels ‘patent claim’ and ‘patent scope’ to identify relevant data gathered from the data sources. The use of labelling enabled us to sort and summarise data, helping the process of writing the empirical chapter as well as drawing conclusions.

Relying on theoretical propositions and thinking of rival explanations are two primary analytical strategies described by Yin (2003) that we have used in the analytical process. Relying on the theoretical propositions initially formulated helps the researcher to focus on essential data and ignoring other data. It also helps to organise the entire case study and even formulate alternative explanations, which in turn can be considered. To support this process we have also used descriptive ways of visualising data as described by Miles & Huberman (1994), such as partially ordered displays, Role-ordered displays and conceptually ordered displays. For instance we built a comprehensive matrix with all the data sources on one axis and the time line

for Cartela's start-up on the other. This helped us to charter the progression of the company as portrayed by the different interviewees. The displays were of course also used to write the empirical chapter, providing the reader with a coherent description of the case.

2.2.4. Reporting

An important decision early in the research process is to consider what impact one wants to have on the reader. The report is also used to strengthen the reliability and validity of the results (Miles & Huberman, 1994). As a familiar structure will ease the reading process, when a study is to be presented the structure should be adapted to the audience in mind. Most common in academia is the linear-analytic structure; introduction with background and research questions, methodology, literature review, presentation of empirical data with a discussion, followed by research results. A single case study is appropriately reported in a descriptive storytelling manner, complemented with graphics and tables (Yin, 2003).

Our study aims to provide company founders as well as academia with an overall perception and mental framework of how to manage IC and foster an embryo of innovation capital in a Biotech industry setting. In view of that, the report is structured in a way that is familiar to academia, yet we have provided numerous examples in the case description, which hopefully will appeal to industry practitioners. The report also contains a detailed explanation of the research process in order to enhance the reliability of the study.

2.3. Research quality

The two concepts validity and reliability are central when determining the academic quality of research (Bryman, 1997). Yin (2003) discusses this in more detail and how it applies for case studies by describing four tests commonly used to establish the quality of any empirical social research: construct validity, internal validity, external validity and reliability. The four tests are used to reflect on the quality of this thesis.

2.3.1. Validity

Construct validity refers to the establishment of correct operational measures for the concept to be measured. Criticisms of case studies often mention that investigators fail to develop operational sets of measures and that 'subjective' judgement is used to collect data. One tactic to counter this is to establish a chain of evidence, i.e. to show the reader how research conclusions were derived from data mapped back to initial questions. When presenting the case and the research results, we have tried to provide sufficient details in order to clearly illustrate the derivation. Another tactic to increase the construct validity is to have a draft of the case study reviewed by a key informant. We adopted this procedure by letting four of our interviewees read a draft of the thesis and return comments.

Regarding internal validity, this only applies for explanatory case studies where the investigator tries to determine that event x led to event y. Hence, this test is of no relevance to our research.

The external validity test is on the contrary very essential, dealing with the problem of knowing whether the study's findings can be generalized beyond the current case study. This is the most common problem mentioned by critics of case studies, typically stating that single cases provide a poor basis for generalizing. However, that implies that the situation can be contrasted to survey research, where a sample readily generalizes to a larger population, which is incorrect. Survey research relies on statistical generalization, whereas case studies are to rely on analytical generalization; a method where the investigator is working to generalize a specific set of results to some broader theory.

The domain to which our results are being generalized, on the whole, consist of the IC theories described in the analytical framework. This is done in the discussion of the empirical results in chapter 5. Additionally chapter 5 includes a discussion of the results with regard to explanatory power and relevance, thus concluding the generalization beyond the scope of this thesis. On the other hand, analytical generalization is also based on replication logic, meaning that the results need to be tested by replicating our findings in a setting where they should occur. Such replications have not been done by us, due to the limited extent of the thesis, but may provide a basis for further research.

2.3.2. Reliability

The objective of the reliability test is to make certain that if a subsequent researcher followed the same procedures as described by us and conducted the same case study again, the researcher would arrive at the same findings. The ultimate goal of reliability is to avoid or minimize errors and bias in the study. To address this problem, we have in this report tried to include all decisions made as well as research methods and procedures used.

2.4. Ethical issues

There is a close connection between ethics and the requirement of high quality in research. The basic fundamentals are not to obstruct the personal integrity of the individuals involved and to follow scientific norms, such as to undoubtedly show what is to be considered own efforts as opposed to works of others. Likewise, taking responsibility of how the research results might be used for various purposes is another must (Wallén, 1996). Concerning the personal integrity of interviewees, Miles & Huberman (1994) discuss informal consent, which means that involved persons are aware of the intention of the study and participate out of free will. This may be difficult due to the fact that the set research direction may be altered during the course of the study.

First of all we can mention that all interviewees were informed about the thesis and the purpose of it. The research has been slightly altered as new data was gathered,

although not to such an extent that we abandoned the overall purpose and research focus. They were also asked for permission to record what was said during the interviews. We have as well been very careful to point out the work of others in this report. Regarding the potential usage of the results for various purposes, we have taken that into account and for instance deliberately avoided to use statements made by six out of seven interviewees in the case description, thus proving a high ethical awareness.

3. Theoretical analytical framework

This chapter presents the framework used in case data collection and case discussion. The first section discusses the concept of IC and how it creates value. In the second section we describe the protection of intellectual assets, thus the main concepts regarding patenting as well as related strategies to consider.

3.1. The Intellectual Capital concept

The following discussion provides a description of the perception of intellectual capital (IC) used in our research. The concept may be difficult to comprehend, not least because different authors define the concept inconsistently. Therefore we have made an effort to interlink the models we have chosen to utilize in this study.

3.1.1. Forms of capital

Intellectual capital is in its most basic sense defined as the difference between book value and market value (Edvinsson & Malone, 1997). Edvinsson (2002) depicts that IC should be regarded as the future earnings potential of the organization; therefore it is about the flow rather than the stock, which is one of the common misunderstandings regarding the entire notion of IC. More lucidly, IC is the combination of human capital, the knowledge and brains of the people who work for the organisation, and structural capital, the work processes, routines, office design and the like. It is in essence having the ability to transform knowledge and intangible assets into value by multiplying human capital with structural capital.

Included in the term human capital are individual capabilities, knowledge, skills and experience embodied in the people working in an organisation. In addition, it also comprises how the intelligent organisation adapts to a changing environment. For example how the people of the organisation upgrade their skills and how those new skills are leveraged. How are new skills as well as older experiences being shared with the rest of the organisation? Another aspect of great importance and included in human capital is the creativity and innovativeness of the organisation (Edvinsson & Malone, 1997).

To define structural capital straightforwardly, it is what remains in the company when people go home (Edvinsson, 2002). It can also be defined as the empowering and supporting infrastructure of human capital. For example systems used to transmit and store intellectual material, organizational concepts, processes and documentation. Obviously, it contains a number of various components, which has resulted in efforts to dissect IC into subcategories of structural capital as well as new capital forms. An example of this dissection is the Skandia Market Value Scheme (figure 3.1), where structural capital can be seen to comprise customer capital and organizational capital, which in turn consists of innovation capital and process

capital. Organizational capital refers to the systems, processes and operating philosophy that facilitate the flow of knowledge through the organisation. It is the codified know-how in the organization as well as the process to leverage that capability. Subsumed in organizational capital is innovation capital, referring to the renewal capability and the result of innovation in the form of intellectual property, such as patents or other intangible assets used to create and bring innovations to the market. Process capital refers to work processes and employee programs that enhance the efficiency, the manufacturing and delivery of products and services. The customer capital is also subsumed under the structural capital and refers to the value of customer relationships, which may be described in terms of loyalty and satisfaction (Edvinsson & Malone, 1997).

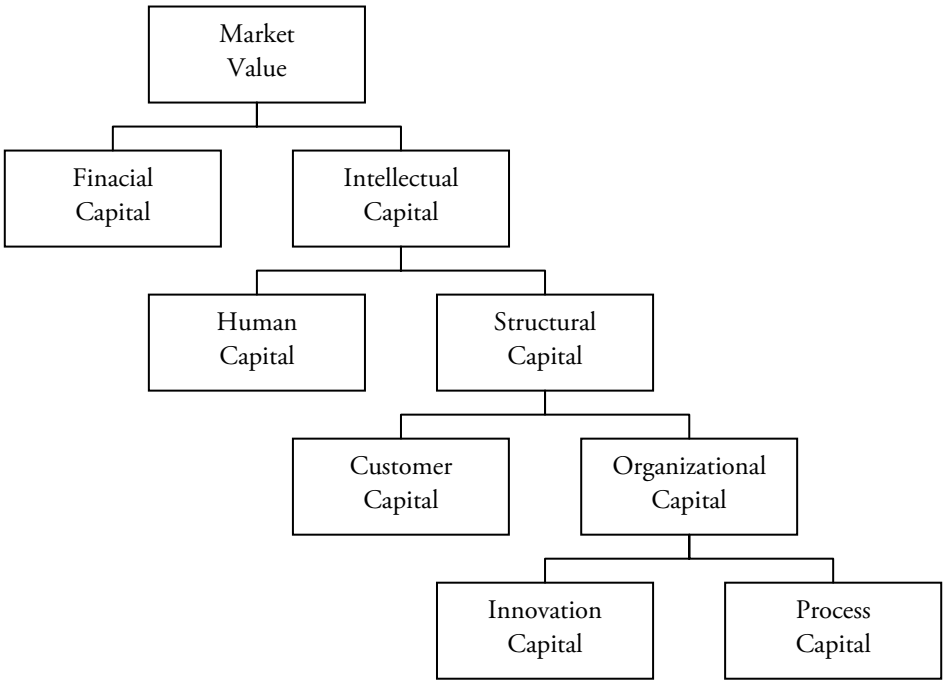

Figure 3.1 Skandia Market Value Scheme (Edvinsson & Malone, 1997, p. 52).

However, Saint-Onge et al. (in Edvinsson & Malone, 1997) describe a model of IC where customer capital is hauled out from structural capital and placed as a separate form of capital equivalent to human and structural capital. The model emphasizes that it is the intersection of the three dimensions that form the basis of value creation.

The IC model with three forms of capital is also a common assembly in recent studies on the topic of IC (Hermans & Kauranen, 2005). The rationale is described in the next section which focuses on value creation.

3.1.2. Creating value

Hermans & Kauranen (2005) show the value creation potential of IC in Finnish biotech companies, using a theoretical division of IC into three partly overlapping forms of capital (figure 3.2), namely human capital, structural capital and relational capital. Their perception of IC is built on the value creation platform model of Saint-

Onge et al. (in Edvinsson & Malone, 1997) and modified in coherence with a definition of IC presented by the MERITUM project 2002. Their modified model adds to the three capital forms. For instance relational capital is an expansion of customer capital, having a wider scope to stress relations with suppliers, academic research networks and partners. With regards to relations, Edvinsson (2002) also emphasizes that relations work on two levels: the corporate and the personal level, i.e. relations belonging to the individual may leave the company together with the employee and can thus not be owned by the firm. Furthermore, Hermans & Kauranen (2005) underline the structural capital, which indicates the company's capability to manage its activities in order for tacit knowledge to be converted into intellectual property rights.

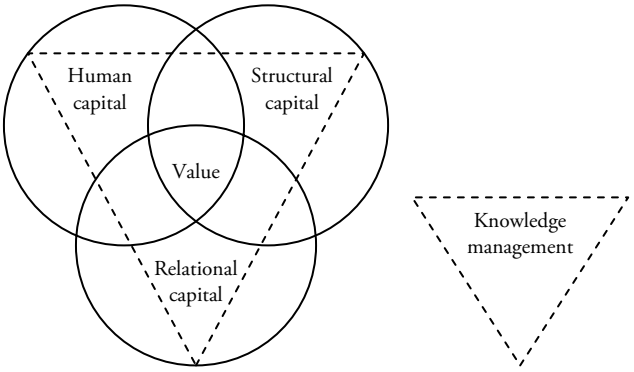

Figure 3.2 The IC Value platform (Hermans & Kauranen (2005), modified from Saint-Onge et al. in Edvinsson & Malone, 1997).

As mentioned, in the model by Saint-Onge et al. it is the balanced intersection of the three dimensions that serve as the basis for value creation. To further elaborate on the value creation of IC, Hussi & Ahonen (2002) argue a close relation between the value creation platform model and the intangible value chain model.

The intangible value chain is presented by Ahonen (2000) and is a classification of intangible assets into generative and commercially exploitable intangibles. Ahonen (2000) argues that the definitions discussed in the IC literature mixes these two types of intangibles and as a result obscures the value creating mechanism in a knowledge organisation. Portrayed in the intangible value chain model (figure 3.3) is that generative intangibles, consisting of human capital, internal structures and external structures, through interaction generate commercially exploitable assets. Examples of commercially exploitable intangibles in this perspective are intellectual property rights and reliable management. Thus Ahonen (2000) also recognizes the importance of achieving a balanced interaction between generative intangibles.

To assess the economic efficiency, Ahonen (2000) argues that MVA (Market Value Added), i.e. the difference between market value and invested capital, is a better measure than for instance EVA (Economic Value Added), which is based on historical records and thus trusts that the future is like the past. The capital market is assumed to consider the effects of all known phenomena regarding the economic

performance of a company in a relevant future. Here the behaviour of the capital market is treated as a metaphor of what occurs in all kinds of businesses, actually in all kinds of organisations, regardless of them being traded in the stock market or not. Assumed is that those changes happening amongst companies traded on stock exchanges happen in other businesses as well. In this perspective MVA can be a useful measure of shareholder value and long term economic performance, although it is admitted to being an imperfect measure as well.

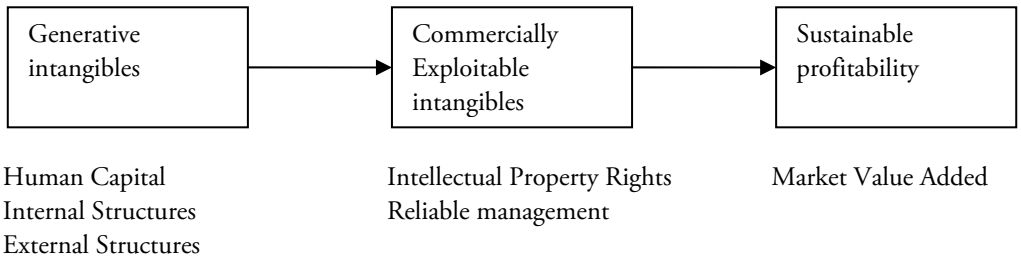

Figure 3.3 The intangible value chain (Ahonen, 2000).

To conclude the intangible value chain, the capital market's expectations of the company performance are reflected in the firm's market value. In turn the market value is in essence depending on the firm's commercially exploitable intangibles, created in the balanced interaction of the generative intangibles. The thought of keeping commercially exploitable intangibles separate resembles the notion of innovation capital, which here can be viewed as a third angle on value creation with tight linkage to both models already discussed.

We have already seen the term innovation capital described in Skandia's market value scheme. However, Chen et al. (2004) argue that innovation capital should not be seen as a part of the structural capital, stressing the importance of innovation in the new economic era where it is a key factor for a company, enabling it to maintain a positive long-term competitive performance. Therefore innovation is not a subject to structural capital; in fact it is argued to be the pivotal link of IC. Stressing the integrative perspective of IC, Chen et al. (2004) place innovation capital at the core of IC and show a remarkable relationship between the four IC elements (figure 3.4).

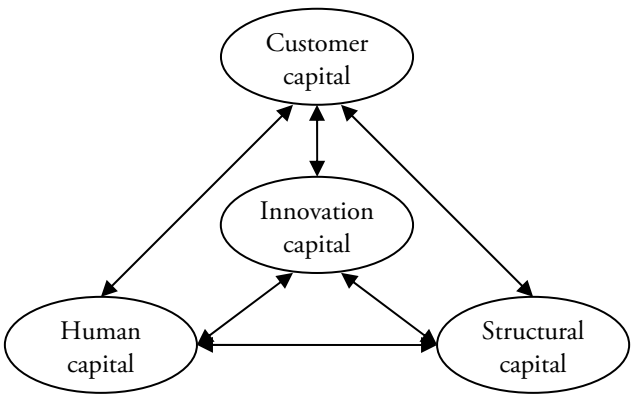

Figure 3.4 IC structure (Chen et al. (2004), p. 202)

Tseng & Goo (2005) also regard innovation capital as the fourth pillar of IC and relate the interaction between the elements to corporate value; underlining the importance of the ability to innovate in the effort to increase corporate value.

We have now described closely related perspectives of value creation: the value platform, the intangible value chain and innovation capital as the pivotal link of IC. When comparing the three perspectives it is evident that intellectual capital is comprised of three forms of capital which have to interact in order to achieve value; with the interaction illustrated in the IC value platform and the corresponding concept of generative assets in the intangible value chain. It is also suggested that innovation capital is actually what is being generated in this interaction and that it, as a part of the IC landscape, should be regarded as the future earnings potential and therefore treated as a separate entity. Consequently the notion of innovation capital, being treated as a detached form of capital, is comparable to the idea of commercially exploitable assets and the derived marked value added shown in the intangible value chain. But, just to make the terminology clear, we may note that the intangible value chain uses the terms internal and external structure, however still implying the meaning of structural and relational capital. Likewise we see that the IC structure described by Chen et al. (2004) still uses the term customer capital. Naturally this may add to the confusion, however Hussi (2004) comments on the fact that different authors use different theoretical terms on the three dimensions; ultimately saying that it does not matter as long as the essence in the discussion on IC is the ability to provide a holistic view on organizational development.

3.2. Protecting intellectual assets

To elaborate further on the concept of intellectual capital, and especially innovation capital, in the biotechnology industry, we need an understanding of patenting and related concepts.

3.2.1. Patenting criteria and procedure

A prerequisite for the development of new pharmaceuticals and methods for medical treatment are research-based inventions. Patenting is essential to protect the development and commercialization of these inventions. This part will explain the criteria and procedure when applying for patent protection.

In order for an invention to be patentable it must meet three prerequisites, being (1) novel, (2) associated with an inventive step and (3) subject to industrial applicability. For example, if no product with an identical combination of physical and functional features has been disclosed previously, it is to be regarded as novel. An assessment of the criteria of novelty includes a clarification of what has been available to the public previously. Likewise, an invention is associated with an invention step if a skilled person would not have had any expectation of success when making the invention. Thus, simple and predictable routine developments are not associated with an inventive step. In addition there are criteria that exempt inventions from patentability, e.g. for moral reasons or specific exclusions such as methods for human

cloning. Both inventions as products and methods can be patented, preventing third parties from: producing (for product patents), carrying out the method (for method patents), using, offer for sale, selling, importing the patented product or obtaining a product using the method for commercial purposes. A patent provides the right to exclude others from exercising the invention claimed in the patent for a period of 20 years (Medicon Valley Academy, 2002).

The first patent application filed by an inventor is priority-founding, describing the invention and establishes the right to claim priority under the Paris Convention. A priority-founding patent application should describe the invention in both general and more detailed terms. In case new important knowledge regarding the invention is acquired within the priority year, such aspects can be included in an updated patent application filed before the expiry of the priority year or described in a new priority-founding patent application. A priority year is the period of 12 months after filing a priority-founding patent application (Ibid.).

The main idea with the Paris Convention of 1883, the first international convention on intellectual property rights, was to ensure inventors protection on more than a national level. Under normal circumstances a patent cannot be filed in more than one country at the same time since it needs a translation and a patent attorney to handle the process. Obviously, filing a patent application in another country at a later date carries risks. For instance, the invention may have become public between the first and the second filing, which according to the novelty criteria causes a problem. The remedy was introduced in the Paris Convention, allowing for a priority period of one year for patents. Within that period, the applicant is entitled to file his application in another country and thus treated as if it was filed at the date of the first patent application, with regard to for instance novelty (Heath, 2000).

However, seeking patent protection in more than one country requires individual applications for each country the inventor wishes to obtain patent protection in, without doubt a very burdensome and costly activity. The European Patent Convention (EPC) is on the other hand an exception in this matter, enabling the European Patent Office (EPO) to grant patents for all member states of the EPC if the applicant so wishes. Still there are no other regional systems as the EPC. The idea of the Patent Co-operation Treaty (PCT) of 1970 was to facilitate the filing of patents in more than one country (Ibid.).

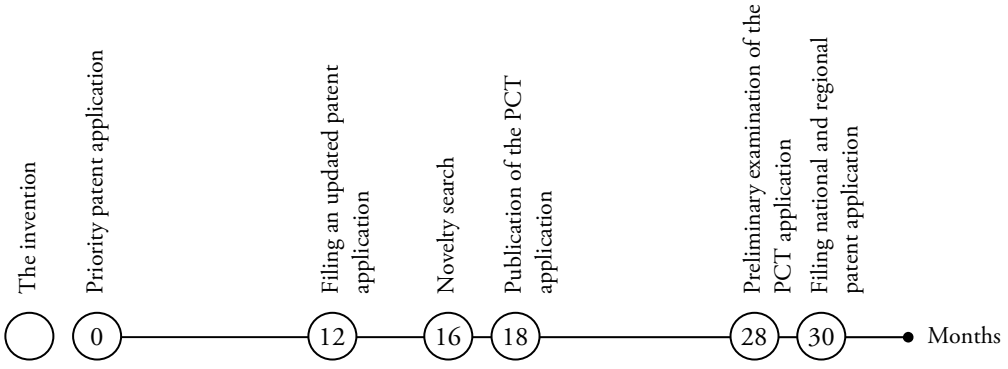

Figure 3.5 Patent application process (Medicon Valley Academy, 2002, p.31).

3.2.2. Patent strategy

Levin et al. (1987) show the varying potential of patent rights to amplify appropriation of returns from innovation across industries. However, drug and chemical industries benefit from a tight appropriation regime where protection by patenting is an effective mechanism. To distinguish the type of industry with regards to patenting Merges & Nelson (1990) established two main types of technological industries, namely discrete and complex industries. While pharmaceuticals are an example of a discrete industry, semiconductors would constitute a complex industry.

Reitzig (2004) studies the exercise of forming bulks of patents to protect an innovation. One type of bulk is called a 'patent fence', which in effort to enhance the value of the innovation is used to block competitors from producing competitive substitutes that can be easily patentable and exploited. Furthermore, the protection of a commercially exploitable product or process in a discrete technology would likely consist of a limited number of patents, whereas it would be comprised of numerous ones in a complex technology. For example in pharmaceuticals, the first-best use of patents is to exclude others from copying. In theory, there is no need for a patent fence in pharmaceuticals because substitutes for active molecules hardly ever exist. Exclusion should yield maximum returns on investment for the patentee unless access to complementary assets held by others is crucial and thus forcing the patentee to share the innovation.

4. Empirical results

Presented in this chapter are the empirical findings of the case study. The first section describes the case study outline with interviewees and the relevance of their views for the study. The second section illustrates the thoughts concerning their roles as expressed by those interviewed belonging to a mixture of organizations that facilitate the technology transfer process. The third section portrays the case company, how it went through the technology transfer process and its continued development.

4.1. Case study outline

In order to conduct this case study, eight persons from different organizations were interviewed. As mentioned in the chapter on methodology, units of analysis and the data collection sources belong to the organizations or external agents taking part in the technology transfer process placed within a chosen entity, Innovationsbron Syd AB. Likewise they represent, with one exception, important contributors and stakeholders along the progressed pathway of the chosen case company, Cartela AB.

Four of the interviewed professionals are active professionals at what can be considered a technology transfer entity, located at Ideon Science Park in Lund, Sweden. The technology transfer entity is structured as a business group and Sven-Thore Holm is the CEO of the parent company, Innovationsbron Syd AB. Forskarpatent i Syd AB is one of the subsidiaries, where Sten Trolle is the working CEO. Adam Schatz is the Managing Director at Teknoseed AB, a second subsidiary, and Per Antonsson is a Business Advisor at a third, Teknopol AB.

Evy Lundgren-Åkerlund is the inventor, founder and CEO of Cartela AB, and has experienced the technology transfer process as well as the subsequent struggle of building a start-up venture. Some interviewees have taken part in the birth and progression of Cartela AB to a larger extent than others. For instance Adam Schatz was for a significant period of time, a member of the board with Cartela AB. Per Antonsson was previously employed by Active Biotech AB and thereby was highly involved in this specific case company's history. Sten Trolle was involved in the pre start-up period when Evy Lundgren-Åkerlund originally made a decision not to start a company of her own; a decision that was to be altered later on.

In the process of commercializing research based technologies, intellectual property rights (IPR) are an essential aspect. External IPR bureaus are often consulted in the technology transfer process as well as in the continued effort of building a research based venture. Regarding external IPR expertise, units of analysis and data collection sources herein were Per-Thomas Karlsson, Managing Director of Wagner Zacco AB and John Karlström, Patent Attorney with Awapatent AB. With regards of relevance, Awapatent AB was the IPR bureau consulted when Cartela AB filed its

first patent application; on top Wagner Zacco AB is the leading IPR bureau in Scandinavia.

4.2. Innovationsbron Syd AB

In 1994, the Swedish government created Teknikbrostiftelsen in Lund, given the task of stimulating economic growth in the southern part of Sweden by capitalizing on knowledge created at universities in the region. Six corresponding organizations were set up in other parts of Sweden in the same year. In order to accomplish this difficult task Teknikbrostiftelsen focused their attention on three important areas. First, a key to achieving growth was to provide companies, with limited resources for conducting R&D themselves, with knowledge steamed from the universities. Secondly, they aimed to facilitate the commercialization of innovative ideas derived from university research. Finally, an emphasis was made on supporting and encouraging relations between the industry and the universities (Teknikbrostiftelsen i Lund, 2002).

In order to fulfill the task Teknibrostiftelsen i Lund created three companies named Teknopol AB, Teknoseed AB and Forskarpatent i Syd AB. In 2005 Teknibrostiftelsen, together with the Swedish Government and Industrifonden, created a new group named Innovationsbron AB. However, Innovationsbron AB is intended to function with the same purpose as its predecessor Teknikbrostiftelsen, and the three companies previously formed, now remain as subsidiaries of Innovationsbron Syd AB (Innovationsbron, 2005).

Innovationbron Syd AB constantly receives a stream of individuals, commonly senior researchers and on rare occasion's even students, proposing an idea or invention. However, to ensure that a steady stream of innovations and ideas flows into Innovationsbron Syd, an agreement has been made with Lund University's department of trade and industry. The university department is hereby obliged to scout various institutions and faculties in search of promising new ideas. In other words, a prescreening is performed by the university with focus on the technology. Once a month representatives from both parties then gather to discuss the findings and decide whether any actions should be taken in order to facilitate technology transfer. If any idea is considered to be commercially feasible, Innovationsbron Syd offers these individuals two pathways to commercially exploit it. Either they sell or license their invention or they form a start-up company. Whichever option they desire it can be facilitated with the support of the subsidiaries of Innovationsbron Syd.

4.2.1. Sell or license

If the individual is not willing to form a start-up venture, yet is interested in exploiting the invention somehow, they can turn to Forskarpatent i Syd AB who will help to license or sell their idea to an industry actor, who in turn uses it to generate products or services. But first the idea or invention is immediately subject to a thorough investigation regarding its originality, i.e. what needs does it fulfill or which problem does it solve? Are there multiple solutions to the same problem? The next

question is to identify a potential customer or perhaps several customers, even different industry settings. In other words a commercial focus is applied to the invention before a patent application is formed. In short, Forskarpatent i Syd AB asses the invention and provides help applying for patent protection if deemed commercially viable. Subsequently the intellectual property right is sold for profit, by which Forskarpatent i Syd AB receives 50 % of the revenues in return for carrying the costs of filing the patent application plus bearing the uncertainty of not finding a buyer for the IPR. Simply put, Forskarpatent i Syd AB consider themselves as an agency, where the research community constitutes the supplier and the industry being the customer; the researcher receives royalties and so does Forskarpatent i Syd AB.

However, this is a simplified scenario and there are of course several options for commercially exploiting research based inventions in an similar manner; like one example described to us where Forskarpatent i Syd AB formed a joint venture in Los Angeles, with American management and investors, instead of just licensing the IPR. The grounds behind the decision were the possibility of attaining venture capital with relative ease as well as favorable conditions for conducting research more efficiently there. Still, the rationale is to grant a researcher an opportunity of exploiting the invention even as they continue to conduct research, perhaps with the possibility of doing so on behalf of the company that acquires the invention.

4.2.2. Forming a start-up

Opting for the other pathway, founding a start-up venture, the individual then turns to Teknopol AB, which in broad terms provides assistance and mentorship when creating a viable business concept. As well as providing help in establishing useful contacts for ensuring sufficient funding and assembling a board of directors for the start-up.

It is underlined that Teknopol AB do not actively manage a company, rather they provide the means for a researcher to become an entrepreneur. A fundamental prerequisite is that individuals have a confident drive, a certain state of mind where anything is possible and personal entrepreneurial capabilities in order for this to work out well. When carrying out its mentorship, an important task for Teknopol is to clarify the common nature of conducting business as well as what is needed from the founders. This clarification often results in despair when entrepreneurs realize how their invention is perceived from a venture capitalist's perspective. Acquiring funding can be a harsh experience for entrepreneurs, especially in life science businesses. This may seem understandable, having venture capitalist bearing the financial risk. Yet the main objective for entrepreneurs is to hold on to as much shareholder equity as possible.

Naturally, researchers who turn to Teknopol are more often focusing on the technology, having spent limited thought on the customer, market and product. Thus a crucial task in guiding the researcher to become an entrepreneur is asking questions such as: who is the customer, what gap in the market is this invention intended to fill, how much is the potential customer willing to pay? Depending on the composition of the product, market and customer, how will this start-up create

revenue? When working with clients Teknopol utilize a comprehensive matrix model, divided into technology, market and business on one dimension and the continuous development of the venture over time in the other dimension. This matrix is also presented in a surprisingly large frame that is actually given to entrepreneurs for them to use in their daily activities while continuing building their business. The matrix covers main aspects to keep in mind when forming the venture, thus allowing the entrepreneur a better and more balanced focus on all aspects. It is on the other hand described to us that this matrix is just a part of a more complex model including further detailed schemes, which can be used for evaluating the progress of a business. In these schemes different aspects are weighted separately and then aggregated; as a method of checking the current temperature so to speak.

4.2.3. Funding

Initial seed funding in these cases is often provided by Teknoseed AB. Their business concept is based on increasing the value in high technology companies by becoming a partner early on. While in general they enter start-ups very early, the level of involvement varies both in terms of capital invested and management support. In some companies they have even been forced to provide semi-operational management support. Though, a prerequisite for making an investment is that the start-up is managed by a determined, goal oriented entrepreneur. If the venture is lacking such an individual with enough drive, the startup is deemed to fail. In order to evaluate the entrepreneurs and the progression of a start-up, a number of subjective determinants are used to create an index. These determinants are broadly divided into different areas of focus such as organization, market and technology. In fact, Teknoseed performs a review of their portfolio once a month, from which an average number is derived for each company. As the management of Teknoseed have motorcycles as one of their personal interests, the numbers are expressed in their own speed metaphor, ranging between 0 and 200 kilometers per hour to emphasize the progress of a particular venture. The review also serves the purpose of providing an insight into the portfolio and the market as well as Teknoseed's performance. Surprisingly any conclusions such as providing an estimate of potential market value etc. are not drawn from the review. Nevertheless Teknoseed finds the actual reviewing process very valuable since it allows everyone to reflect and analyze every company in a structured manner.

From Teknoseed's point of view, there are many early stage ideas with potential as well as many traditional venture capitalists, however there is nothing in between and thus this is the gap that their business model is trying to fill. Teknoseed's resources are nonetheless limited and the organization is dependent on acquiring additional funding for the startups, whereas Teknoseed can make an exit within 3 to 7 years. During the process of searching for additional capital and promoting a start-up, the network and external contacts are essential. With this in mind it is also expressed that Teknoseed is simply the organization that stitches together a financial solution and finds the competences needed to achieve success.

In the usual manner, prior to any investments being made, a due diligence and more importantly a freedom to operate analysis is performed. If the analysis proves

that there are no obstacles, a technological review where potential risks are identified is performed, followed by the creation of a project plan with milestones. The purpose of working towards milestones is to monitor the progression and whenever a milestone is achieved a potential risk has been minimized. The injection of capital is also managed in conjunction with milestones reached.

4.2.4. The rationale of patenting

Patenting is necessary to address when dealing with technology rich inventions, either when to be licensed or continuously developed in a start-up. At Teknopol they recognize patenting as a key component of extracting value in start-ups and the start-up process includes an assessment of the possibility for being granted a patent. Similarly, patenting is regarded as an important component in Teknoseed's concept, although there are other components of equal or more importance. The most important factor is regarded to be the human attitude and capability, yet no investments are made in companies without viable patent strategies. It is underlined that the Life Science area is quite peculiar, where patenting has a more central role in facilitating value. Nevertheless, the individual entrepreneur and the invention's ability to bridge a gap in the market are the key ingredients.

Of course, Forskarpatent i Syd strive towards producing patents with great commercial potential. It is suggested that the best approach is aiming for the creation of a very broad all encompassing patent, which to a great extent prohibits and limits the competitors from releasing similar products. It is also important to aim high, thus writing the application with as broad patent claims as possible, since the boundaries are not known until they are breached. The consequences of having research results publicized are also emphasized, since a publication limits others from acquiring a patent. However, a troubling phenomenon is when a competitor or any other industry actor for that matter, on rare occasions is able to patent, for example in life science, a method for applying a patented substance to a patient. In such cases, the two patent holders are mutually dependent on each other to conduct business and as a result of this cross-licensing commonly becomes the solution.

The following is an example of the potential risk associated with achieving an inadequate level of control. One of Wagner Zacco's clients who had years of experience in patenting its inventions suddenly received a notice from the patent and registration office, claiming that the company's operations was infringing on another patent, although the company could not realize why. Apparently a company representative had attended a research conference where he had revealed a process of applying a certain compound; however a supplier of this compound was also attending the same conference. The supplier then applied for a patent regarding the process and as a consequence Wagner Zacco's client became dependent on the supplier, thus were forced to pay a royalty. This example stresses and visualizes the importance of achieving control and answering questions such as; what, when, how and who should be responsible for patenting?

Patenting research based inventions comes with a slight absurdity. First of all, breakthrough discoveries are naturally subject for publishing in scientific journals, yet one needs to apply for patent protection before it is published, in order to fulfill the

novel criteria. Even if a researcher submits the application before publicizing, this sometimes creates additional problems when the researcher outlines how this achievement could have been reached by alternative means; undermining his or her own patent application by reducing the inventive step.

4.2.5. Patenting done wisely

When it comes to patenting a key is to link the business concept with the patenting strategy and it is here that problems may arise, since it in many cases is a question of financial resources. The limitation of available funds often leads to a patent application which might not realize the innovations full potential. Patent protection apparently being a very abstract phenomenon, various analogs and metaphors has been described to us.

Sten Trolle used the metaphor of a small plant when describing an invention; a fragile plant that can be squashed rapidly without much effort unless well protected by a patent. The inexperienced researcher who applies for patent protection may write a patent claim that constitutes a rather small roof covering the plant (figure 4.1). However the competitors can plant an entire forest around it, which is just as effective to suffocate the plant. To resolve this, a large roof (1) as well as several subsequent medium-sized ones (2, 3, 4) has to be constructed in order to cover the entire field on which the plant grows, i.e. several claims varying in width.

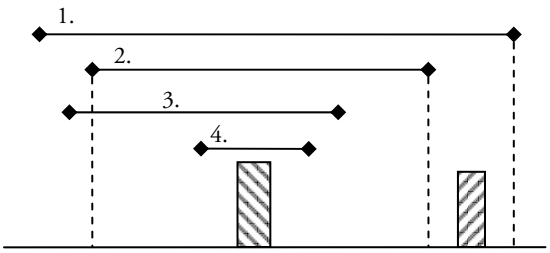

Figure 4.1 Scope of patent claims (Sten Trolle, 2005).

Another interviewee makes an analogy with the process of hanging a painting on a wall. If an individual invents a method of hanging up a painting using a thread and nail, a patent application should not be limited to using just those components. The patent would then be easy to circumvent since a nail easily can be replaced with a screw or even a stick, and it is this way of thinking that patent consultants work with. The initial question that needs to be answered is; what is the actual invention? Thus the aim is to create a well defined patent, containing a minimum of well articulated claims, yet still encompassing other possible means to achieve the inventions purpose. In other words if a patent is to be useful it has to have clear boundaries and a sharp definition that can easily be communicated in a court room when countering infringements.

Patenting can be further visualized in a model, described to us by Per Tomas Karlsson at Wagner Zacco AB, incorporating the legal, time and technology dimensions. In the model the base area represents the legal scope with a time span of 20 years, shown by the height of the cylinder. In order to survive the height of the

cylinder has to constantly increase, through development of new technology followed by patent protection within the confines of the base. As time progresses new cylinders are added and eventually the legal scope consists of large number of narrow patents, thus a large part of the technology is unprotected and available to all. However, those companies who are taking advantage of the formerly protected technology are still dependent of the narrow patents, or peaks. As an example; think of the combustion engine which is to a large extent based on unprotected technology such as pistons, cylinders, valves etc. However, new patented technology in the form of, direct fuel injection has emerged and offers substantial advantages to the consumers. Even though a large extent of the technology is unprotected the engine producers, wishing to create superior engines, are still dependent on the fuel injection patent which can be illustrated as a narrow peak.

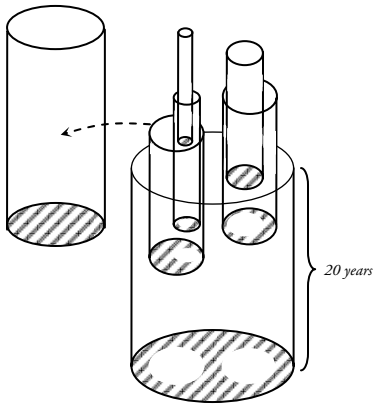

Figure 4.2 Cylinder model (Per Tomas Karlsson, 2005).

At this point a technology shift may occur, rendering previous patents useless, as in the case of combustion engines where radically new technology in the form of fuel cells is entering the market. Consequently, new cylinders are added outside the initial patent's legal scope as depicted in figure 4.2. The model places an emphasis on the importance of renewal and implies that even though a comprehensive patent has been obtained it is at all times necessary to scan the industry for potential threats, identifying customer needs and finding new paths to follow. Consequently intellectual property management is, and always will be, dynamic in nature where prerequisites are bound to change. The aim is to make products profitable for a long time through the creation of a carefully considered strategy of safeguarding.

Sten Trolle also showed us a model that describes the scope of claims as well as continuous patenting over time. The perspective was described using the metaphor of a road, where roadblocks in the form of patents are built in order to hinder the competitors from advancing. As illustrated in figure 4.3 the importance of having a strong and wide initial roadblock is stressed, i.e. having clear and encompassing patent claims. If not, the road is easy to access by inventing around the initial patent, comparable with the small roof covering the plant. Yet, there can be a possibility to reach the destination, such as an effective treatment of a

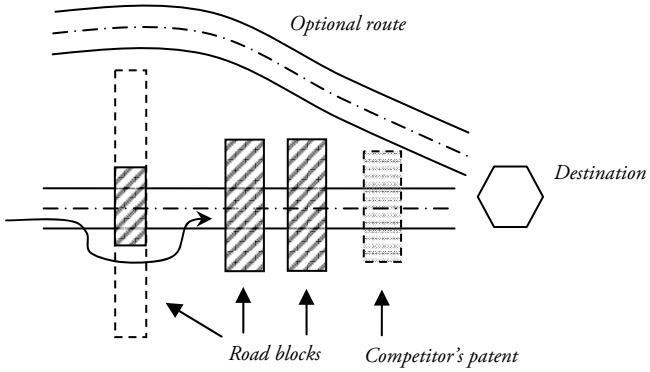

Figure 4.3 Roadblock model (Sten Trolle, 2005).

disease, via an optional route, thus achieving the same benefits as the original road. This is similar to the technology shift displayed in the cylinder model, figure 4.2. Furthermore, it is emphasized that the competitors may have the option of placing a roadblock of their own further ahead on the road, for example the application of a patented substance. Thus making the two competitors mutually dependent on each other, with cross licensing as the most common solution.

4.3. Cartela AB

Cartela was founded in September 2000 by Associate professor Evy Lundgren-Åkerlund, Professor Karl-Olof Borg and Professor Stefan Lohmander. However, Cartela's history stretches further back in time and it all emerged from Lundgren-Åkerlund discovery of the integrin alpha10beta1 in the mid 1990s. An integrin is a protein, which in this case is placed on the chondrocytes in cartilage. Their function as signaling molecules point to their potential as therapeutic and diagnostic targets in arthritic disease treatment.

The case of Cartela is rather peculiar since the inventor and founder still is the CEO. On the other hand, several interviewees underlined that without Lundgren-Åkerlund's knowledge and personal capabilities, Cartela would never have existed. Whilst conducting the interviews it became evident that she encompassed an undisputed entrepreneurial drive.

4.3.1. Discovery, patenting and sale to Active Biotech

The discovery of integrin alpha10beta1 was made when Lundgren-Åkerlund still conducted research at Lund University. The potential of this integrin was recognized very early, as a means of diagnosing and treating arthritic disease. Consequently a need for patent protection appeared and more or less by accident she came in contact with Forskarpatent, who provided assistance and pointed her in the right direction. As a result a patent application came into existence. The description of the invention and the patent claims were written by Lundgren-Åkerlund herself. Since

improvements to a patent could be made within a year following the original application, the application was aimed at merely providing basic protection.

Soon after in 1999 the patent was with the help of Forskarpatent sold to Active Biotech, and she joined as a researcher. This solution provided Lundgren-Åkerlund also with the essential means for conducting further research and development of the idea, thus allowing its true potential to be realized. Yet, the basic protection of the patent rendered a need for rewriting it. This was done at Active Biotech, and in the end the number of claims was almost ten folded.

4.3.2. Sale back, forming a start-up and seed capital

However, a change in Active Biotech's strategic direction put the project of integrin alpha 10 beta 1 on hold. Having met new people and realizing that this may be possible to achieve by other means, Lundgren-Åkerlund also decided to continue with the idea on her own. She had also met and worked with Per Antonsson at Active Biotech, and as a result she turned to Teknopol, where Antonsson now worked, receiving assistance with general advice in writing a business concept, as well as clarifying the investors' expectations. They also helped her with an initial loan and together with Teknossed, brought in an additional investor, Volito. With assistance from Forskarpatent, the IPRs were then repurchased and Cartela was founded.

Cartela was already from the start focused around a solid idea and has managed to sustain the same vision and strategic direction ever since. Nevertheless, it takes more than just a solid idea to become successful and survive in a harsh environment such as the Biotech industry. From Cartela's point of view, the human resources are the key to survive and ultimately succeed. Therefore the employees are carefully handpicked from both academia and industry. Recruiting takes a "hire for attitude and train for skills" approach, since the company is very small and teamwork is the norm. Capital is injected on a milestone basis and it is important that the individuals are aware of that, to handle the pressure knowing that the company is dependent on its investors.

In the case of Cartela, capital was initially provided by Teknoseed who entered at a very early stage together with another investor named Volito. This capital was essential for allowing the company to survive and Teknoseed states that they were particularly involved in building the financial solution and took the lead responsibility. On the other hand, Lundgren-Åkerlund claims that she has been struggling since day one to attract capital and that it takes a good salesman in order to do so. Her most valuable assistance in this task is the patent portfolio. Nevertheless, the process of finding and convincing venture capitalists to invest is placed high on Cartela's agenda. It is a constant battle and it is essential to convince the investors that the concept is plausible although it might take several years to reach. Cartela strive towards the goal of using their target molecule, integrin alpha 10 beta 1, as a means of treating arthritic disease. In order to attract additional investors, a great extent of groundwork is required. A solid proof of principle is desirable, where the substance is validated through a biomodel, e.g. the substance has documented effect on mice, since it is a strong signal of future potential.

Yet, Teknoseed is still involved to some extent as an equity holder and will eventually make an exit when new investors enter. According to Teknoseed, the most plausible exit is that a large pharmaceutical company will acquire Cartela and a more complex exit is a merger between Cartela and some other entity in order to enter the stock exchange.

4.3.3. Business development and partnering

It is however stated that the business model used since the start has been less suitable when it comes to attracting large amounts of capital, yet Cartela has found it to be a realistic model. A strategic change is now taking place, now aiming to bring substances into the first clinical phases. Previously, Cartela focused on developing substances within preclinical trials, e.g. proving the concept on animals, and the reason for this change is that preclinical substances are substantially undervalued if sold, in contrast to a substance that has reached clinical trials. Naturally a strategy change of this magnitude requires additional funds, which Lundgren-Åkerlund now is searching for. Paradoxically, following the new strategy and the acquisition of large amounts of capital may be easier to ensure than gathering smaller amounts while pursuing the original strategy.

To a large extent Cartela relies on the founders personal network, which has been developed during several years of work within the life science area prior to Cartela's existence. Lundgren-Åkerlund, in the role of being a business developer, has used her network and now reestablished contacts with several of the larger pharmaceutical companies such as Astra, Pfizer, GlaxoSmithKleine and Novartis; perceived as customers and not competitors. Cartela has managed to build a unique knowledge mass, and it is most likely that a trade-sale to a larger corporation will take place at some point in time; mainly due to the fact that Cartela was first with this approach in this particular field with its attractive market lacking effective products for therapy of arthritic disease. Using the ability to create relations, partnering with other companies such as Bioinvent further enabled Cartela to increase its knowledge mass since it ensured access to a comprehensive set of antibodies used for their continuous research.

Cartela is a company which falls under the definition of a knowledge company. Since its value is derived from the minds of the individuals and in order to legally protect the commercially exploitable value, a number of patents have been constructed.

As previously mentioned an initial application was created by Lundgren-Åkerlund in conjunction with Forskarpatent followed by an updated application. Currently there are six published patents, which all have been created with the use of external agents, namely Awapatent and Albihns. Recently Cartela also decided to hire a former employee of Albihns who specializes in intellectual property rights, and this is intended to provide Cartela with a more strategic approach to patenting. Having an intellectual property rights specialist is considered essential since it facilitates for a higher level of codification of knowledge, greater insight into the patent portfolios of competitors as well as monitoring possible infringements on Cartela's patents. The task will predominantly include developing a close working relationship with the

company's researchers, as a means of identifying new discoveries and evaluating at a very early stage if and what to patent.

Cartela consists of a mere 13 individuals of which one is dedicated to managing patents, this proving the level of commitment to patenting. The increased focus is viewed as a part of the maturity process where it is natural to begin with a defensive approach followed by a more offensive approach. An offensive approach is from Cartela's point of view more appropriate when having accumulated a larger portfolio of patents and when a more aggressive overall strategy is used.

As in many industries it is possible to circumvent the patents, however the human body sets limits and even if it is possible to find other integrins with similar functions, the patents cannot be completely circumvented. It may also be possible to find other ways of treating arthritic disease, however Cartela's approach is unique and efficiently legally protected. Lundgren-Åkerlund affirms: "…without patents we would not have anything, we would not be able to attract any capital".

4.3.4. Patent portfolio

Cartela's patent portfolio is built around the initial patent which acts as an umbrella under which the other more narrow patents emerge. The narrow patents provide even greater protection around the central patent, preventing competitors from utilizing alpha 10 beta 1 as a target molecule in several ways. If however an industry actor applied for a patent where the usage of Cartela's integrin as a target is deployed, they will become dependent on Cartela.

As of today, Cartela has six published patents in its portfolio (table 4.1) and the first page of each patent, including abstract, is available in the appendix. But despite having these patents regarding the use of integrin alpha 10 beta 1 as a target molecule, Cartela do not necessarily intend to further develop all the ideas included in the patents by themselves. To be able to reach their vision of developing a treatment for arthritic disease, Cartela needs to keep a narrow focus and continue to conduct research in a limited scope. Yet, related patents will bring a great deal of value through licensing or partnering, and a key note is that all the patents form an important indicator of strength and future potential in the eyes of investors.

No.	Title	Priority date
1	An integrin heterodimer and a subunit thereof (alpha10beta1)	April 1998
2	An integrin heterodimer and a alpha subunit thereof (alpha11beta1)	June 1999
3	Knockout mice and their use	April 2002
4	Marker for stem cells and their use	June 2002
5	Methods and uses of the integrin alpha 10 chain, for preventing progression atherosclerosis plaque formation	June 2002
6	New monoclonal antibody capable of binding integrin alpha 10 beta 1	April 2003

Table 4.1 Cartela's patent portfolio (published)

The first patent is the foundational patent that was written by Evy in 1998, soon sold to Active Biotech and later repurchased when Cartela was to be started. The foundational patent (1) is very encompassing; the sequence in itself for one but also the various ideas for possible applications. Such encompassing claims would not be approved in a patent application if it was to be submitted today. The set of guidelines have become limited since then. Today you would be forced to withdraw some claims and save for later usage.

The second patent protects the usage of another closely related integrin, alpha 11 beta 1. This integrin was discovered by a research colleague of Evy and the patent was later purchased by Cartela.

The third patent is interesting since it protects the use of mice from which the gene for integrin alpha 10 beta 1 has been removed. The intent is to use the mice as a model for studying possible diseases that mice without the gene might develop; as a consequence it effectively blocks the competitors from performing similar research. Although in the event that these mice become important models for performing some type of screening, Cartela can capture revenue from licensing.

The fourth patent protects the usage of alpha 10 beta 1 as an efficient marker for stem cells, enabling the sorting of stem cells from bone marrow to make new tissue. For instance, one could gather stem cells in a simple step with this marker and subsequently make cartilage in order to heal cartilage damage. Still, this area is not in Cartela's focal area of research and they are now seeking a partner to license this usage of alpha 10 beta 1, yielding additional revenue from licensing.

The idea protected in the fifth patent is not yet developed, but may turn out to be very interesting in the area of atherosclerosis (the same area of treatment as for substances developed by Esperion Therapeutics). The idea came out of a collaborative project with Lund University. The discovery was that plaque in veins begins to produce cartilage molecules; for some reason the cells in a vein start performing the wrong task. Possibly, alpha 10 beta 1 can be an effective target used to prevent atherosclerosis, plaque in the veins. If that becomes the case, this is something most likely to be out licensed as well.

The sixth patent constitutes an important milestone reached for Cartela. The patent protects an antibody that binds to alpha 10 beta 1 and can send a signal through the integrin to the cell core. An antibody can be a product in itself; it is seen as a tool in the attempt to manipulate the cell. Finding a suitable antibody has demanded years of research and was made possible through the partnering with Bioinvent, who provided the technology to develop human antibodies.

5. Discussion and conclusions

This chapter presents an analytical discussion on the empirical results and how we perceive the interaction of intellectual capital components. This includes a number of plausible conclusions on how innovation capital might be viewed and portrayed in a technology rich start-up over a longer period of time.

5.1. Analytical discussion – Elevating innovation capital

To recapture, in the theoretical analytical framework it is evident that intellectual capital is comprised of three forms of capital which have to interact in order to achieve value; with the interaction illustrated in the IC value platform and the corresponding concept of generative assets in the intangible value chain. It is also suggested that innovation capital is generated in this interaction and that it, as a part of the IC landscape, should be regarded as the future earnings potential. Apprehending this notion, we compare this to the idea of commercially exploitable assets and the derived marked value added, shown in the intangible value chain. With these concepts at hand we may portray how this IC rationale is evident in the case.

5.1.1. Technology Transfer – deploying generative assets

Initially Evy Lundgren-Åkerlund turned to Innovationsbron Syd and Forskarpatent i Syd AB, carrying an embryo of innovation capital, opting for the pathway of licensing her invention. Thus, in order to leverage the value of the idea, Forskarpatent i Syd AB triggered and provided the means of interaction through the selling of the invention to Active Biotech. As a consequence the capital forms needed to foster the embryo became accessible.

With the value platform in mind, Active Biotech's processes, offices and equipment represented structural capital; the human capital was embodied in Active Biotech's employees assigned to the project as well as Lundgren-Åkerlund joining the company. The relation capital came with the organizations existing relations. With these forms of capital, an adequate environment emerged in which the embryo could be developed. In our perspective, Forskarpatent i Syd thus found the desirable generative assets needed to embrace the embryo and continue to build innovation capital. Yet, the renewal capability was already present to a large extent, embodied in the preexisting IC of Active Biotech.

However, when Active Biotech altered their strategy the embryo did no longer fit within the research portfolio. Consequently the intent was lost, leaving Lundgren-Åkerlund with her invention without the support of neither form of capital. This

became even more evident when Lundgren-Åkerlund left Active Biotech and repurchased the patent, basically returning to square one.

In order to reinstate the embryo in a fostering environment new generative assets needed to be gathered, and Lundgren-Åkerlund again turned to Innovationsbron Syd. In this sense the technology transfer entity facilitates the deployment of human, structural and relationship capital, subsequently establishing a platform where generative assets can be formed as well as interact; enabling the elevation of innovation capital. For example Teknoseed, in addition to capital injection, also provided human, structural and relational capital; having Adam Schatz as a board member providing management support, translates to human- and structural capital.

Similarly Teknopol assisted with clarifying the terms expected by venture capitalists, initially Volito, bettering the conditions for Lundgren-Åkerlund in building the relational capital of Cartela. Obviously the platform establishes the right conditions to form generative assets and thus the potential of building commercially exploitable assets. Nevertheless the platform is bound to change when the startup is expected to self perpetuate, thus altering the composition of generative assets, i.e. bringing in additional human capital and improving structural capital. Yet, the platform is highly dependent of the initial human and relational capital carried by Lundgren-Åkerlund, stressing the importance of the entrepreneur's capability.

5.1.2. Interaction between generative assets

The story of Cartela reveals how the three forms of capital interact and thereby the growth of innovation capital. Lundgren-Åkerlund has handpicked employees with the intent of creating a tightly integrated team able to work under less than perfect conditions, building the human capital. Of course employees need to be competent but the right attitude is stressed, revealing that human capital is more than just knowledge. These employees are multiplied with structural capital through tightly integrated work processes. Research results, goals and the vision of reaching a therapeutic product, are routinely evaluated and shared amongst employees, thereby incorporated into work processes.

In coherence with the conclusions of Zahra (1996), we may observe that the founder of Cartela places a considerable interest in the fate of the venture and that a sense of risk taking is present. The autonomous venture clearly benefits from the undisputed entrepreneurial drive encompassed in the human capital of the founder.

Collaborative research conducted with university partners as well as BioInvent constitutes the impact of relational capital. The border between relations belonging to the organization and the individual is somewhat fuzzy. An example of this phenomenon is Lundgren-Åkerlund's pre-existing relations with individuals working for large pharmaceutical companies, in this stetting constituting a potential buyer of Cartela. Similarly, relations with investors such as Teknoseed would be regarded as relationships belonging to the organization through contractual agreements. Yet, attracting capital might be highly dependent on personal relations. Having established a relationship with a partner such as BioInvent, is also a strong indicator of organizational fitness and capability in establishing collaborative research partnerships.

Evidently, Cartela has built upon the embryo of innovation capital, producing new inventions and aggregating a mass of knowledge, thus showing their renewal capability finally embodied in several patents. The accumulated value of the innovation capital, i.e. the market value added, is the combined effect of two more or less correlated occurrences; reduced uncertainty and elevated knowledge mass. While the aim of conducting research is to accumulate knowledge and reach proof of concept, a positive side effect is reduced uncertainty which in turn yields a lower risk premium. The concept is simple, reducing the risk premium equals an increased market value and reduced uncertainty also aids the acquirement of additional funding. A fundamental prerequisite of reducing uncertainty is a buttressing of the innovation capital via thorough patenting. The importance of transforming knowledge into patents is as well reflected in Cartela who recently employed an intellectual property specialist with the sole purpose of facilitating a higher level of strategic patenting activities.

5.1.3. Analytical discussion summary

Having discussed the different occurrences that take part in the progression of innovation capital, it enables us to distinguish the primary aspects and their interrelation, illustrated in figure 5.1 and 5.2.

The technology transfer entity provides the means to establish a platform where the entrepreneur can build its own generative assets. By handpicking its human capital, constructing work processes and establishing relations with external parties, the firm starts building the value platform and the interaction commences. Whilst the interaction, working towards the vision of a therapeutic product, is increased, the ability of renewal is improved and results start to amass, thus innovation capital is elevated. The results may be seen as an accumulated mass of explicit knowledge. The mass is in need of safeguarding in order to appropriate the rents from innovation and hence the use of patent protection is put into effect, turning intellectual assets into intellectual property rights.

The value from this is derived from two aspects: commercial value of safeguarded explicit knowledge mass (SEKM) and degree of uncertainty (DoU). This matches up to the corporate valuing mechanism, market value added, argued to be the most appropriate in the intangible value chain. Whereas the safeguarded explicit knowledge mass translates into potential commercial value (PCV), uncertainty degree renders a risk premium (RP). Thus, market value added (MVA) can be easily explained: MVA = PCV – RP.

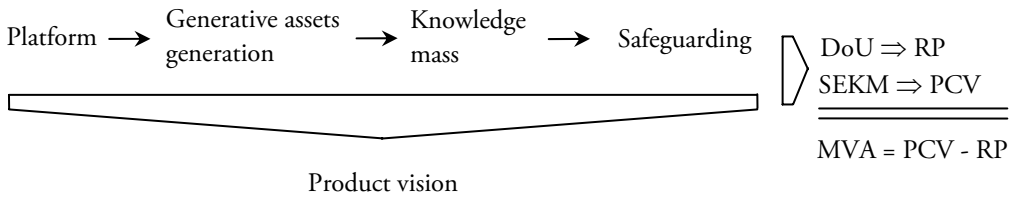

Figure 5.1 Interrelation of primary elements (Alvén & Ekelund, 2006).

Although the interrelations of primary elements portray the derived market value added as well as the awareness of an ultimate product vision, we may simplify the elements and show this in the combined perspective of the intangible value chain and the IC value platform (figure 5.2).

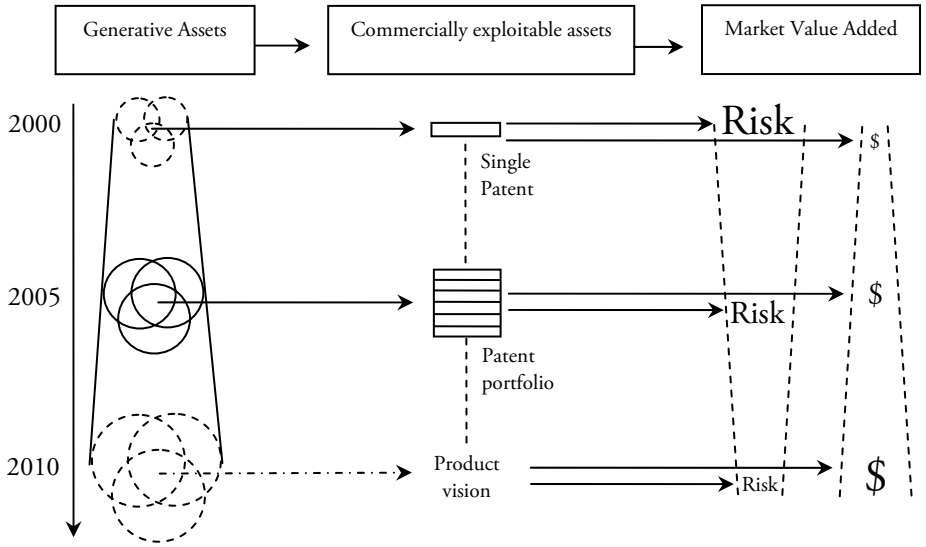

Figure 5.2 The value chain perspective (Alvén & Ekelund, 2006).

Taking into account the impact of time, we clearly see the benefits of forming a start-up, cultivating the innovation capital embryo over time. Several of the interviewees frequently underlined the economic gain to be seized by forming an autonomous start-up, compared to the option of licensing the innovation. Again, the impact of reduced risk by continuously building on the innovation and thereby obtaining proof of the fundamental concepts potential is apparent. Naturally, the realized economic gain to be captured by the inventor is substantially reduced when opting for a licensing solution. The whole matter is a question of who wants to bare the risk encompassed in an unproven innovation and carry the cost of proving its potential, whether it's the inventor or a licensing partner.

6. Visualizing innovation capital

Our concluding thoughts on the interaction between generative assets, translated into the concept of innovation capital, can be summarized into an illustrative comprehensive model portraying the value and progression of innovation capital. The value perspective of the model emphasizes the impact of time and uncertainty. We also discuss the relevance and explanatory power of this model.

6.1. A model for visualizing innovation capital

The model contains two mirrored perspectives describing innovation capital and derived market value added. Both dimensions are highly subjective in nature since estimates are based on perceived elevation.

The innovation perspective (figure 6.1) depicts the agglomerated explicit knowledge mass and the continuous buttressing of patents, safeguarding the intellectual assets. The accumulated knowledge mass indicates previous renewal capability as well as future efforts needed to reach the desired milestones. Knowledge in this aspect refers to intellectual assets with potential commercial value that can attain legal protection, such as the discovered usage of a specific integrin in treating arthritics. The innovation perspective is an agglomerated view of total achieved knowledge mass; this can of course be dissected into separate research directions, however still based on a foundational innovation.

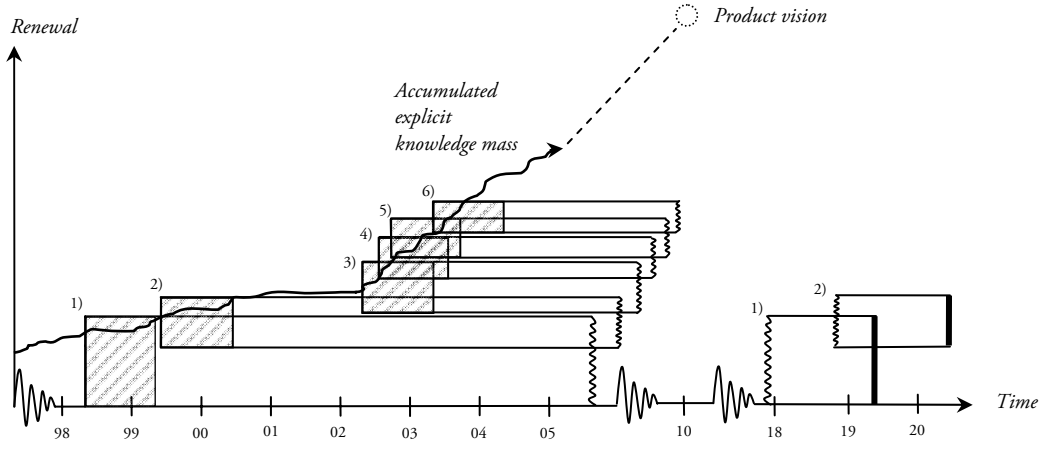

Figure 6.1 The perspective of renewal and safeguarding (Alvén & Ekelund, 2006).

In figure 6.1, intended to visualize the innovation perspective, the various patents (see appendix) related to Cartela are depicted. The illustration of patents is largely based on the patenting models described in the empirical material, but it also includes the characteristics of patenting, such as the priority year and the limited

lifetime, described in the theoretical framework. Building our illustration rationale upon the 'cylinder model' (figure 4.2) as well as the model illustrating the scope of patent claims (figure 4.1); we can depict both a scope and time dimension in figure 6.1. Yet, since the height constitutes a technological – legal scope, the height is highly subjective due to the difficulty of providing an accurate measure related to knowledge mass. Although it is evident that the initial patent should represent a larger share of safeguarded knowledge mass since it builds upon several years of research, prior to the filing of a patent application, as well as it represents the foundational invention.

As previously mentioned, new important knowledge acquired within the priority year, can be included in an updated patent application thus elevating the height during the course of a year. As an example; in the case of Cartela several changes were made to the initial application resulting in an increase of the legal scope represented by the shaded area exceeding the knowledge mass graph. Nevertheless the figure illustrates Cartela's effort of safeguarding the knowledge mass and thereby transforming knowledge into commercially exploitable assets.

Increasing knowledge mass is obviously dependent on various different aspects, yet on a whole it would be considered a result of the interaction between the generative assets. In the case of Cartela this is represented by the continuous work towards finding a suitable therapeutic method, in essence multiplying the human capital with structural capital. For example Cartela's current search for a suitable antibody that can transmit a signal through the integrin to the cell core, where teamwork, routines and the knowledge of the employees constitute the main active ingredients. Another example would be how this search is amplified by partnering with BioInvent, assuring a vast set of antibodies, further enabling the continued increase of knowledge mass. The illustration of a knowledge mass as a curve in figure 6.1 may also display a lack of innovation. In this sense a flat line would constitute a situation where no new knowledge is agglomerated. Likewise, if the line progresses upwards but lack patent protection, thus leaving the knowledge area without safeguarding, this indicates a failure in the management of innovation capital.

Since the innovation perspective highlights commercially exploitable assets, the perspective of derived market value added (figure 6.2) would be more or less a mirrored image. Evident in the empirical findings is the impact of uncertainty on market value. By elevating and buttressing the knowledge mass uncertainty is reduced thereby efficiently lowering the risk premium. Increasing the knowledge thus lowers the risk premium in an interrelated manner.

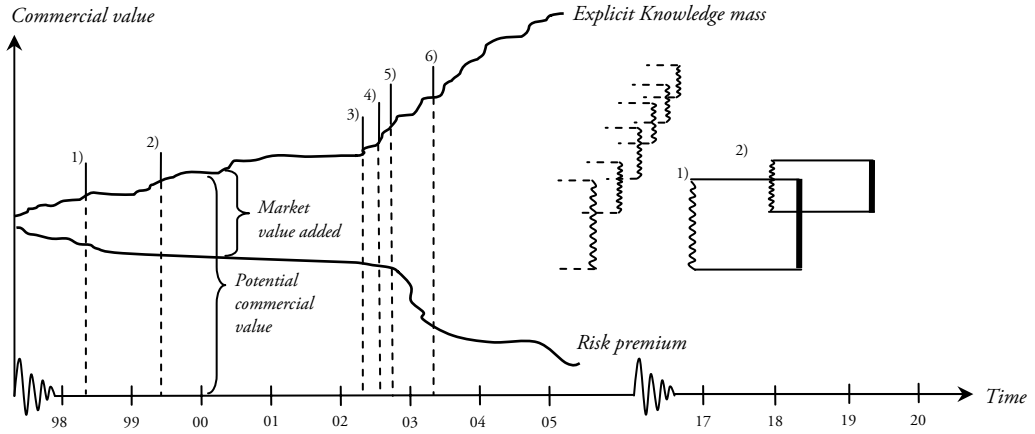

Figure 6.2 The value perspective – derived market value added (Alvén & Ekelund, 2006).

The value scheme underlines the gain of fostering the innovation capital embryo in a start-up venture. Market value added is almost multiplied two fold per additional unit of innovation. However this stresses the importance of continued and intelligent patenting of innovation thus reducing uncertainty for the potential buyer, much like the rationale described in the intangible value chain. Without this safeguarding, this risk premium is not lowered, on the contrary it may even be increased as a result of poor management. An example of this is the hostile patenting of a coating method, being described in the empirical results, which led to a cross licensing situation, certainly reducing the economic gain.

The importance of intelligent patenting is frequently underlined in the empirical findings, especially through the visualized metaphors. This also stresses the importance of a continued renewal capability since patent protection is limited to 20 years. In essence having an updated patent portfolio enables an appropriation of economic rents from achieved innovation.

6.1.1. Explanatory power and relevance

After reviewing the model, we have identified two possible limitations. The first one is with regards to the time dimension. Naturally the model is aimed at describing the emergence and growth of innovation capital over a longer time span, where striving towards reaching one or a few set milestones is evident. Thus, applying the model to a technology setting with a time span less than two or three years would be more or less pointless.

The second limitation is on a different note. In accordance with theory the use of patenting and the forming of bulks of patents in order to safeguard the innovation capital is not done as a means of blocking competitors from producing competitive substitutes, i.e. patent fences are not constructed. This is predominantly due to the lack of knowledge regarding which research path will lead to the most suitable and effective therapeutic method or product, since substitutes for active molecules or equally efficient antibodies hardly ever exist; the nature of the human body cannot be reinvented. Consequently, each industry player places its faith in their own research,

believing it is the correct path in achieving the most efficient treatment. This is also illustrated in the proposed model for innovation capital, where patent safeguarding is fairly simplistic without the usage of sophisticated patenting strategies to hinder competitors from making substitutes. In short, the usage only portrays an efficient safeguarding of the proprietary therapeutic method over time. This leads to the fact that if the innovation capital model would be applied to a complex technology industry, where more sophisticated strategies for constructing patent protection are more common, the illustration of patent buttressing would lack ways to describe the usage of strategies such as a patent fence. Yet, as we also have shown in the empirical findings, the use of such patent strategies is most likely not being made by a start-up firm due to limited resources.

The value scheme incorporates the concept of risk premium, predominantly lowered by reducing uncertainty through the build up and efficient safeguarding of the knowledge mass. However, the concept of uncertainty may be reduced by other means than increasing knowledge mass. For instance, assuring linkage with an important and prestigious investor, the uncertainty might appear as lowered when a potential buyer favors a company having a certain source of funding. Herein, uncertainty lies in the eyes of the beholder.

Moreover, the amount of value derived from innovation is most likely to be dependent on the specific idea and innovation, of course varying in its potential of achieving a market blockbuster effect. For example, this would differ with regards to the specific part of the biotech industry and even therapeutic area. However, this is a fundamental prerequisite for even founding a start-up; ensuring a sufficient market potential. Hence, the model is not foolproof in the sense that although innovation is agglomerated and safeguarded sufficiently, it is not guaranteed that it translates into high market value added. As mentioned, market value added is a subjective concept in nature and the value progression estimation in figure 6.2 is here treated as the phenomenon occurring in a stock market valuation, involving multiple factors being treated with subjective measures. However, the fact that the study supports a market value added rationale to be used in an IC context is apparent in this industry setting where no actual profit is being made. With the intrinsic condition followed by product development lasting several years, economic value added is not a viable measure. This in turn supports Ahonen's (2000) intangible value chain perspective.

Finally, with regards to the relevance of the model in relation to previous work, the model adds a clarifying angle on IC and innovation capital in a longitudinal dimension as well as the buttressed safeguarding of commercially exploitable assets. Of course the deployment of the model is highly subjective in nature, but still provides a mental measuring framework in the process of managing the firm's intangible value progression in a manner that is similar to what Mouritsen (2004) constitutes as the purpose of understanding IC. IC is more concerned about value as a verb, more about the process of valuing than to determine a value. IC is "… not to be evaluated on its reflection of reality but rather on its ability to help actors transform their reality" (Mouritsen, 2004, p.257).

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7.2. Interviews

Per Antonsson, Business Advisor, Teknopol AB, 2005-12-05

Stina Gestrelius, Vice President, Medicon Valley Academy, 2005-11-08

Per-Thomas Karlsson, Managing Director, Wagner Zacco AB, 2005-12-12

John Karlström, Patent Attorney, Awapatent AB, 2005-11-15

Evy Lundgren-Åkerlund, CEO, Cartela AB, 2005-12-16

Adam Schatz, Managing Director, Teknoseed AB, 2005-12-07

Sven-Thore Holm, CEO, Innovationsbron Syd AB, 2005-11-30

Sven Trolle, CEO, Forskarpatent i Syd AB, 2005-12-05

8. Appendix

8.1. Patents

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International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :		(11) International Publication Number:	WO 99/51639
C07K 14/705, A61K 38/17, C07K 16/28	A1	(43) International Publication Date:	14 October 1999 (14.10.99)

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(30) Priority Data:
9801164-6 2 April 1998 (02.04.98) SE
9900319-6 28 January 1999 (28.01.99) SE

(71) Applicant *(for all designated States except US)*: ACTIVE BIOTECH AB [SE/SE]; Scheelevägen 22, S-220 07 Lund (SE).

(72) Inventor; and
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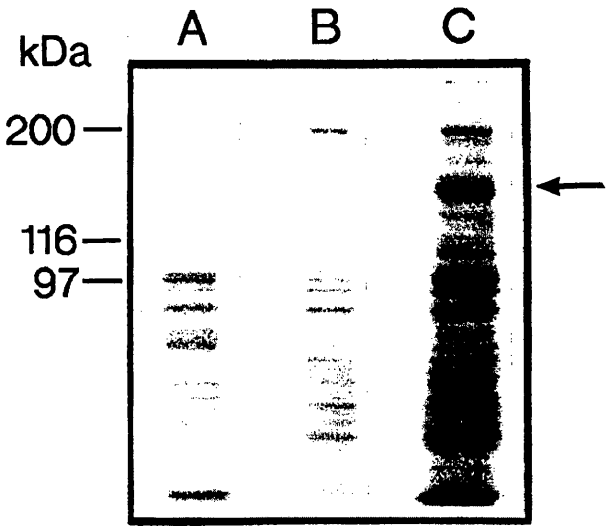
(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: AN INTEGRIN HETERODIMER AND A SUBUNIT THEREOF

(57) Abstract

A recombinant or isolated integrin heterodimer comprising a novel subunit $\alpha 10$ in association with a subunit β is described. The $\alpha 10$ integrin may be purified from bovine chondrocytes on a collagen-type-II affinity column. The integrin or the subunit $\alpha 10$ can be used as marker or target of all types of cells, e.g. of chondrocytes, osteoblasts and fibroblasts. The integrin or subunit $\alpha 10$ thereof can be used as marker or target in different physiological or therapeutic methods. They can also be used as active ingredients in pharmaceutical compositions and vaccines.



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: PCT/SE00/01135

(22) International Filing Date: 31 May 2000 (31.05.2000)

(25) Filing Language: English

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(30) Priority Data:
9902056-2 3 June 1999 (03.06.1999) SE

(71) Applicant *(for all designated States except US)*: **ACTIVE BIOTECH AB** [SE/SE]; Box 724, S-220 07 Lund (SE).

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(75) Inventor/Applicant *(for US only)*: **GULLBERG, Donald** [SE/SE]; Björkgatan 3F, S-753 28 Uppsala (SE).

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *With international search report.*
— *Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 00/75187 A1

(54) **Title:** AN INTEGRIN HETERODIMER AND AN ALPHA SUBUNIT THEREOF

(57) **Abstract:** A recombinant or isolated integrin heterodimer comprising a novel subunit α11 in association with a subunit β is described. The integrin or the subunit α11 can be used as marker or target of all types of cells. The integrin or subunit α11 thereof can be used as marker or target in different physiological or therapeutic methods. They can also be used as active ingredients in pharmaceutical compositions and vaccines.

Takes the place of EP1496886 (art.158 of the EPC)

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(51) International Patent Classification[7]: A61K 67/27
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(25) Filing Language: English

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(30) Priority Data:
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(71) Applicant *(for all designated States except US)*: **CARTELA AB** [SE/SE]; Biomedical Center, I 12, SE-221 84 Lund (SE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **GULLBERG, Donald** [SE/SE]; Björkgatan 3 F, S-753 28 Uppsala (SE). **LUNDGREN-ÅKERLUND, Evy** [SE/SE]; Trollsjövägen 165, S-237 33 Bjärred (SE).

(74) Agents: **DAHLENBORG, Katarina** et al.; c/o Albihns Malmö AB, P.O. Box 4289, S-203 14 Malmö (SE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 03/101497 A1

(54) Title: KNOCKOUT MICE AND THEIR USE

(57) Abstract: Non-human mammals and their progenies comprising an integrin alpha10 gene, integrin alpha11 gene, or both genes are provided, wherein at least a part of the integrin alpha10 gene, the integrin alpha11 gene, or both genes, of said non-human mammal and its progeny has/have been replaced with a DNA sequence comprising at least a portion of one exon of the integrin alpha10 coding sequence, the integrin alpha11 coding sequence, or both coding sequences, linked to a selection marker sequence. Also included are methods for generating said non-human mammals with a disrupted alpha10 gene, a disrupted alpha11 gene or both genes disrupted, as well as the use of said non-human mammals.

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(71) Applicant *(for all designated States except US)*: **CARTELA AB** [SE/SE]; Biomedical Center, I 12, SE-221 84 Lund (SE).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **LUNDGREN-ÅKERLUND, Evy** [SE/SE]; Trollsjövägen 165, S-237 33 Bjärred (SE).

(74) Agents: **ALBIHNS MALMÖ AB** et al.; P.O. Box 4289, S-203 14 Malmö (SE).

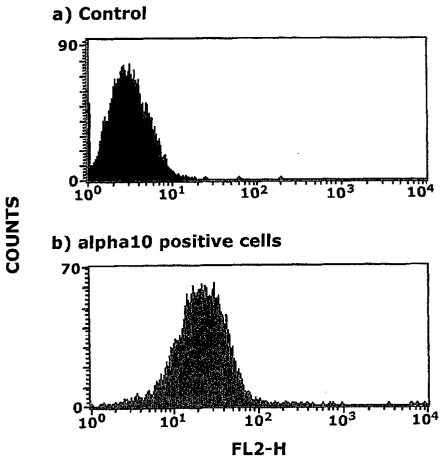
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:
— *of inventorship (Rule 4.17(iv)) for US only*

[Continued on next page]

(54) Title: MARKER FOR STEM CELLS AND ITS USE



(57) Abstract: A marker for mesenchymal stem cells (MSC) is provided, comprising an integrin alpha 10 chain and/or an integrin alpha 11 chain expressed on the cell surface of or intracellular in a MSC. The marker is used in methods for identification of mammalian MSC and in methods for isolation of MSC. Also included are isolated cellular populations of mammalian MSC and a cellular composition comprising the latter. Moreover, uses of said marker for isolation, modulation and identification mammalian MSC are provided.

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(21) International Application Number: PCT/SE03/01012

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(25) Filing Language: English

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(30) Priority Data:
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60/388,747 17 June 2002 (17.06.2002) US

(71) Applicant *(for all designated States except US)*: **CARTELA AB** [SE/SE]; Biomedical Center, I 12, SE-221 84 Lund (SE).

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(75) Inventor/Applicant *(for US only)*: **LUNDGREN-ÅKERLUND, Evy** [SE/SE]; Trollsjövägen 165, S-237 33 Bjärred (SE).

(74) Agents: **ALBIHNS MALMÖ AB** et al.; P.O. Box 4289, S-203 14 Malmö (SE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

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(54) Title: METHODS AND USES OF THE INTEGRIN ALPHA 10 CHAIN, FOR PREVENTING PROGRESSION OF ATHEROSCLEROSIS PLAQUE FORMATION

(57) Abstract: An antigen indicative of the presence of atherosclerotic plaque is provided. The antigen is used in a method for slowing or arresting progression and/or effecting regression of atherosclerotic plaque in a mammal, comprising administering to the mammal a binding agent having binding sites specific for said antigen of said mammal. Also included are methods for diagnosing a mammal who has a risk of developing atherosclerosis, comprising determining the amount of said antigen. Moreover, uses of said antigen for detection and diagnosing atherosclerosis is provided.

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(21) International Application Number: PCT/SE2004/000580

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60/320,112 16 April 2003 (16.04.2003) US

(71) Applicant *(for all designated States except US)*: **CARTELA AB** [SE/SE]; BMC, B 12, LUND, 221 84 (SE).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **LUNDGREN-ÅKERLUND, Evy** [SE/SE]; Trollsjövägen 165, BJÄRRED, 237 33 (SE).

(74) Agent: **ALBIHNS STOCKHOLM AB**; Linnégatan 2, Box 5581, S-114 85 Stockholm (SE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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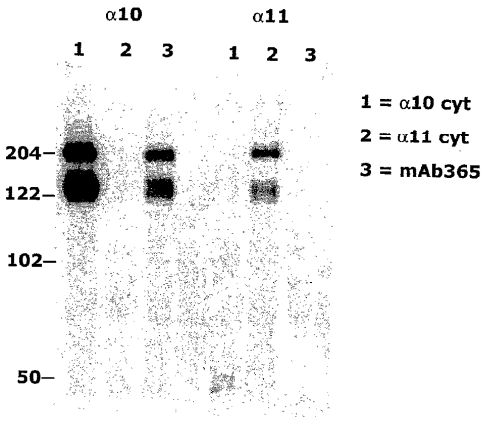
(54) Title: NEW MONOCLONAL ANTIBODY CAPABLE OF BINDING INTEGRIN ALPHA 10 BETA 1



(57) Abstract: The present invention provides a monoclonal antibody or a fragment thereof binding to the extracellular I-domain of integrin alpha10beta1 and a hybridoma cell line deposited at the Deutsche Sammlung von Microorganismen und Zellkulturen GmbH under the accession number DSM ACC2583. Furthermore, the present invention also provides a monoclonal antibody or a fragment thereof binding to the extracellular I-domain of integrin alpha10beta1 produced by the hybridoma cell line deposited. Methods and uses of said antibody or a fragment thereof in identifying and selecting cells of a chondrogenic nature for treatment purposes, in particular for the identification and isolation of chondrocytes, mesenchymal progenitor cells and embryonic stem cells for tissue engineering of cartilage, or for identifying diagnostic and therapeutic tools in studying the biological role and the structural/functional relationships of the integrin alpha10beta1 with its various extracellular matrix ligands are also included.

WO 2004/089990 A1