UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master Degree Project in Innovation and Industrial Management

Creating Innovators

A case study on University-Industry Collaboration

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ABSTRACT

The ever accelerating technological and societal development require firms to become more innovative to keep up with competition. Increasingly, companies engage in external innovation networks to gain insights and support through partnerships, and a part of this development is that industry engage in partnerships and collaborations with university. One group within university that possess a tremendous innovative power are graduate students, and they are not being offered enough opportunities to connect with external partners. Both students and industry could gain several benefits from closer collaborations but this is still a rather underdeveloped area. Research in this area has been focused on collaborations on a more advanced and institutional level of collaboration so the purpose of this thesis has therefore been to examine how students and industry can collaborate and what value this can generate. The research has been conducted through a qualitative multiple case study on multidisciplinary collaboration models, in combination with a brief quantitative pilot study. Findings indicate that the value participants can get out of collaborations depends on their commitment to the process. Industry can contribute as sponsors and provide students with all the benefits of solving real problems in action oriented environments, but firms stand more to gain if they were to participate on equal terms as students. However, close collaborations are hindered by misalignments between corporate and academic culture, and a lacking understanding for the potential value that can be achieved.

Keywords: *collaboration, co-innovation, multidisciplinary, knowledge transfer, knowledge creation, creativity, project based learning*

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LIST OF ABBREVIATIONS

UIC	University industry collaboration (links / relationships)
ICT	Information and communication technology
R&D	Research and development
NPD	New product development
PBL	Project based learning
DT	Design thinking
TM	Talent management

DEFINITIONS

Co-creation
Broadly defined as the creation of value by consumers and more specifically as; "The joint creation of value by the company and the customer; allowing the customer to co-construct the service experience to suit their context" (Prahalad and Ramaswamy 2004).

Collaboration
Cooperative arrangement where two or more parties, which may or may not have any previous relationship, work jointly towards a common goal (businessdictionary.com). An effective method of transferring know-how and critical to knowledge management in organisations.

Cooperation
Voluntarily arrangement in which two or more entities engage in a mutually beneficial exchange instead of competing, but each party can have various reasons for it. Cooperation can happen where resources adequate for both parties exist or are created by their interaction (ibid.).

Innovation
The term innovation can be adapted to a range of purposes and meanings, and by analysing some 60 definitions of innovation, Baregheh et al (2009) propose that innovation is "the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, to advance, compete and differentiate themselves successfully in their marketplace." This definition is chosen for the thesis since it defines that innovation is both a process and that it must generate value.

Innovation process
Innovation defined as a process, entail several phases and these are defined as creation, generation, implementation, development and adaption (ibid.).

Discontinuous innovation
Also referred to as radical innovation, causes paradigm shifts in science, technology or market structure of industries, are new-to-the world, and thus entail a learning curve for both incumbent firms and users (ft.com/lexicon).

Incremental innovation
Simply put, this is the opposite of radical innovation. It is the definition for the continuing improvement of existing products, services and practices (ibid.).

Disruptive innovation
This is similar to discontinuous innovation, but not necessarily totally new-to-the world. It is context specific to the challenges incumbent firms face in developing new ideas. An innovation that creates a new market and value network and eventually disrupts an existing market and value network, displacing established market leading firms, products and alliances (Christensen 1995). It can come in the form of new organizational practices, new business models or new technology.

Talent Management

Defined by Davies and Davies (2010) in McCracken et al (2016) as the "systematic attraction, identification, development, engagement/retention and deployment of those individuals with high potential who are of particular value to an organisation", refers in this thesis to the graduate student recruitment process of companies.

Value

Value is an ambiguous term that can have several different meanings, such as economic, ethical or semiotic (Debreu 1959). Since this thesis is conducted to assess output from collaboration, the term value is regarded as a determinant of benefit that participants can gain, thus, value is analysed through the economic perspective. *Theory of value* comprises how and on what basis economic value can be measured, but this lies beyond the scope of this research paper, as no attempt is made to compare or evaluate different value outcomes. In this paper, the term value is simply used as a term to describe perceived outcomes.

1 INTRODUCTION

1.1 BACKGROUND

1.1.1 THE INNOVATOR'S DILEMMA

In many industries innovation is now the primary driver of competitive success. The globalization of markets and advances in information technology and computer-aided design and manufacturing have resulted in shorter product life cycles and increased competition (Schilling 2013). In many industries products developed within the past five years stand for more than one third of revenues (Barczak et al 2009) and firms are increasingly dependent on new product development (NPD) and innovation. As described by Schumpeter (1934), capitalism is dynamic and evolutionary, constantly subjected to creative destruction where new products and processes replace old ones, and non-innovating firms will inevitably also eventually be replaced. Thus, firms constantly need to seek innovation opportunities, and these can come from a range of different sources; they can be purely technological, or come from unexpected events, process needs, changes in industries and markets, demographics, or public perceptions. In the face of radical technological innovations, a persistent theme is that incumbent firms rarely manage to adapt to changes, and as a result they go into decline (Hill & Rothaermel 2003). Even though these are the firms with the most resources at their disposal, they often lack the capability to adapt to market changes and they are constantly faced with the threat of new entrants. This problem is intuitively described by Clayton Christensen as the "Innovator's Dilemma", in his book with the same name, in which he labels the threat to incumbent firms as disruptive innovation. Even well-managed companies tend to fail with time, and Christensen (2000) explains that this occurs because the pursuit for higher margins and production volumes tend to make managers biased toward serving their existing customers' needs, instead of searching for and investing in new opportunities. Eventually, though, even the most loyal customers will switch to newer technologies offered by competitors if it is superior enough.

1.1.2 EXTERNAL SOURCES OF INNOVATION

Faced with this dilemma incumbent firms seek opportunities to increase their innovation capabilities and recent studies on corporate innovation have revealed a growing importance of external sources of innovation power; organizations rely increasingly on external sources through inter-organizational innovation networks (Perkmann & Walsh 2007; Nissen et al. 2014). Traditionally, innovation processes have predominantly been internalized to corporate R&D departments but the new paradigm of open innovation, introduced by Chesbrough (2003), is changing the way businesses innovate. The open innovation paradigm views R&D departments as open systems, available to multiple external agents, as opposed to traditional closed innovation. Open innovation suggests that new ideas can come both from inside and outside the company (Chesbrough, 2003), and approaching innovation through inter-organizational networks enable stakeholders to engage in research projects that would be impossible for any one party to do on their own. As an example of this new paradigm, many firms elect to engage in crowdsourcing of innovation, providing the firms with a large scope of

perspectives and ideas, offering unparalleled opportunities (Boudreau & Lakhani 2013). Besides the evident benefits of pooling resources, cross-sectoral collaborations involving different stakeholders can also generate benefits from being interdisciplinary (von Hippel, 1988). This makes sense since knowledge creation and innovation is a socially embedded process (Brown & Duguid 1991; Lundvall 2007), meaning that it requires personal interactions; when people with different backgrounds and experiences meet is usually when unexpected innovations emerge.

1.1.3 INNOVATION THROUGH COLLABORATION

Organisations can attempt to generate innovations through various collaborative approaches, and several innovation concepts have been put forward to describe them. Firms engage in open innovation with a range of external actors, through strategic alliances and inter-industry ventures (Hagedoorn & Duysters 2002), inter-firm collaborations throughout the value chain (Li & Vanhaverbeke 2009), in market collaborations with different customers (Christensen & Bower 1996; von Hippel 1988), and in collaborations with academia and government through the triple helix approach (Etzkowitz & Leydesdorff 2000). Triple Helix in this context, refers to the capitalization of knowledge through university-industry-government collaboration and has become an increasingly important source of innovation. Traditionally, the role of university has been to focus on an "endless frontier" of long-term basic research and education, but universities are now pressured to fulfil a "third mission" of contribution to government, society and the private sector (Etzkowitz & Leydesdorff 2000). The purpose and position of universities is still a debated issue, but today universities are expected to take a more active role in technology and knowledge transfer as part of a national system of innovation (Lundvall 2007). The role of universities is currently changing around the globe as more institutions engage in university-industry collaborations (UIC) (Ankrah & Al-Tabbaa 2015) and lately, there has been a significant increase of UICs in several nations including the United States and the European Union. This trend is fuelled by the societal pressure on universities to become engines of economic growth, and as previously mentioned by pressures on industry from rapid technological advances, shorter product life cycles, and intensified global competition (ibid.).

1.2 PROBLEM DESCRIPTION

1.2.1 THE TRIPLE-HELIX MODEL

Triple-helix collaborations most notably take the form of science parks and are a prominent example of open innovation, where the knowledge and resources of academic institutions are applied to benefit society. Government is the third party, resulting in the triple helix form, and is often an important initiator and source of funding. Since government usually provide a great deal of funding, the objectives of triple helix collaborations are often formulated to benefit society. This often mean that triple helix collaborations take on large societal problems that lie outside the reach of individual universities or corporations. The projects usually depend on substantial investments and due to the complex nature of the targeted problems, the academic and professional participants are seasoned researchers and to some extent PhD students. Partnerships and collaborations with academia have proven to be a great source of innovation capacity for industry (Viale & Etzkowitz 2010), and many firms are increasingly exploring

different possibilities for extending these collaborations to include students at a greater degree. Triple helix collaborations are relatively frequent and continually generate useful results, however, they don't directly benefit ordinary students going through higher education. Collaborations between university and industry, with an emphasis on students' interaction with companies, can be an efficient way of bridging a divide that still exists between academia and industry. Students could, similarly to other external stakeholders such as consumers, offer fresh and radical alternative viewpoints on innovation processes at firms, alleviating the innovative inertia that large corporations often become victims of. Additionally, many students will eventually enter the job market and become part of the corporate innovation sphere, so co-creation projects between students and firms can both serve as a source of innovation and alleviate the student's path into the job market.

1.2.2 STUDENTS AS INNOVATORS

Opportunities for students to interact with and engage in co-innovation with companies exist in several different forms. In the Swedish educational context, the main opportunities for industry integration are internships, industry cases in university curricula, and thesis projects in collaboration with companies. These collaborations enable students to gain greater insights into industries and offer an opportunity for students to apply their knowledge to practical problems. However, despite that Sweden ranks very high internationally in terms of collaboration between industry and higher education (OECD 2015), our initial pilot survey targeted at Swedish graduate business students and professionals (Appendix A), revealed strong support for our own perception, that Swedish university educations should include more collaborations with industry. This contradiction can be explained by the fact that the clear majority of university-industry collaboration is conducted on a higher level, such as through science parks, or in highly specialized educational contexts, such as applied engineering programs. In terms of open innovation, there is also an issue regarding the openness of current collaboration practices between students and industry. The aforementioned approaches may enable students and firms to connect and collaborate, with the benefits of increasing employability and solving problems for the companies, but the potential for unexpected innovations and the scope of innovation is limited through these collaboration models. None of the models accommodate open idea sharing and co-innovations, as the projects are targeted at problems posed by the partnering firms and often only include a limited number of students. Opportunities for students to engage in interdisciplinary innovation are limited in the Swedish context, but do exist in other parts of the world. This mode of co-innovation has proved to be a powerful source of innovation and can be a remarkably enlightening experience. Triple helix collaborations often include a variety of disciplines and there exists an opportunity and a potential for increasing the innovation power by extending these practices to the graduate level.

1.3 RESEARCH GAP

We are in the middle of a transformational age; but educational institutions still use curriculums that emerged in the mid-20th century (Freeman 2014). Despite a growing debate over the evolving role of universities (ibid.), there exists an evident lack of co-innovation opportunities for graduate students and industry that prevent potential innovations from taking place. A

recent study on the very topic of multidisciplinary interactions between students and industry partners revealed that it is a topic that has received very little attention (Huhtelin & Nenonen 2016), but that it is potentially very promising. On one hand, we see that industry needs external innovation sources, and on the other hand we have students who don't feel that they get to collaborate with companies enough. The topic is relevant to study to increase understanding of how interdisciplinary co-innovations on the graduate level can create value for those involved. This mode of collaboration could greatly complement current co-innovation processes as it would enable greater exploitation of the innovative capacity of graduate students.

1.4   RESEARCH PROJECT BACKGROUND

This research project is conducted in partnership with a corporate innovation network named *Innovation Pioneers*. This is a network of global leading firms, founded in 2008 to support collaborations and innovation-thinking[1]. The network exceeds 50 member firms that meet every quarter for single topic think tank meetings to exchange ideas and collaborate on new concepts. A project has been initiated by a group of member firms within the network, with the objective to increase the opportunities for collaboration with students. The initiating firms are CGI, Stena, Volvo Cars and SKF, and they share the consensus that firms should be able to interact more closely with graduate students for the purposes of both recruitment and innovation. As a complement to current practices, the group have an idea of a collaborative arena where firms and students from different backgrounds can meet and interact, and this conceptual vision has inspired the focus of the thesis. The project is in the idea stage and the findings of this thesis has been shared with the group to further their work on the topic.

1.5   CASE STUDY CONTEXT

To gather knowledge about solutions and approaches to the problem, a wider initial research study was conducted. The research revealed that there are multiple student-industry links that either target innovation through a varying degree of collaboration, or that focus on recruitment and talent scouting. In the global and the Swedish context, students can connect with companies through many different types of models. These differ in terms of how closely students and companies interact, and what purpose they are designed for. A selection of models that have emerged through this study are mapped in figure 1 below, this is a positional matrix constructed based on the identified characteristics of the models.

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[1] IP (2017)
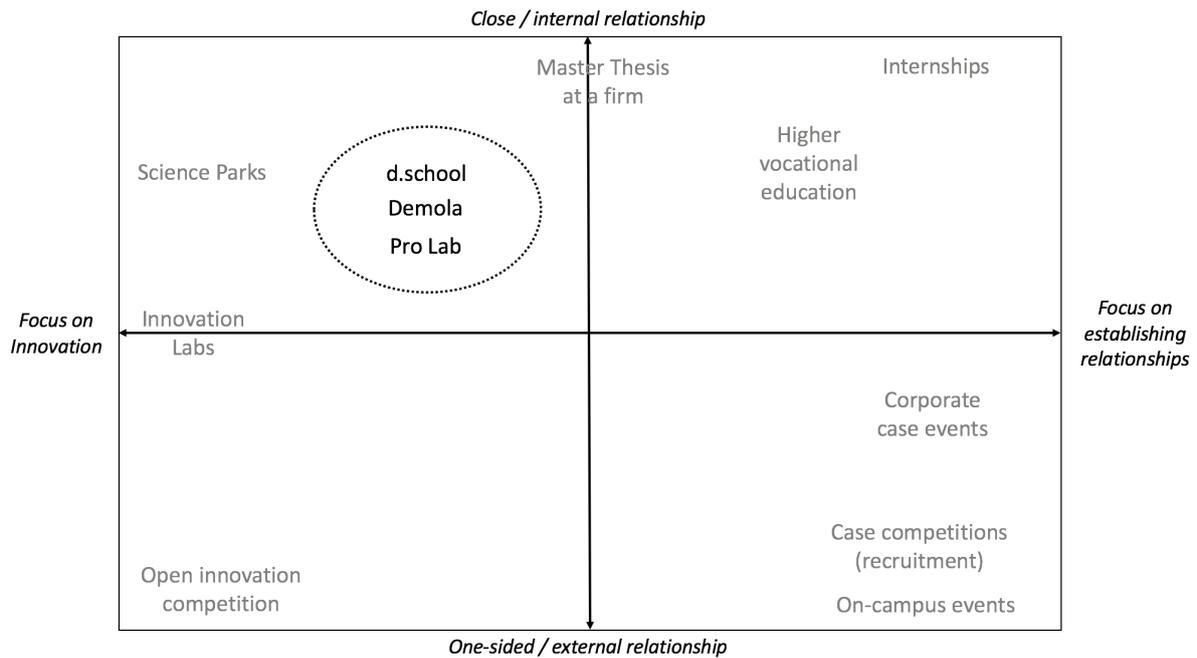
Figure 1-1. Mapping of modes of collaboration between students and industry.

The figure shows how different concepts are positioned, and those concepts identified to be of high relevance are highlighted in the figure. As the figure shows, models of student-industry interactions differ in terms of focus or purpose and mode of interaction. Additionally, one can see from the model that many interactions are formed to alleviate recruitment through establishing relationships, and by doing so, potential innovation power is neglected. Since this study is aimed at co-innovation between students and companies, models that are positioned in the upper left quadrant of the matrix are most relevant. There are some models that either clearly or partly have this focus, that despite this are less relevant. These are Science Parks, Innovation Labs and Thesis projects. The thesis project model is not relevant as it is not interdisciplinary, nor open, since it is conducted by one or a small group of students and often at the facilities of the partnering firm. Science parks on the other hand are often highly interdisciplinary and engage parties in close collaborations. Collaborations on this level, though, are often focused on advanced levels or large scale research that involve massive resources and specialized researchers working on long term projects, they seldom include graduate students and encompass a larger scope than what this study is aimed at. Finally, innovation Labs have a very strong focus on independent open innovation, often with a focus on social innovations, making the model less relevant for industry centred collaboration projects.

The models that are of high relevance to the study were identified as Stanford d.school, Demola, and ProLab. These are concepts that in different ways enable interdisciplinary co-innovation opportunities for graduate students, in close collaboration with industry and they are the empirical base of this study.

1.6 OBJECTIVE

The purpose of this exploratory research on the topic of interdisciplinary co-innovation is to determine how and why companies and students engage in such forms of collaboration, and how existing models have been created and designed, to further the knowledge of how this type of collaboration can generate value.

1.7 RESEARCH QUESTION

The observed problem and the purpose of the study has lead us to the following research question;

How can multidisciplinary collaboration generate value for students and firms?

Value is an ambiguous term, and the perceived value that can be attained from something is highly dependent on the recipient. A specific event can be perceived to generate different value to various actors, so to answer our research question, we firstly focus on exploring why industry, students and university engage in collaboration, what may prevent them from doing so, and what the outcomes can be. By having done so, when we analyse the design of the targeted collaboration model, we will be able to assess the potential value that it can generate to the participating actors.

1.8 DELIMITATION

The study has been targeted at the specific demographic group of graduate students, and does, thus, not include concepts of co-innovation on higher levels of education. The focus of the study has been to identify methodologies for idea generation, idea sharing, and co-creation of new concepts. It does not cover later stages of the creative process. Since the purpose of the study has been to research the gap between academia and industry, the focus has been on co-innovation with external stakeholders, and not internal co-creation within universities.

1.9 THESIS DISPOSITION

Theoretical framework - This chapter covers relevant knowledge from our literature review, starting with a general perspective on innovation and collaboration and gradually moving into the specific context of co-innovations between academia and industry. It is structured according to stakeholder perspectives.

Research design & methods - This chapter covers the grounds for the thesis project and how it has been conducted. In this section, we clearly present all our data sources and research techniques, and explain the rationale for choice of approach.

Results - This chapter contains a summary of the findings gathered during the thesis process. It consists of data from interviews and observations, and is categorized and structured around the cases of observation and the stakeholder groups. Richer data that can be of interest to the reader are provided in the appendices. The introduction of the chapter consists of a brief description of the background of the studied concepts and the interviewees.

Discussion - In this chapter, the empirical findings are connected to the theoretical framework to find answers to the research question. The chapter is structured according to the previous presented themes.

Conclusions - In this final chapter, we present our conclusions by providing a summary model describing the key findings from our research. The model illustrates the most important barriers to overcome and design factors, as well as the potential outcomes that can be generated.

Structure for presentation and analysis

The core sections of the thesis have been structured to fit the research objectives.

Table 1-1. Thesis structure.

	Needs and motives	**Barriers**	**Outcomes**	**Design and context**
Theoretical framework	Why do graduate students and firms engage in multidisciplinary co-innovations	What are the barriers that prevent stakeholders from engaging in UIC	What are the outcomes for involved participants from multidisciplinary collaborations	How are this type of collaboration models designed to generate value, and what dictates the design
Collected data	Interviews with stakeholders about motives to engage in collaboration and perceptions of value	Interviews with stakeholders related to the studied concepts and the thesis	Interviews and secondary data on outcomes from collaborations through the studied cases	Field observations, secondary data, and interviews with facilitators and participants in the studied cases
Analysis	Analysis of the drivers for engagement through a stakeholder perspective	Identification of key barriers that hinders the emergence and growth of UIC	Analysis of value that can be generated through collaborations	Analysis of the studied models and synthetisation of design findings with previous analysis

2 THEORETICAL FRAMEWORK

This chapter covers relevant knowledge from our literature review, starting with a general perspective on innovation and collaboration and gradually moving into the specific context of co-innovations between academia and industry. It is structured according to stakeholder perspectives.

2.1 THE ROLE OF UNIVERSITY-INDUSTRY RELATIONSHIPS

The type of collaboration that this study is targeted at is in literature generally referred to as university-industry collaboration (UIC), interchangeable terms that may be used are university-industry links or university-industry relationships. Through a literature study on 49 relevant articles on university-industry relationships, Perkmann & Walsh (2007) have synthesized a typology of UIC based on commonalities of the previous research studies. The study provided the authors with indications of the frequency of UIC as well as the relative importance of relationships over other forms of transferring of codified knowledge. The results showed that these types of collaborations are increasingly important to both academia and industry, and that they are becoming more frequent. This comes as no surprise given the societal changes that we discussed in the introduction, so of more interest to us are what the study revealed regarding what UICs provide to academia and industry and why they choose to engage in these collaborations. Perkmann & Walsh (2007) suggest that there is evidence that relationship-based mechanisms generate wider contributions to industrial innovation processes, as compared to simply transferring university-created innovations and breakthrough technological findings. The study showed that public open research can provide new ways of solving problems, which is consistent with nonlinear views on innovation proposed by von Hippel (1986) among others. Traditionally, UICs are measured based on number of patents and start-ups that the collaboration generates, but additional studies show that the main impacts are broader, generating other values, such as knowledge flows and education of students (Salter & Martin 2001). UICs can generate radical innovations through traditional research, but increasingly they can also provide useful incremental innovations for later stages of the innovation cycle, such as product improvement and differentiation. UICs can, thus, play a multifaceted role depending on the nature of the collaboration.

2.2 MOTIVES FOR ENGAGING IN UIC

2.2.1 WHY INDUSTRY SHOULD ENGAGE IN COLLABORATION WITH UNIVERSITY

The motives for industry to engage in UICs are often perceived as generic benefits such as getting access to students and gaining insights into emerging technologies and increasing their knowledge base (Perkmann & Walsh 2007). The underlying reason is a perceived need to innovate as this has, as we described in the introduction, become an imperative of doing business in a modern economy. One of the most widely adopted explanations for this development was introduced by Christensen (2000) when he coined the term disruptive innovation. He studied large successful corporations and found that even those that were well managed had difficulties keeping up with market developments.

2.2.1.1 Christensen's principles of Disruptive Innovation

1. Companies depend on their customers and investors for survival, and companies must provide these stakeholders with the products, services and sustained profits that they demand. As an effect of this the best performing companies, that eventually grow large and become market leaders, have well developed systems for producing improvements to the products that their customers buy, or in other words incremental innovations. The flipside of this is that these systems are designed to kill ideas that the customers don't want, i.e. disruptive or radical innovations. Therefore, it becomes hard for these firms to invest in new, low-margin opportunities, until their customers demand them, and by then it is too late.

2. Small and emerging markets don't offer the sustained growth that large companies need. To maintain share prices and sustain internal opportunities for employees, large companies need sustained and predictable growth, and as they grow they need an increasing revenue just to maintain the same growth rate. To accomplish this, they must focus on large markets.

3. Markets that don't exist cannot be analysed, and this becomes a problem for many firms since they often have investment processes that demand projections and quantification of market size and returns before they can enter the market. Since this is hard or nearly impossible for disruptive innovations, they are often systematically killed using such tools as the stage gate model.

4. Disruptive innovations can initially only be used in small markets, but eventually become competitive in mainstream markets. This is because technological progress often exceed market needs and customers will stick to established products and offerings since it covers the basic functions that the customer needs. Once two products offer the same performance, however, customers will find additional criteria to evaluate them, and new technology often have advantages over older technology in terms of functionality, convenience and price.

As the principles describe, larger firms are prevented to be innovative through their corporate structure and may lose sight of technological and market evolution. This phenomenon can also be referred to as incumbent inertia or management myopia among others so Christensen's terminology innovators dilemma should not be seen as the only explanation. However, as it is one of the most widely adopted ones, it servers well as a theoretical explanation for one of the drivers for innovation that many industries face.

2.2.1.2 How industries overcome the innovator's dilemma

As with many impactful theories, the theory of disruptive innovation has been intensively debated and Yu & Hang (2010) have conducted an interesting review of the research on the topic. Besides discussing definitions and predictive value of the theory, they offer a revealing synthesis of the explanations for how companies can manage disruptive innovation. Empirical evidence imply that discontinuous innovations are developed and commercialized by new entrants (Anderson & Tushman 1990), but there are also large incumbent firms that have

managed this feat (Ahuja & Lampert 2001), and these are most notably those firms that adopt entrepreneurial strategies such as exploration and experimentation. In their review, Yu & Hang (2010) identifies four factors in the literature that essentially decides a firm's success; organization, customer orientation, environment, and technological strategies. Of these, the first two were found to be heavily favoured in studies, proving that the innovative capacity of the firm is highly related to managerial impact and less to environment and technology.

Organizational issues

One important aspect of organization is that managers don't understand the impact of disruptive innovations, since they rely on views based on their current experiences and education (Yu & Hang 2010). They have often been trained in management of organizations in established markets with defined product lines, and this is what they have practiced. Additionally, incentive plans are often short-term oriented. Another aspect is the concept of organizational culture. This is often revered as something that distinguishes successful companies, but in the case of disruptive innovations it can be hard to unlearn practices and inject changes when the culture is deeply entrenched. On the other hand, it helps to nurture a culture of entrepreneurship, risk taking and creativity as this creates a flexible organization. Resource allocation, as already mentioned by Christensen, can also impact initiatives negatively if all projects are subjected to a stringent evaluation based on quantifiable indicators. Structured routines and previous investments can also drive firms to continually invest in existing operations. Lastly, the organizational size impedes innovative capacity, as a large organization has consistently been found to be negatively associated with the success of disruptive innovation (ibid.).

A widely-accepted solution to some of the organization problems is that the incumbent firm can maintain flexibility through smaller business units, but this is not without its own managerial implications. The key to operating sub-organizations is that they are granted autonomy to pursue commercialization of promising opportunities, an approach that many firms have done successfully, such as J&J, ABB and HP. Another approach promoted by researchers is open innovation which encourages collaboration across company boundaries.

Understanding customers

The second major area of importance found by Yu & Hang (2010) is the ability of firms to identify changing customer needs and market developments and linking these to technological advances. An issue for established firms, according to Henderson (2006) is that they tend to become expert on their immediate customers. They know everything about them, and can articulate why their customers choose to buy their products. Such firms often develop deeply embedded cognitive models and systems for customer understanding. When customer perceptions and requirements change, however, the firms need to change their marketing as well, entailing changing behaviour and cognitive perceptions which can be hard to achieve. Improving customer understanding is perhaps the most important aspect that firms need to focus on, as the inability of firms to find markets for new technologies is perceived as the most serious innovation handicap (Christensen & Bower 1996). The review reveals that learning about customers can be reached through different techniques, and popular methods include

customer visit programs, empathic design, research on customer's customers and targeting emerging markets. However, it is posited that understanding the needs of new customers is still a question of tremendous interest.

2.2.1.3 The graduate recruitment process

Talent management (TM) has become a critical consideration for many organisations as the business environment becomes increasingly uncertain and competitive (McCracken et al 2016). TM is acknowledged by researches to be an extremely complex issue for industry, as the processes for successful recruitment and retention relies on a multitude of factors, and needs to be adopted to suit the targeted group of hires, the so-called *talent pool*. One of the more common, and most complex, talent pools is that of graduates. Many organisations view this group to be a key source of high potential employees (ibid.), however, graduates are often perceived as an enigma since their high potential is often offset by challenges such as a lacking work readiness and unrealistic expectations of the working world. In addition to this, current graduates fall into the Generation Y category, often referred to as millennials, who are recognised to have unique attitudes, expectations and motivations (Luscombe et al 2013) in (McCracken et al 2016). Graduates are often described as "high potential" employees, but this is usually measured based on past performance data; however, graduates rarely have previous experience and therefore firms need to adopt intricate selection methods such as assessment events, aptitude tests and multiple interviews (Gallardo-Gallardo et al 2013). The problem lies in the fact that without previous work experience, it's very hard for employers to assess the suitability of graduates for job positions, and they naturally perceive it as a very risky endeavour. There is a great deal of uncertainty about the skills and competencies needed to carry out a job effectively, and personal attributes needed to benefit individually and to contribute to the employer and the wider economy (ibid.). Firms adopt different approaches to overcome these uncertainties, through things like adopting graduate- or trainee programs, often in combination with extensive recruitment processes, and the downside is that this requires substantial investments, further increasing the importance of subsequent successful retention. Activities for recruiting and developing graduates are also becoming increasingly important, given that most current graduates belong to Generation Y.

2.2.2 *MOTIVES FROM A UNIVERSITY PERSPECTIVE*

2.2.2.1 The entrepreneurial university

Universities are today on a global scale having to adapt to societal changes. The purpose and position of the university has changed through the centuries, since medieval times universities were focused on the preservation and transmission of knowledge and during the 19th century the research university emerged (Etzkowitz 2008). The first academic revolution that is still ongoing was the transition from a teaching- to a research institution, and the second revolution that universities face today is to adopt an economic and social development mission. The modern university can no longer consist of isolated scholars, nor can it only focus on teaching and research; universities of today are taking on a more fundamental role in society that make them crucial for future innovation, job creation, economic growth and sustainability (ibid.). Universities are incentivized to reach out and become social institutions, and around the world

academia is taking on a leading role in organizational and technological innovation. This new mission is realized in different ways in various contexts and new approaches and modes of production are constantly emerging. In Europe universities are encouraged by national government through policy trends, with governments borrowing policies and ideas from each other. This focus on commercialization has by universities typically been introduced through a focus on entrepreneurship, through teaching and encouraging students to carry out new venture creation. This has in many cases generated dual overlapping networks of academic research groups and start-ups, in various alliances with large firms and universities, and typically new knowledge is either patented and transferred to industry through technology transfer offices, or embodied in spin-off firms through incubator facilities.
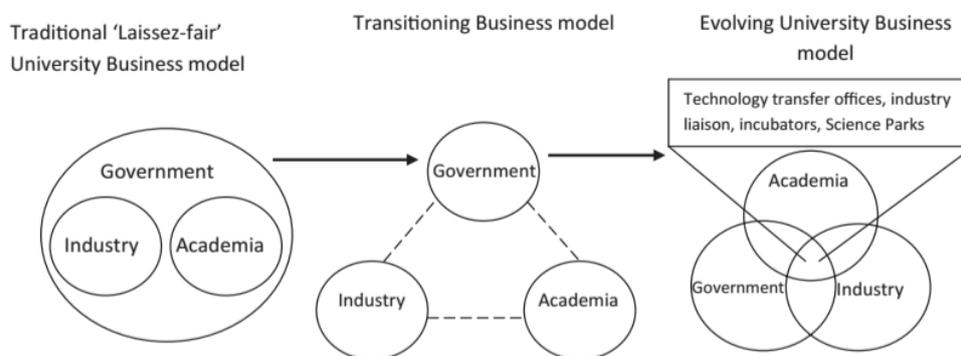
Figure 2-1. The transitioning university. Adapted from Etzkowitz & Leydesdorff 2000

2.2.2.2 Student employability

In general, TM practices of firms for graduates comprise recruitment, development and retention, and for this thesis, the recruitment phase is of interest. The primary challenge in this phase, which has dominated the literature on graduate recruitment (McCracken 2016), is that of employability of graduates. A natural purpose of academic education, that sometimes is overshadowed by the pursuit of academic excellence, is to provide students with a useful education that enables student employability, however, various authors presented by McCracken et al (2016) comment that there is a discrepancy between the expectations of employers and the skills and competencies that graduates actually possess. McCracken et al (2016) and Pujol-Jover et al (2015), argue that employers increasingly perceive that higher education institutions are failing in producing employable graduates. Even though graduates receive degree-specific knowledge, they often lack the soft skills needed in the work environment. The competencies that firms find that some students lack are skills in time management, adaptability, communication skills, team working and an entrepreneurial mind-set; and these qualities have been deemed to differentiate potential graduates. As a result, employers increasingly search for transferable skills rather than job-oriented skills and knowledge, and this can be greatly enforced through university-industry links (Ishengoma & Vaaland 2016). Primarily company internships have been proven to increase student

employability, followed by joint projects and involvement of companies in modernizing university curricula.

This competency gap was also observed by Holmquist & Håkansson (2010) who studied engineering students' academic development and career progressions. They found similarly that students were ill prepared for the requirements of their professional positions, and the authors found that a fruitful solution was to engage students in real projects as part of their academic learning. The links that student could establish with companies also increased the chances for students to get Master thesis projects, which in turn is a promising opportunity for students to be hired.

2.2.3 SUMMARY OF MOTIVES FOR UIC

As we have presented, collaboration between university and industry is increasingly perceived as a source of innovation through knowledge creation and transfer, and the topic has been researched from various perspectives. The summary is presented in table 2.1 and our review is supplemented with findings from a comprehensive review on the topic by Ankrah & Al-Tabbaa (2015).

Table 2-1. Summary of motives for University and Industry.

	Industry	**University**
External motivations	Societal and economic changes, the emergence and growth of the network economy Technological development Shifting markets Increased competition Shortening product life-cycles Government incentives	Societal and economic changes Government policy Societal pressure, servicing the community Academic recognition, producing new discoveries and publications
Internal motivation	Commercialisation of university generated technology Cost savings Enhance innovative and technological capacity Access to students and faculty for hiring Difficulty of hiring graduates Enhanced corporate image	Access to funding (research grants & industry funding) Access to expertise and state-of-the-art equipment and facilities Exposing students to practical problems and applied technology Employment opportunities for graduate students

2.3 WHAT HINDERS ENGAGEMENT IN UIC

2.3.1 MISALIGNED OBJECTIVES

Studies have revealed that industry sometimes can act opportunistically and only participate in UICs as long as they are subsidized through public funding (Feller et al 2002), and much of the financing comes from public, rather than private sources (McKelvey 2014). Company participation has been found to be somewhat fragile on several occasions, which indicates that

measures of the willingness of companies to engage in UICs may be biased. Berman (2008) argues that an explanation for this may be that companies are less interested in the science and primarily look for the practical benefits to their products or processes. Academic research can span very long timeframes and firms need to be persuaded to invest time and resources. The companies are often pessimistic in their projections of their opportunities to gain from university collaborations and do often refrain from it due to poor risk-reward ratios.

Another recurring criticism is that university-industry collaborations often emphasize the value system of universities (Hughes 2001). As already discussed, academics and professionals usually have very different belief systems, and when the collaboration rests too heavily on terms and conditions of the university, which is often the case, it can become unequal and generate substantial friction. The problem as described by Hughes (2001) is the divide between what universities and firms want or are looking for. Simply put, companies want access and exposure to students for possible hires, access to new ideas and education opportunities for their employees. Additionally, they want the ability to test and explore ideas and the ability to apply these in their products and services. These needs are seldom met as universities often pursue more academic values. Hughes (2001) provides comments on problematics of different types of UIC modes, and regarding student oriented activities he finds that internships are undervalued and neglected by universities, and that student design projects rarely achieve their potential due to a lack of understanding among teachers and faculty.

This reluctance by academia to engage in equal collaboration described by Hughes (2001) can partly be explained by consequences of academic engagement studied by Perkmann et al (2013). Their comprehensive review of relevant articles about university-industry relationships revealed that academia is concerned about several potential consequences that can emerge from collaboration with industry. Firstly, there is a fear that productivity of researchers will suffer due to collaboration, this was not found to be supported, but the academic height of research was seen to be affected negatively. A second fear is that engagement with industry could shift the agenda of researchers, and thirdly that it could impact and restrict communication among researchers. Neither of these concerns appeared to be substantiated. Recent research shows, thus, that there are unsubstantiated fears among academia related to UIRs. Even so, these preconceptions still appear to prevent many universities from engaging in UIRs. Additionally, when universities do engage in collaboration with industry, Perkmann et al (2013) conclude that companies need to be aware of and prepared to meet specific requests of academic researchers. Researchers mostly seek academic benefits, and will only engage with industry if the projects accommodate their academic needs. These principles result in a high level of bureaucracy and red tape, making any UIC a slow and tedious process. Berman (2008) concludes that this cultural divide is the primary reason why many companies are reluctant to enter in partnerships with universities.

2.3.2 CHALLENGES OF MANAGING PBL

Project based learning is a promising model for enabling students to gain fuller learning, but it does impose some challenges. Mansor et al (2015) identified three major areas of concerns in their study on PBL as an educational practice; student motivation, student skills, and resource

requirements. The first issue, student motivation, was found to rely on understanding and trust. As PBL can be unfamiliar to many students, they initially distrust the approach, and they are uncertain of how to engage in it, additionally, besides not trusting the model, they can mistrust their peers. The suggested solution is to establish clear boundaries, actively engage students in overcoming group dynamics issues, and that teachers or facilitators engage in guiding and triggering curiosity.

The second issue the authors found was that students, having been taught through traditional models for many years, lack skills that are essential for managing independent projects. Students in PBL projects were constantly observed asking for assurance and direction, and found it confusing that different teachers could approach the process in different ways depending on their own understanding of PBL. Under these circumstances, many students tend to revert to traditionally taught methods, and a recommendation is that any PBL project has a clear structure, and that facilitators must have adequate understanding of the process.

The third issue was that or resource requirements. The time requirements to guide, advice and supervise participating students is far greater than in conventional teaching. A teacher can't handle the same number of students successfully in a PBL setting as compare to a conventional class, too many students or too many groups becomes a problem. The teaching, or facilitation, is more action oriented and hands-on. Due to this, the teacher must also prepare ahead of class in much more detail, so it demands more time before and during class to conduct PBL.

As a final note, Mansor et al (2015) found that students' motivation to engage in PBL depends much on their perceptions of the approach. As conventional classes are standardized and familiar, students value these highly since they know their grades carry a value in themselves. PBL projects, even if they provide a multitude of valuable soft skills, are not equally valuable, in so that the outcomes cannot be codified in a traditional manner. Thus, students need to be incentivized to participate, as they otherwise naturally tend to over-prioritize their other course works.

2.4 POTENTIAL OUTCOMES

2.4.1 BENEFITS FOR FIRMS TO ENGAGE EXTERNALLY

Even though empirical evidence show that firms that are more entrepreneurial are those that more often succeed in disruptive innovation, studies show that conservative firms have more to gain from external networks (Baker et al 2016). Conservative firms that lack an entrepreneurial culture benefit disproportionately from extracting information and knowledge from external networks. However, this primarily regard SME's or large organizations that is poor in social capital. Furthermore, the authors posit that conservative firms will probably not going to become innovation leaders, but instead of being shaken by disruptive innovation, they may instead adapt and become fast followers. Their recommendation is that firms focus on processing market knowledge and commit to learning, if they are to succeed (ibid.). Boosting innovation capacity through engaging with different external actors is a strategy that Sacramento et al (2006) have found support for, in their study of collaboration effects on team innovation capacity. Innovation teams in organizations were found to benefit from

collaborating with each other within the teams and with other teams, but most notably, innovation capacity is greatly affected by boundary spanning collaborations. Teams that actively engage with outsiders, initiate programs with outsiders, and revise their knowledge of the environment through connecting with external parties are better performers than others.

Small firms often have innovative capacity but lack the resources of larger firms, and alliances and collaborations can be beneficial for both parties. Collaborations and joint ventures raises the question of appropriability, intellectual property, and trade secrets, and Yu & Hang (2010) found that the existing literature has not discussed this clearly. In other words, firms can benefit greatly from collaborations, but face problems in doing so with potential competitors; a difficulty that is avoided in university-industry collaborations. The issue is clarified by Hyll & Pippel (2016), as they have found differences in effect on innovation success depending on the type of cooperation partner firms engage with. Their research reveals that cooperation with competitors or suppliers offer no benefits against innovation failures compared to not cooperating at all, but that partnering with customers or public research institutes do help firms succeed in their innovations.

2.4.2 BENEFITS TO STUDENTS

From a student perspective, UICs can provide an opportunity for project learning, the opportunity to engage in a challenging context where the student can develop skills and knowledge that are hard to achieve through conventional learning activities. Project based learning (PBL) is a field that has been extensively researched to design learning environments for children (Blumenfeld et al 1991), it has become a cornerstone in design education, and is increasingly being implemented in engineering, medicine, law and business (Dym et al 2005). Promoters of project based learning state that it enables students to acquire a better understanding of key concepts and principles. Through working on a case or project that is connected to an external context, students are exposed to realistic problem-solving environments, which can help to build bridges between theory and practice. PBL places the student at the core, offering freedom to choose what to study and how to approach problems. This freedom requires knowledge, persistence, effort and responsibility from the students; it requires them to devise plans, do research, evaluate the approach and findings, and create solutions and prototypes. Thus, this approach to learning can be an effective model to familiarize and prepare students for the challenges of the business environment. In their study of industry connected projects, Meredith & Burkle (2008) assert that student learning is considerably improved by adding real-life experience. Participating in practical projects, like a consultancy approach, generates fuller learning and prepares students for professional career challenges. This in turn, alleviates one of the primary concerns of industry discussed earlier; finding graduates with soft skills, and for the students this becomes a competitive edge over their peers in recruitment processes.

2.5   MODELING UIC

2.5.1   TYPICAL UNIVERSITY INDUSTRY LINKS

As described earlier, universities and industry can collaborate in various ways, for various purposes. To gain a better understanding of the context, we look at the findings of Wallin et al (2014) who have done a similar case study on the gap between university and industry. Their study included a review of 20+ years of close and sustained collaboration between a global company and university to map the different types of collaboration that were conducted through the partnership. The findings of Wallin et al (2014) are synthesized in a model that provide a helpful overview of UIC, and even though it is based on a single relationship the model resonates well with typical relationships (Perkmann & Walsh 2007) between university and industry.
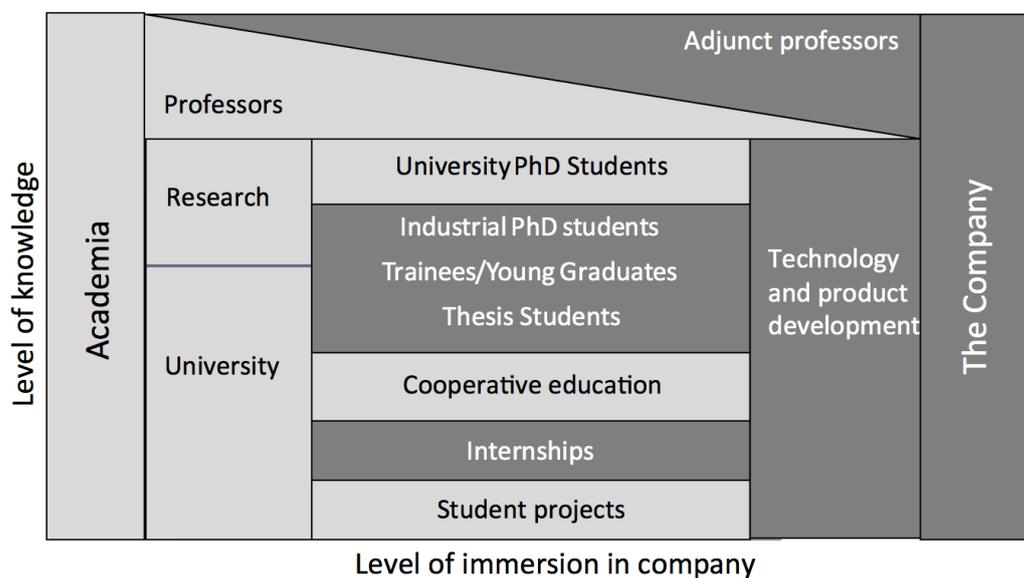
Figure 2-2. Overview of university-industry collaborations. (Wallin et al 2014).

As the model illustrates, various collaborations projects involve different actors, however, it is also visible that projects are conducted either within the academic context or in the company organization, actual collaboration in a common context is limited. The authors explain that this depends on the diverging expectations and objectives of the two parties in terms of scientific depth and breadth of research projects. This separation creates barriers that hinder the innovation potential from collaboration and the authors conclude that greater efficiency could be achieved through facilitation of mutual understanding, facilitation of co-creation and facilitation of ideation. As we will see, these recommendations resonate with other research findings on the topic of UIC.

2.5.2   INNOVATION: CREATION AND SHARING OF KNOWLEDGE

Successful innovations are often simple solutions that no one have thought about, and finding these often require dynamic ways of thinking. Innovation as a discipline is according to Drucker (2002) both conceptual and perceptual, meaning that innovators must complement

conceptualization with insights from the market. In the case of NPD, this entail an iterative process of analytically identifying potential innovations and testing these among users to study expectations, values and needs. This require innovators to go out and interact with potential users to gain new perspectives. This view that innovation relies on gaining new knowledge is also presented by Nonaka & Takeuchi (1995), and since their works, the concept of innovation has been closely related to the notion of "knowledge creation". The process of knowledge creation consists of an iterative process where the individual overcomes the constraints of previous information and experiences by getting a new context, or perspective of the world and new knowledge. By then interacting and sharing knowledge with other, the individual enhances the ability to define and solve problems by applying the acquired knowledge. This knowledge creation can be a process that any one individual practices for their own benefit. When it comes to organizational knowledge creation, the process will have to involve other members of the organization as well, this entails amplifying the knowledge through sharing and connecting it with the organization's knowledge system (ibid.). Therefore, it is essential that knowledge is both gathered and disseminated to generate innovation in an organization. Nonaka & Takeuchi (1995) have conceptualized the process of knowledge creation in a spiral model known as the SECI model (Socialization, Externalization, Combination, Internalization) that describes how tacit and explicit knowledge is constantly interacted between individuals.
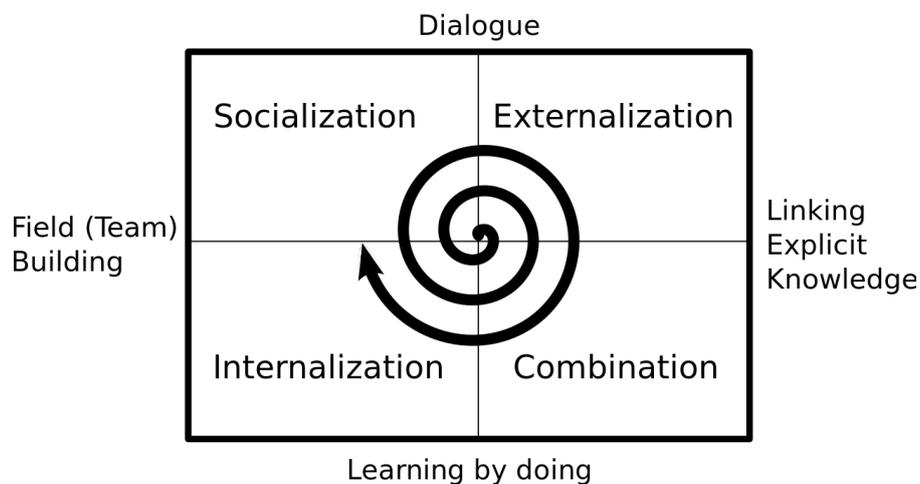
Figure 2-3. The SECI model. (Nonaka & Takeuchi 1995).

As the model illustrates, an organization will go through different stages of knowledge creation and assimilation, interactively with the environment. The initial socializing phase entail close and personal interactions between individuals, where they can share experiences, observe, imitate, and brainstorm without criticism. Moving on to the next phase, the shared knowledge that has been generated is codified in writing through metaphors and analogies, or models, and it can also entail simple prototyping. Knowledge is visualised and made tangible. As knowledge has been externalized and coded, everyone can get in on the combination phase through collaboration and hands on learning. Through sorting, categorizing, and combining

knowledge, methodologies and best practices can be identified. The final phase of the cycle is when this knowledge is internalized by individuals through reflection or by organizations through culture. As the spiralling model shows, this process keeps reiterating, generating new knowledge as soon as people come together and can share their experiences.

2.5.3 KNOWLEDGE TRANSFER IN UNIVERSITY-INDUSTRY COLLABORATIONS

The SECI model is widely adopted and useful in any different contexts. In the case of co-innovation, it could be argued that the purpose of knowledge transfer is the capitalization of knowledge, since the collaboration hopefully will generate results useful in a business context. Viale (2010) defines capitalization of knowledge as knowledge generating an economic added value, that can be either direct, as in the sale of personal know-how, or indirect, as when an organization accrues knowledge that is embodied in goods or services. The advent of the triple helix model and other institutional links between academia and industry are examples of a new form of capitalization of knowledge, reminiscent of open innovation, and Viale (2010) argues that important determinants for these new forms of knowledge capitalization are its epistemological and cognitive aspects. These determinants explain the emergence of the concept of university-industry research collaborations, but an analysis of this lies outside of the scope of this study. Although, even without going deeper into the underlying explanations, we can conclude that they offer pragmatic guidelines, or boundaries, for the capitalization of knowledge through university-industry collaborations.

2.5.4 FIVE KEY ASPECTS OF TRIPLE-HELIX INNOVATION

These are aspects of knowledge transfer that according to Viale (2010) should be considered to improve collaboration outcomes.

2.5.4.1 Generalizability

Knowledge to be transferred can either refer to singular empirical events, as in the case of teaching someone a specific practical method for doing something, or purely descriptive knowledge. These are types of knowledge that lack explanatory power and that can't enable an enlargement of the innovation field. On the other end of the spectrum, knowledge can consist of general theories. Generalizable knowledge can be transferred to different contexts and add to the innovative power. This type of knowledge often offer valuable insights when it is transferred across different natural and disciplinary domains, and Viale (2010) points out that this require interdisciplinary training and organizations that are able to identify potential innovation areas to generate technological knowledge. Thus, capitalization of knowledge implies that knowledge of general nature is transferred, and that the innovation potential is strengthened through interdisciplinary collaborations. This can be very resource intensive and Viale (2010) notes that it can only be afforded by research universities or large corporations, which act as a driver for close triple-helix collaborations.

2.5.4.2 Complexity

As knowledge becomes increasingly complex, it will extend beyond the cognitive capacity of any one person. A network of minds will be required to have a complete picture of the

knowledge and to be able to process it and to deduce consequences of it. This again often implies an interdisciplinary network of researchers and scientists, and "big science" projects can also often lie beyond the capacity of any one firm. The ever-accelerating pace of scientific and technological development, thus, create a growing need for triple-helix collaborations. This implies that universities need to take on more industrial roles and engage more closely with businesses (Viale 2010).

2.5.4.3 Knowledge nature

Capitalization of knowledge, require that one can sell it or use it somehow to create economic added value. The knowledge needs to be completely understandable and reproducible both by the original inventor and the recipients, and in transfer, there is a risk that some of the meaning of the knowledge is lost. Knowledge can be purely explicit, meaning it is codified and easily transferrable, or tacit, meaning it can only be transferred through learning-by-doing. In terms of R&D, tacit knowledge transfer has gradually lost importance through practices of patenting knowledge and the ICT revolution, as technological knowledge has become almost purely codifiable and explicit (Cowan et al 2000). However, Viale (2010) states that this representation doesn't consider all aspects of tacitness. Competential know-how has become codifiable through ICT technology, but aspects of background knowledge and cognitive rules can't be codified as easily. These tacit factors serve to transfer knowledge about social norms, values, and meaning. They can give reason to the data and make it easier to find solutions to problems. A patent can contain "complete" codified knowledge allowing it to be traded, but buying a patent doesn't mean that the buyer may be equipped to understand and use it directly. Academy and industry can collaborate on a distance through virtual networks, but the aspect of tacitness implies close proximity between university and industry, and the creation of hybrid organizations where face-to-face collaboration can take place. This is supported by a study on knowledge flows between European firms by Arundel & Geuna (2004), the study found that knowledge flows between public science and firms directly benefit from close proximity between the involved actors.

2.5.4.4 Shared background knowledge

Beyond the aspects of tacit knowledge transfer, proximity in innovation collaboration is necessary for linguistic purposes as well (Viale 2010). Professionals and academics are members of different cultural communities and possess different background knowledge. This can create misunderstandings and make collaboration difficult, especially so if communication is done through intermediaries. To obtain effective knowledge transfer and capitalization of knowledge, the involved parties need to engage in face-to-face communication to gain a common understanding. This supports the creation of open public spaces where members of universities and companies can meet and engage in cultural exchanges (ibid.).

2.5.4.5 Cognitive styles

A major impediment to university-industry collaborations is the difference in cognitive rules of researchers from academia and industry, which entail contrasting perceptions of time and risk (ibid.). To companies, "time is money", and it is important to find concrete results as

quickly as possible not to waste precious resources. Businesses often employ time-discounting, and focus lies on the survival of the company, whereas academic researchers mostly employ a longer time frame and focus on exploring boundaries of research and uncertain knowledge, rather than the application of existing models. The main perceived risk for businesses is economic, while academic researchers are wary of the risk of losing scientific reputation, and this difference in cognitive styles can generate misunderstandings and conflicts in triple-helix collaborations. A possible solution presented by Viale (2010) is the emergence of academic researchers trained closely to industrial labs, or hybrid organizations to bridge the divide between academia and industry.

2.5.5 SUMMARIZING KNOWLEDGE CREATION AND TRANSFER IN UICS

As the theories presented show us, the participants in UICs need to interact through close personal relationships for knowledge to be transferred fully. Differences in cognitive style, background knowledge and the purpose of collaboration, contrasted to the knowledge spiral indicate that collaboration for the purpose of innovation between students and firms is heavily dependent on personal interactions. These findings are consistent with similar studies (Vrasidas & McIsaac 1999; Rourke et al 1999 through So & Brush 2008) who concludes that social presence is critical for developing a community of inquiry, and that students in particular require a sense of trust and belonging to engage in collaborative learning. Similarly, studies have shown that engaging in collaborative projects using ICT, even though it may offer practical benefits, have a dramatically negative impact on participation and motivation (So & Brush 2008).

2.5.6 THE BA FRAMEWORK

These aspects about knowledge sharing in UICs have been conceptualized by Huhtelin & Nenonen (2016), through a review of 210 references, to describe which type of space that will best support knowledge sharing in UICs. The basis for the model is an adaptation of the SECI model, that was developed further by Nonaka et al (1998) by adding the concept of "Ba". Ba refers to the context, or place, that is shared by those who interact with each other and it can be either a physical, virtual, or mental space. Knowledge, in contrast to information, cannot according to the authors be separated from the context; it is embedded in ba. To support the process of knowledge creation, a foundation in ba is required and there are four types: Originating Ba, Dialoguing Ba, Systemizing Ba, and Exercising Ba. Each Ba supports a specific mode of knowledge conversion and provides a platform for each specific step in the knowledge spiral.

In their extensive review, Huhtelin & Nenonen (2016) have analysed how the concept of Ba can support collaboration in the UIC context from different relevant perspectives; strategic, innovation and product development, and spaces and services.

2.5.6.1 Strategic requirements

As we have already mentioned, universities and industry have different strategic reasons for engaging in collaboration, and this is a relevant factor in designing the space. Universities and companies have different requirements for the openness and verification of knowledge, and

can have different cognitive frames of reference. The less the parties know about and understand each other, the more important it is to establish trust and shared goals. This can be achieved in the originating Ba, as it supports idea generation, tacit knowledge transfer and trust building. In UIC, originating Ba is where new ideas and concepts emerge, it's where new technologies emerge, and it's where social networks are created (ibid.). This trust is in turn necessary for the creation of establishing a learning dialogue, thus, dialoguing Ba that supports more efficient knowledge transfer is not possible without trust building through originating Ba.

2.5.6.2 Requirements for innovation and product development

Innovation is often focused on developing new products or services and the NPD process consist of several phases. The process can be defined in various ways with more or less detailed steps, but in general it starts with an ideation phase, that goes into concept development, that continues into technical development and subsequent testing and launch. by connecting the NPD process to the knowledge creation process, it appears that each phase in NPD can entail several knowledge creation modes (ibid.). Of these, the concept phase is particularly supported by originating Ba, and the development phase is supported by Systemizing Ba. The innovation process in turn is very similar to the NPD process and the required know-how can be reached through external collaborations if the required it's not available internally. The front end of the innovation process consists of opportunity identification, identifying customers' needs, idea generation, concept definition and project selection, and these are stages that are supported by originating Ba. The concept of co-creation generally refers to creation of value by customers, but the term can be equally applied to UIC as there are elements that reflect the requirements of knowledge co-creation. Customers' can provide critical knowledge by testing and evaluating products without having to meet with the product developers, and this type of explicit knowledge co-creation that also can occur in UICs is supported by dialoguing Ba.

2.5.6.3 Space and service requirements

Collaboration between individuals can take place in a physical place, but the space can also be virtual, like e-mail or teleconference, or mental, like shared experiences and ideals. With the development of ICT, the "networked office" (Duffy 2008 through Huhtelin & Neonen 2016) has emerged, describing new virtual ways of working, and an important consequence of this development is that tacit knowledge is no longer transferred on a daily basis. The tacit knowledge transfer that innovation relies on is supported by originating Ba, and the authors suggest that a creative space should allow for interaction, movement, and grouping of people and ideas, and visual thinking should be encouraged using whiteboards, post-it notes and coloured pens. A creative space should encourage fun and create an atmosphere of limitless abundance, and it should be designed with accessibility in mind in terms of visibility and placement in rooms or in buildings, and allow many kinds of special events like lectures, work-shops, pop-up experiences, meet-ups and other sorts of social events. The design should allow for rapidly changing programs and events, that may be curated and led by different organizations and users.

In addition to the physical space there should be accompanying services, such as "champion facilitators" that guide and support interaction and facilitate trust, and information services to

create buzz about the collaboration (Huhtelin & Nenonen 2016). Buzz in this case is described by the authors as an information and communication ecology created by face-to-face interactions and co-presence and co-location of people and firms. Actors continually benefit from and contribute to diffusion of information simply by "being there" and information networks with continuous updates augment knowledge diffusion.

2.5.6.4 Summarizing Originating Ba

Given these requirements, Huhtelin & Nenonen (2016) propose that a space for collaboration in the UIC context should primarily be designed according to the concept of originating Ba where:

- Social networks for UIC are developed
- Trust is formed between UIC partners through face-to-face interactions
- Tacit knowledge is transferred and co-created for the product concept phase and research projects
- New ideas for concepts and research projects are generated
- Emerging technologies are identified
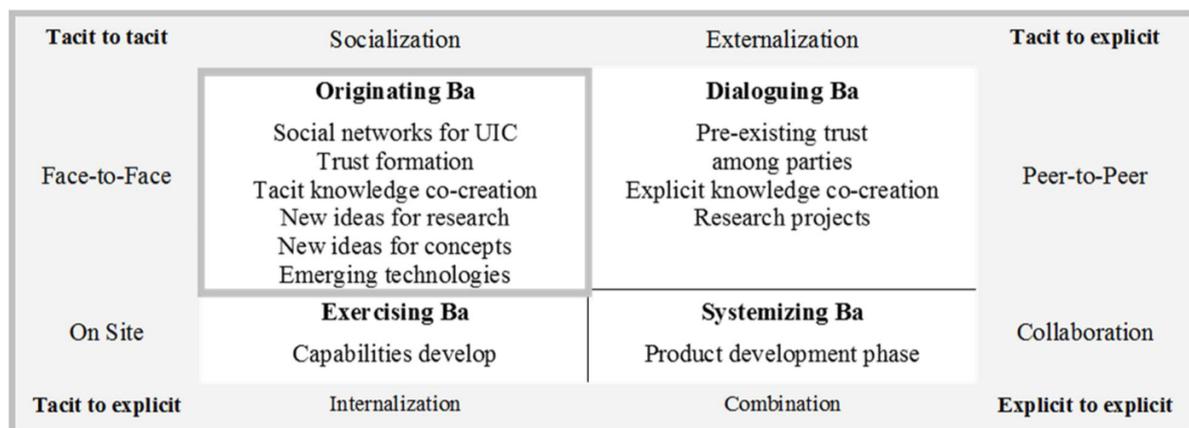
Figure 2-4. Conceptual framework for Ba. (Huhtelin & Nenonen 2016)

2.6 SUMMARY UIC MODELING

Conventional approaches to UIC are limited in terms of interpersonal exchanges (Wallin et al 2014), meanwhile, innovation can be defined as the creation and sharing of knowledge (Nonaka & Takeuchi 1995). New knowledge is created through a process of socialization, externalization, combination and internalization, whether it occurs within one individual or in an organisation. Old knowledge constraints are overcome by a process of experiencing new perspectives in a new context, and through the steps of the knowledge creation spiral, the new knowledge eventually becomes internalized, or embodied within individuals or organisations. The knowledge has become verified and accepted. The key takeaway from the SECI model, is that the process is initiated and reiterated as soon as people come together and are able to share their experiences; personal interaction are essential for knowledge creation.

Transfer of knowledge in UIC also rely on personal interactions. Firstly, the knowledge that is intended to be created and shared is general and complex, as the purpose is to capitalize and generate innovation. This creates a need for collaboration, not only cooperation. Secondly, the knowledge that can lead to innovation is not only explicit, but also tacit. People may need to understand the whole context not to lose the meaning of knowledge as it is transferred, and this requires transfer of tacit aspects. Finally, the people that are intended to collaborate come from different backgrounds, and may for that reason have different "languages" and ways of thinking. These are barriers that are overcome through close interdisciplinary interactions.

To accommodate these interactions, a physical space is needed, and this should be designed to encourage creativity and idea sharing (Huhtelin & Nenonen 2016). Interactions through ICT will not suffice to generate the desired outcomes. The space should be transformable, to allow for a variety of activities and events, so that it becomes a natural hub for collaborations. And it is highly beneficial if it can be located in proximity to the targeted actors as co-location creates buzz and enhances information diffusion. The activities that take place in this space should be oriented toward the initial stage of the knowledge creation spiral, focused on social interactions, idea sharing and concept development. As such, it needs to enable activities related to the initial phase of development processes, such as; socialization, idea sharing, brainstorming, mind-mapping, visual thinking, collaborative idea generation, dramatization, basic prototyping and so on. The requirements for this are basic; whiteboards, post-it notes and coloured pens will cover most needs and basic materials for modelling ideas covers prototyping needs; and all furniture, including whiteboards, should be easy to move around depending on the activity.

Table 2-2. Key modeling factors according to theory.

Modeling UIC in theory	
Knowledge creation	Follows an iterative process (SECI)
	Socialization is the initiating phase
	Reiterated when people come together
	Personal interactions are essential for knowledge creation
Knowledge transfer	Objective of knowledge transfer requires collaboration
	Knowledge is both explicit and tacit, need to understand meaning
	Different backgrounds create barriers
Space requirements	Physical space that encourages creativity
	Co-location creates buzz and information diffusion
	Should be oriented toward the socialization phase
	Transformable to accommodate variety of activities
	Basic tools and materials for ideation and prototyping

3 Research design and methods

This chapter covers the grounds for the thesis project and how it has been conducted. In this section, we clearly present all our data sources and research techniques, and explain the rationale for choice of approach.

3.1 Research Strategy

3.1.1 Qualitative approach

A qualitative research strategy has been chosen for the main part of this study, since this enables a more exploratory study, using more flexible and open research methods (Bryman & Bell 2015). This increases the possibility of gathering unexpected and revelatory data, whereas a quantitative study would be more dependent on predetermined parameters that could limit possible findings. This has been determined to be a suitable approach for this study, since qualitative research is about studying people's lives and behaviour under real world circumstances, including contextual conditions, and contributing insights into existing or emerging concepts to help explain human social behaviour (Yin 2011). Business research strategies can take several different approaches depending on the research perspective. To complement the research strategy, the interpretive paradigm has been the basis for our epistemological position as researchers. To this end, we have refrained from any judgmental actions as the intention has not been to change the studied concepts or organisations, but rather to explore and understand them. The research strategy thereby differs from a positivistic approach in the sense that it is more heuristic with an open-ended research question (Phothongsunan 2010), with the aim to find new connections of ideas to find suitable answers to our research question.

3.1.2 Inductive iterative process

A qualitative strategy will require interpretation of responses and is usually coupled with an inductive research approach to gain an increased understanding of the subject and generate theory (Bryman & Bell 2015). This study follows the general qualitative approach in so that it has been initiated through a review of existent theory and the research process has been designed to gather data for interpretation and analysis, with the aim to possibly add to the existing body of knowledge. The inductive approach may appear to be a linear process based on a thorough theoretical base that is contrasted to new findings, in a student research project on the other hand, the process can be highly iterative since the research process often reveals new themes (ibid.). This reflects the process since new insights and themes have constantly emerged during the research, promoting review and adaptation of the theoretical framework. Given the chosen research strategy, and that this research project has been conducted under a limited time scope, the gathering of existing theory has been done through a narrative literature review. Bryman and Bell (2015) emphasize the importance of having a strong knowledge base and make a thorough background research, not to "reinvent the wheel", and this is often achieved using systematic techniques. This, however, require a deep knowledge about the topic at hand, ample time, and resources, since the researchers need to clearly define the search criteria before theory is gathered. Under an inductive and interpretative approach a narrative

review is more suitable, since the research process may reveal unanticipated issues important to the area of study that can alter the boundaries of the project (Noblit & Hare 1988). Interpretative researchers are more likely to change perception of theory because of analysis of collected data, and the narrative review allows for this needed flexibility.

3.1.3 *QUANTITATIVE PILOT STUDY*

A pilot study has also been conducted going into the research project, to assess the extent of the perceived problem. The pilot was conducted through a quantitative study targeted at the graduate student population of Gothenburg University. This data collection has relied on predetermined parameters that have been used to identify the perceived prevalence of the issue from a student perspective. Thus, this study incorporates quantitative elements but only in the pilot, the main strategy for the research has been to adopt a qualitative approach, since this was deemed to be the best fit with the purpose and focus of the research project.

3.2 RESEARCH DESIGN

The study has been designed as a multiple case study. This is a common approach in qualitative research, as qualitative researchers often strive to use multiple sources of evidence, rather than relying on a single source (Yin 2011). This has enabled comparisons to find commonalities or unique aspects across the cases, which according to Bryman & Bell (2015) is one of the key benefits of the approach. A comparison of cases can be very similar to a cross-sectional design, and the focus of the study is what determines which design is most appropriate. A multiple case study is beneficial if the focus is on the unique aspects of the cases and in this regard the multiple case study approach fits the study well, due to the descriptive and exploratory purpose, and due to the uniqueness of the phenomena.

3.3 RESEARCH CONTEXT

One of the pioneering institutions in the field of interdisciplinary education is Stanford University, and one particular institution within the institution of design, called d.school has inspired similar initiatives in Sweden and around the world. The d.school at Stanford University was chosen as the primary case of this study, and related concepts in Sweden have been included to form the multiple case study. Due to time limitations, it has not been possible to conduct ethnography at all included cases of the study. Data has been gathered on the cases of Demola and ProLab through interviews with key representatives and secondary data.

3.4 RESEARCH METHODS

Qualitative research is associated with practices of using flexible designs, the collection of field data to capture both the participant's perceptions and contextual conditions, the use of non-numerical data and with an emphasis on interpretation (Yin 2011). The flexibility of qualitative research allows for a wide array of possible methods to choose from, and the study can either follow one approach or a combination through a generalized form of research. Following the generalized form can entail epistemological considerations, as combining different methods may result in fundamental conflicts (ibid.). However, one can assume that "all types of inquiry, insofar as the goal is to reach credible conclusions, have an underlying epistemological

similarity" (Phillips, 1990, p.19). On this basis, this study follows a generalized form of qualitative research, incorporating elements of case study research, combined with participant observation and ethnography techniques, with the purpose of achieving a high level of quality and credibility. Interviews has been the main method for collecting data, and as we managed to get close access to our primary research case this allowed for the implementation of additional techniques.

3.4.1 NARRATIVE LITERATURE REVIEW

The theoretical framework has been constructed through a form of snowballing strategy, as it proved to be a suitable fit to the inductive approach. A selection of keywords was used in the initial research, and in-depth reviews of citations and sources of articles soon became the main methodology for finding relevant research. The review was conducted using common electronic databases covering relevant fields and physical library resources. No clear inclusion or exclusion criteria have been adopted in the review, other than a focus on finding sources of high relevance and citation rate. The review has generated a solid framework for the study as most sources are both well cited and on relevant topics.

3.4.2 ETHNOGRAPHY TECHNIQUES

The main case has been studied through organizational ethnography, which also can be defined as participant observation of social relations related to certain goal-directed activities (Rosen 1991). This methodology entails more than just observation (Bryman & Bell 2015), and data has been collected through experiencing the context and environment, rather than simply observing it from a distance. Ethnography is usually coupled with other methods for data collection, and this study also rely on data collected through interviews and documents. In the case of a study that is conducted within a very limited timeframe, such as a master's thesis in this case, the methodology is often labelled as micro-ethnography (ibid.). Due to the limitations of time and continued access, it can be argued that ethnographic techniques have been applied to the study, rather than that actual ethnography has been conducted (Fetterman, 1988). A full-scale ethnography would require spending considerably longer time in the observed environment, but even a few weeks of participations have generated valuable insights.

When conducting ethnography, the researcher can be either covert or overt (Bryman & Bell 2015). We chose to be overt in our participation, as this made it easier to get access to the facilities and to respondents. Some of the areas that have been studied have been open to the public, but the classes and activities where relevant events took place required negotiation to get access to. Also, in this environment, taking a covert role would have generated curiosity and suspicion among the other participants, which could have impacted the research. Ethnography can also vary in terms of how active the role is of the observer, ranging from complete participant to complete observer. According to Gold's (1958) classification scheme, we as researchers took the role of observer-as-participants. In this role, the researcher is mainly an observer and interviewer, and only participates to a limited degree. As observation took place in classroom settings, we initially took a passive role, and engaged actively when invited to join in the activities.

3.4.3 INTERVIEWING

Interviewing is a widely-adopted technique in qualitative research, and compared to ethnography it offers a valuable flexibility. Interviewing entail time consuming transcription and analysis, but this can be done whenever it suits the researcher. The interviews of this study have followed the semi-structured format, meaning that an interview guide has been used. The main benefit of this method is that it gives respondents room to elaborate, yet at the same time it ensures that the topics discussed are relevant for the study (Bryman & Bell 2015). It also allows for more straightforward comparisons and analysis of the data gathered through the interviews. A disadvantage of following a semi-structured interview format can be the potentiality of revealing too much information or steering the respondent into a certain direction, this is a balancing act that we have tried to manage to the best of our abilities.

3.5 DATA COLLECTION

Gaining access to organizations is probably the biggest impediment to ethnography and qualitative research in general (Bryman & Bell 2015), and this affects the possibilities for sampling. We faced limitations in the access that was granted to classes by individual teachers and staff and as a result the study initially followed snowball sampling. This means that we had to go from person to person to gain access to new participants, since it was hard to get in touch with relevant respondents through e-mail or by phone.

3.5.1 GAINING ACCESS

Gaining access to our primary case, the d.school at Stanford University was by far the hardest, which eventually forced the use of snowball sampling. Since the case we intended to study was geographically far away we were restricted to establishing relationships on a distance. An early recommendation that we received from people with previous experience of the Bay Area (San Francisco and Silicon Valley) was to approach universities and corporations through established intermediaries, so the initial requests were sent through representatives of VINNOVA[2], SCANCOR[3], and SACC[4] in Silicon Valley. These are organisations that in different ways act to support Swedish interests to do research and business in the area. The objective was to get in contact with relevant representatives to establish an initial relationship, so that interviews could be planned before our arrival. Establishing these connections was harder to achieve than we imagined so a second approach was an attempt to establish connections directly with targeted institutions, once we were in the Bay Area however, the aforementioned organisations were very helpful with providing information and introductions. When we directly contacted the d.school institution at Stanford, we were informed that requests

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[2] Vinnova is a Swedish government funded organisation that operates internationally to develop Sweden's innovation capacity (www.vinnova.se/en/EU-and-international-co-operation/Stanford-office).

[3] Scandinavian Consortium for Organisational Research operates facilities at Copenhagen Business School, Stanford University and Harvard University, with the purpose to facilitate international organisational research (www.scancor.org/about-scancor).

[4] Swedish American Chamber of Commerce, San Francisco and Silicon Valley, is the leading facilitator of transatlantic trade and knowledge sharing between Sweden and Northern California (www.sacc-sf.org/about).

for access to classes had to be accommodated by each specific teaching team, other than that the university grounds were accessible to the public and the d.school facilities were also openly accessible. Given that access to courses depended on approval of certain teachers, our initial plan of only including specific courses in the study had to be adapted, this is where the snowballing came into the picture. To our delight, several teaching teams agreed to let us visit and observe in class, and to interview teaching staff and students. In the end, introductions through third parties enabled us to get access to valuable respondents involved in relevant classes taught at d.school, including corporate representatives. Gaining access to key respondents from the two Swedish cases, ProLab at Lund University and Demola at Linköping University was more straightforward. Respondents were contacted in advance and interviews were scheduled and conducted either in person or through conference calls. The reason for conducting interviews on a distance was that they coincided with the research trip to USA.

3.5.2 STRATIFIED SAMPLE

The aim when negotiating for access to places, organisations, and people, was to build a stratified sample of respondents which we eventually managed to a satisfying degree. A stratified sample is purposively designed to ensure a wide range of characteristics of interviewees, or to make sure that key respondents are included in the sample (Bryman & Bell 2015). To enable comparison and analysis, and to be able to answer our research questions, the study was designed around a stakeholder analysis framework in which stakeholder groups are made out of the student community, university, and industry. The chosen representatives for these groups were students, teachers and staff, and corporate representatives, all connected to the studied cases or with first-hand experience of the topic.

Table 3-1. Semi-structured interviews in USA.

Interviews related to d.school, Stanford University			
Respondent role	**Date**	**Interview mode**	**Duration**
Student	2017-03-06	In person, individual interview	25m
Student	2017-03-06	In person, individual interview	15m
Student	2017-03-06	In person, individual interview	20m
Student	2017-03-06	In person, individual interview	10m
Corporate representative	2017-03-06	In person, individual interview	15m
Corporate representative	2017-03-06	In person, individual interview	25m
Corporate representative	2017-03-06	In person, individual interview	15m
Corporate representative	2017-03-06	In person, individual interview	20m
Corporate representative	2017-03-06	In person, individual interview	10m
Research fellow d.school	2017-03-09	In person, individual interview	1h
Teaching team, d.school (3)	2017-03-13	In person, group interview	2h20
Teaching fellow, d.school	2017-03-13	In person, individual interview	1h40
Teaching team, d.school (2)	2017-03-14	In person, group interview	1h
Student	2017-03-14	In person, individual interview	40m
Student	2017-03-14	In person, individual interview	20m
Student	2017-03-14	In person, individual interview	30m
Director d.school	2017-03-14	In person, individual interview	1h
Student	2017-03-14	In person, individual interview	35m

Table 3-2. Semi-structured interviews in Sweden.

Interviews related to ProLab, Lund University			
Respondent role	**Date**	**Mode**	**Duration**
Director	2017-02-13	In person, individual interview	3h
Project manager	2017-02-13	In person, individual interview	2h
Student coordinator	2017-02-13	In person, individual interview	1h15
Interviews related to Demola, Linköping University.			
Respondent role	**Date**	**Mode**	**Duration**
Director	2017-03-14	Conference call, group interview	2h20
Student coordinator			
Corporate coordinator			
Interviews with corporate representatives in Gothenburg.			
Respondent role	**Date**	**Mode**	**Duration**
Innovation Directors (2)	2017-01-18	In person, group meeting	1h
Innovation Directors (4)	2017-01-18	In person, group workshop	2h
Innovation Directors (2)	2017-02-15	In person, group meeting	1h
Innovation Director	2017-04-18	In person, individual interview	1h15
Innovation Director	2017-04-19	In person, individual interview	1h
Innovation Director	2017-05-02	In person, individual interview	1h
Innovation Directors (4)	2017-05-16	In person, group workshop	5h

The sample of settings for observations in the study are described in table 3-3 below and a short description of the class settings is available in appendix B.

Table 3-3. Settings for participant observations.

Micro-ethnography conducted at Stanford University.			
Setting	**Date**	**Mode**	**Duration**
d.school class	2017-03-06	Class participation	2h15
d.school facilities	2017-03-06	Observation	1h
Stanford campus	2017-03-07	Guided tour	1h30
d.school class	2017-03-08	Class participation	2h50
d.school facilities	2017-03-10	Guided tour	1h
d.school facilities	2017-03-10	Observation	2h
d.school class	2017-03-13	Class participation	2h30
d.school facilities	2017-03-13	Observation	2h
d.school class	2017-03-14	Class participation	2h20
d.school class	2017-03-15	Class participation	2h
d.school class	2017-03-15	Class participation	2h
d.school facilities	2017-03-13	Observation	1h40
Stanford Campus and Silicon Valley	2017-03-01 through 2017-03-16	Observations throughout the visit to the Bay Area	-

3.5.3 GATHERING ETHNOGRAPHIC DATA

Since the human mind can only store and digest impressions to a certain degree, as much data as possible was collected through field notes and recordings. This enabled us to observe and experience more closely, since the data could be easily analysed afterward. An additional methodology for data collection is visual ethnography. This entails taking pictures and videos of the environment and activities. Photographs can capture data that would often be missed in an interview setting and provides a richer understanding of the environment and processes (Buchanan 2001). Given these benefits, photography was used as a data collection method when this was permitted.

3.5.4 SECONDARY DATA SOURCES

In addition to the primary data collected, secondary data is included in the form of documents, literature, and online resources. A variety of data was publicly available about the cases included in the study, which made it redundant to include inquiries about this basic information in the interviews. In some cases, respondents even referred to the publicly available sources as reply to certain questions. When documents are used as a source, this may entail qualitative content analysis to identify themes and meanings (Bryman & Bell 2015). This has not been necessary for the secondary data due to the direct and clear nature of the documentation.

3.6 METHODS OF DATA ANALYSIS

3.6.1 GROUNDED THEORY

Grounded theory has become the most widely used framework for analysis of qualitative data (Bryman & Bell 2015), it is a very flexible and adaptable method that can be very beneficial, especially coupled with rich data from ethnography and intensive interviewing (Charmaz, 2014), so consequently the method that has been chosen for our data analysis. The process of analysis consists of breaking down the data and reassembling it into concepts and categories, and it's a continuous process where the purpose of the methodology is to generate a theory through an iterative process. This process focuses on gathering recurring evidence among the research, until no deviating patterns seem to emerge, thus it entails an ongoing verification of data gathered (ibid.). This process has been conducted throughout the study, in parallel to the construction of the theoretical framework, and has enabled us to discover links and themes to draw conclusion from.

3.6.2 STAKEHOLDER FRAMEWORK

Whilst the grounded theory method, if applied to its full extent, has the potential to generate unexpected new theory, the methodology can also be partly applied to an established framework in the data analysis phase. Since this study is targeted at exploring a phenomenon from the perspective of different demographic groups, it made sense to employ a stakeholder approach. Stakeholder analysis encompasses a range of methodologies that can be employed for analysing stakeholder interests, needs, and impact (Crosby 1992), and for our study the approach has been used as a basic framework for the purpose of data analysis. The stakeholder

approach has been applied throughout the paper, providing a structure for analysis and presentation of the theoretical framework, gathered data, analysis and conclusions.

3.7 RESEARCH QUALITY

Qualitative research aims to capture the meaning of real-world events as perceived by the participant's, and a risk to be anticipated is that the researcher may assume another set of meanings through interpretation of the same event (Yin 2011). This multiplicity of meanings and interpretations are an integral part of qualitative research, and as researcher you can only hope to limit your own contamination of the research, it can't be eliminated; the researcher cannot act as "a faceless robot or a machinelike recorder of human events" (Powdermaker 1966, p. 13). Issues with research quality can be mitigated through transparency, acting methodically, and by adhering to evidence (Yin 2011). To this end, this study is described in detail and all research documented, so that it can be reviewed and scrutinized by a third party. Similarly, we have attempted to approach each case of the study methodically following the same steps, not to create some bias or skewed emphasis on any particular data. In terms of evidence adherence, the conclusions of the study have been drawn from analysis of the data collected, but naturally all conclusions incorporate our own interpretations in varying degrees.

3.7.1 VALIDITY AND RELIABILITY

In all fields of research, validity and reliability of findings are important, and the nature of ethnographic research present a special case. It has been criticised for weak reliability and lacking in validity but in their review of the research field LeCompte and Goetz (1982) conclude that despite the criticism, ethnographic research is a very powerful approach since it offers unmatched opportunities to study and understand human behaviour. Furthermore, the specific concerns regarding ethnographic research are less relevant for our study since it has been limited to adoption of ethnographic techniques in combination with other research methods. Qualitative research can be assessed in terms of credibility, transferability and dependability, in parallel to validity and reliability. To strengthen the credibility of our research results mixed research methods have been adopted, as this has enabled comparison of different types of data through data triangulation. In addition to this, we have adopted investigator triangulation (Thurmond 2001); which is a method where involved researchers, without prior discussion or collaboration with each other, individually performs their own interpretations of the data and compare it to one another. Furthermore, in terms of transferability, also often referred to as generalizability, the study counteracts some of the common issues commonly related to qualitative research. The issue resides in that qualitative research is very contextually dependent, and in this regard this study may have some upsides. Even though it has been done on a limited number of respondents and observations, the study has been conducted in the academic context which is highly institutionalized and standardized. This means that the findings may very well be transferable to other students and institutions. In terms of dependability, the study has adopted practices that Denzin & Lincoln (1994) suggest, by keeping record of all phases of the research. To counteract interviewer bias, all interviews have been conducted in pairs, with researchers taking parts in recording and interviewing roles.

3.7.2 ETHICAL CONSIDERATIONS

Business research entails ethical issues regarding harming or misrepresenting respondents in different ways (Bryman & Bell 2015), and throughout the research process the aim has been to avoid breaking any code of ethics. Informed consent has been acquired when asking for interviews in the sense that the respondents have been informed about the purpose of the study, the scope, and to which extent the results are to be used. This is, however, very hard when doing observations so for research purposes and ethical considerations, all respondents have been anonymized and sensitive details from observations are not included in the data. Ensured of their anonymity, respondents are free to more openly express their opinions without having to weigh their words, hopefully adding to the quality of the collected data. A downside is naturally that it can hurt the reliability of the study since it becomes less transparent, this is however something that we have aimed to mitigate by clearly describing the research process and data sources, without revealing the true identities of respondents.

4 RESULTS

This chapter contains a summary of the findings gathered during the thesis process. It consists of data from interviews and observations, and is categorized and structured around the cases of observation and the stakeholder groups. Richer data that can be of interest to the reader are provided in the appendices. The introduction of the chapter consists of a brief description of the background of the studied concepts and the interviewees.

4.1 BACKGROUND

As the thesis follows a multiple case study design, and since the studied phenomena involves interaction between different parties, the study contains data from multiple perspectives. Collaboration has been studied from the perspectives of graduate students and companies in multiple settings, facilitated by university staff, thus, there are three groups of respondents that have been interviewed. These interviewees in turn share four contextual backgrounds; representatives from the three groups have been interviewed in each of the three specific case contexts, and in addition to this, the fourth context consists of external corporate representatives belonging to Innovation Pioneers.

4.1.1 THE CONTEXT OF STANFORD UNIVERSITY AND SILICON VALLEY

It's no coincidence that d.school is situated at Stanford University in the heart of Silicon Valley. Home to the most influential tech companies on the globe, Silicon Valley is a melting pot of innovation, achieved through a vast interconnected business network. People that visit the valley are often struck with the magnitude and of the deeply rooted business culture shared by all actors. As a Swedish industry respondent put it;

"It's a completely different world over there, what they (companies in Silicon Valley) can do, we can only dream about." - Interviewee C7.

It's often thought of as a cluster for technology innovation, breeding an endless flow of start-ups, but the top companies also consistently manage to stay ahead and they successfully manage disruptive innovation, so there is something particular about the region besides being high-tech. A brief look at the history of Silicon Valley, provided by Steiber & Alänge (2016), helps put it all in context. Information technology is a fast-moving industry that forces companies to stay innovative, which means they must have flexible and adaptive capabilities and entrepreneurial organizations. This type of business culture has naturally grown out of the valley as it was once empty fields that attracted incoming settlers during the gold rush in Northern California. These people had to rely on cooperation and were very open to partnering and networking, and since everything was being built anew, people had to work across conventional sector boundaries. During this time, Leland Stanford who ran multiple businesses and was briefly governor of California, founded with big visions and goals, Stanford University in 1891 on the family's horse farm, and it was to become the nexus of Silicon Valley. The first tech company in the region, Federal Telegraph Company, was started by a Stanford engineering graduate and it soon spawned several pioneering technology spinouts. This created university-industry linkages with Stanford and from this, Hewlett Packard

emerged in 1939, among other businesses. The resilience and continuous growth of the technology cluster in Silicon Valley is often credited to the region's dense networks of social, professional and commercial relationships. As a contrast, on average a Stanford alumni CEO sits on 5 company boards while a Harvard alumni only sits on the board of one other company[5].

This culture of multidisciplinarity is something we witnessed during our visit to Stanford as it appears to permeate the whole campus. Starting off with the physical layout of the campus, every structural decision seems to be done in consideration to the multi-disciplinary context. Going back to the original building called the main quad, situated at the centre of campus, this was intentionally designed to house all different faculty disciplines to induce collaboration across boundaries. Whether this was the case back when the university was founded is not certain, but the main quad is being used in this manner today. Our tour guide, a senior graduate student, explained this as;

> "It's interesting when you look at where you go to have class, you often have to go to class rooms in different buildings and areas, and you often find yourself having a class in say psychology right next to a class on electrical engineering or something like that...
>
> ...this means that when you're walking down the hallways you can overhear people talking about things that are totally unknown to you, or going to and from class you can bump into and get to know people from very different fields, people you might not otherwise have met at all." – Interviewee S2.

This intentional mixing of disciplines is permeated throughout campus. The lands that Stanford is situated on is vast and allows the university to grow, and new buildings are constantly constructed. These new buildings are nowadays designed with multi-disciplinarity at the core, where one example was a three-story building that was shaped as a doughnut, with nothing but windows looking inward over a courtyard. A professor, interviewee U5, explained to us that it was a research centre that housed some six or seven different disciplines, and that these researchers could openly see what everyone else was doing, which essentially removes all physical barriers to interdisciplinary collaboration. This type of layout was being reiterated across campus in undergoing construction projects and we observed other elements of collaboration facilitation as well. When we visited the engineering quad[6], to look at the original Google server that was on display there, we were struck by the arrangement of the furniture in the common areas of the building. In an open seating area, sofas were turned inward, forming a square where you faced someone else wherever you were seated[7]. We first didn't think so much about it, but the recalled how a similar space that we often use at our home university is arranged, there the sofas are turned out, forming a cross, so instead, wherever you sit your back is turned to someone else. This way of arranging spaces to induce collaboration is something

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[5] Rubens et al. (2011). http://www.innovation-ecosystems.org/wp-content/uploads/2010/12/2011.educon.pdf. Accessed 2017-05-07.
[6] Stanford (2017)
[7] See appendix C, picture 1.

that was consistent throughout the d.school where we spent most of our time doing our study, but to see it in other apparently common areas around campus gave us a deep understanding of how dramatically different the culture was there compared to our home institution. As a simple contrast, the University of Gothenburg is geographically and institutionally separated[8], so a business student can go through their five-year education without ever meeting an engineering student for instance.

Collaborations with external partners, such as high tech companies in the area, is also a common element of campus life. However, as we found from interviews, similarly to the general way of conducting UICs research projects in collaboration with corporate partners are primarily done at the PhD level. The link between graduate students and companies is mainly confined to internships or other shorter corporate events like hackathons or case competitions, as explained by interviewee S1. From our observations, we found that students seemed to emphasize entrepreneurial projects more than connecting with existing companies. And this is something that the university heavily encourage, as one student explained;

> "If you have a subject of interest that no student union is already engaged in, or there is a project you want to realize, the university will gladly provide you with the means to pursue it. For example, I know of a group of students that received a $20.000 funding to start a new campus paper, they just had to get together and make a basic business plan." – Interviewee S2.

This brief summary of our observations and of the history of Stanford, hopefully provide enough illustration of the contextual background that has impacted the analysis of our findings and possible conclusions.

4.1.2 INTRODUCTION TO D.SCHOOL, STANFORD UNIVERSITY

The primary case of this study is the Hasso Plattner Institute of Design, also called d.school at Stanford University, USA. This is an independent institution within Stanford that offer opportunities for students from different fields to interact with each other and with industry[9]. The institute approaches innovation through *Design Thinking[10]*, which is central to all classes. Design thinking focuses on the intended user or customer to identify the core behavioural drivers of the individual, through empathizing with the user and quick prototyping, the process enables a quick path to useful solutions and innovations. The institution was founded in 2004

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[8] GU (2017)

[9] D.school (2017)

[10] Design Thinking can increase innovation capabilities in the early phases of product development, advocated by theorists and practitioners, and it originates from engineering, as design is widely considered to be the central activity of engineering (Dym et al 2005). Engineering is characterized by scoping, generating, evaluating, and realizing ideas, and this thought-process that follows a design process drives the development. It is a methodology that can be implemented in a variety of settings and fields and enable practitioners to gain new perspectives. The user centric approach is very powerful in today's quickly developing economy as understanding of the core needs and desires of customers can enable firms to change or create whole new markets (Suarez & Kirtley 2011). A deep focus on customers' needs enabled firms like Apple, Google and Facebook to dethrone incumbent rivals and reshape their markets (ibid.).

thanks to a sizeable donation from Hasso Plattner. This enabled the founders to set up the d.school as a non-degree granting centre that serves all departments on campus with introduction to human-centred design thinking. The concept has not been without its controversies, as it departs quite remarkably from the traditional academic format.

> *"d.school is not just unconventional; it's extremely radical...*
> *and still a controversial concept."* - Interviewee U7.

The institution is open to the public and tours of the facilities are hosted on a weekly basis. This enables prospective students as well as curious industry representatives to openly experience the collaborative environment and effortlessly connect with the school. During our visits to the facilities, and throughout campus, we frequently observed external visitors from various backgrounds.

Interviews in this context consist of respondents from all three groups; university faculty and staff, students, and industry representatives.

Table 4-1. Interviewees related to d.school at Stanford University.

Background	Assigned number & Position
Faculty d.school	(U1) Teaching Fellow
	(U2) Research Fellow
	(U3) Professor of Design, involved from founding
	(U4) Teaching Fellow, Design
	(U5) Professor of Design
	(U6) Director
	(U7) Executive Director
	(U8) Founder & Director
Student at d.school	(S1) Student, Management of Science & Engineering
	(S2) Student, Art
	(S3) Student, Law
	(S4) Student, Product Design
	(S5) Student, Management of Science & Engineering
	(S6) Student, Business
	(S7) Student, Product Design
	(S8) Student, Business
External corporate partner	(C1) Project leader, Public transit organisation
	(C2) CEO, Apparel retail brand
	(C3) Business owner, catering services
	(C4) d.school alumni
	(C5) d.school alumni

4.1.3 INTRODUCTION TO DEMOLA, LINKÖPING UNIVERSITY

Inspired by the d.school, Demola was founded in 2008 in Tammerfors, Finland[11], it works in a similar way as d.school, by facilitating multidisciplinary courses at universities. Demola offers courses to students where the focus differs from regular teaching models, where PBL (Project Based Learning) is utilized, and corporations partner by providing real cases. The corporate partners range from non-profit and SMEs to large corporations and public organisations. Demola differs from d.school in the sense that it is an independent company that acts as a facilitator for universities that want to incorporate PBL and collaborations with companies. Both the university and corporate partner buys this service from Demola.

Table 4-2. Interviewees related to Demola East Sweden.

Background	Assigned number & Position
Faculty & Staff	(U9) Head of Demola East Sweden
Demola at LIU	(U10) Facilitator, Industry relations
	(U11) Facilitator, Student relations

4.1.4 INTRODUCTION TO PROLAB, LUND UNIVERSITY

At the time of this thesis being written, the ProLab initiative had been shut down. The initial platform was derived from a concept developed at Öresund University where the focus was aimed at bridging the gap between companies and students and to enhance the innovation energy at firm level with the help of students[12]. Due to political implications, the initiative lost funding and the concept was migrated into Lund University by faculty members and students and quickly started to generate revenue from projects done with corporate partners. However, as the initiative started to gain traction the University retracted their support since they perceived it to stray too far away from academic institutional principles. At this point the project leaders attempted to run the concept independently under the name ProLab and some projects were headed before it was finally terminated. ProLab shared many similarities with the other concepts and it is highly interesting to include to empirically study institutional obstacles related to this type of collaboration models.

Table 4-3. Interviewees related to ProLab at Lund University.

Background	Assigned number & Position
Faculty & Staff	(U12) Director
Prolab at LU	(U13) Project Leader
	(U14) Facilitator, Student relations

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[11] Demola (2017)

[12] The background of the concept was provided by the interviewees.

4.1.5 INTRODUCTION TO INNOVATION PIONEERS

In addition to studying the selected cases, the research also includes insights collected from relevant industry representatives. As mentioned in the thesis introduction, the research project has been conducted in partnership with selected representatives engaged in the business innovation network Innovation Pioneers. The respondents that have been interviewed are key figures in their respective organisations, highly engaged in, and responsible for, external collaborations and innovation projects. A number of member corporations in the network have initiated a project to engage more closely with students and the findings of our research project has been shared with the group. In exchange, the representatives have shared their views on the topic through several interviews and workshops.

Table 4-4. External Corporate Interviewees.

Company	Assigned number & Position
CGI	(C6) Innovation Lead
Stena	(C7) Chief Digital Officer
Volvo Cars	(C8) IT & Innovation Manager
SKF	(C9) Innovation Manager

4.2 EMPIRICAL FINDINGS

The primary data collection has been done through semi-structured interviews, and the questions have been adapted according to the interviewee responses and situational factors. The whole set of interview questions can be seen in appendices D-F. The key empirical findings are presented in this chapter, and the interview responses, along with observational data, can be viewed written out in appendix G.

4.2.1 MOTIVES TO ENGAGE IN COLLABORATION

This section of the results consists of empirical findings regarding the underlying motivations and incentives for students and companies to get involved in co-innovation. The results are presented through a stakeholder perspective, including firms, university and students and categorized accordingly. The data is presented in a condensed format through three tables, one for each perspective.

Motivational factors for industry to collaborate with students and university	
Interviewee	**Response**
Interviewee C1	When you are facing major internal barriers, or when you can't really see the solutions, an outside perspective is invaluable to get.
	Collaborating with university and students is less risky than working with other firms.
	Getting in the same room helps to get going.
	Learning and establishing connections.
Interviewee C2	Critical to understand the customer and your market.

	Students have a fresh perspective, they are more in tune with social media and customer preferences. (C9)
	Students bring a fresh school mentality of "trying things quicker" that can help companies applying innovation. (C9)
	It's valuable to get a lot of different perspectives on the same issue. (U12)
Interviewee C5	Everyone thinks differently, you will uncover unexpected things by collaborating over boundaries.
Interviewee U3	A changing world requires you to connect with new people, to get new perspectives. There is no point in developing products if there is no need for them in the market.
	The new world is built on pulling, not pushing.
	Innovation is not siloed. (U12)
	Graduate students are "free electrons", they make things happen! (C6)
	Firms are attracted for the opportunity to expose their brand name to students, and since it is a low risk option for experimenting or doing market research.
Interviewee S2	More firms are realizing the value of user empathy for business and product development.
Interviewee C4	Students are the "creative juices", they bring the new ideas and new concepts, and they think outside the box.
	Students are not restrained; in a company efficiency is everything, we don't have the slack necessary for innovating.
	Bringing students in creates a different level of energy. (S3)
Interviewee C3	Firms are incumbent, they are constantly struggling with the broader vision of the company, student have a fresh perspective.
	Students are not burdened by "false" beliefs that hinder companies from innovating.
Interviewee S3	Companies are often too set in their ways, they live in a closed universe.
Interviewee U9	Getting access to students and employing students locally.
	Increase interdisciplinary thinking in organisations. Companies often lack competence to gain value from different disciplines.
Interviewee U10	Letting students into the operations of a company can help managers get new insights and perspectives.
Interviewee U6	Students have knowledge about new technologies that employees don't really understand, students can come in and facilitate things.
Interviewee U13	Recruitment of future employees
Interviewee C8	Companies have a responsibility to foster new generations, collaboration may not generate direct benefits, but be valuable indirectly in the future.
	Students can help in the early phase of development, collect insights.
	Getting access to theoretical findings. Students have time to study literature, which there is no time for in companies.
Interviewee C6	There are plenty of ideas at our company that were initiated by students.
Interviewee C7	Replacing hiring practices and base it on relationships from collaboration.
Interviewee C9	Idea generation in external networks are much more effective than if done in the internal line operations.

Motivational factors for students to collaborate with companies

Interviewee	Response
Interviewee S1 (S2, S4 & S8)	Learn more about how companies work, and learn about industries. Get opportunities to network, to get interviews and career opportunities. Learning new approaches to solving problems, different from traditional classes taught in programs.
Interviewee S2	Collaborating with others, especially students from other backgrounds. (S7) Regular classes don't translate business cases to reality very well.
Interviewee C4	Companies have a lot of resources to get things done. Students value working with companies to understand how things work. It's important for students to learn the frictions that are in companies.
Interviewee C5	Students thrive on learning and want to change the world, but the "real" world have different limitations and political forces that are good to learn and understand for students.
Interviewee S7	It's easier to put in the time and effort when you get to do something real, for someone else. (S8) Came to Stanford for the d.school I wanted to work on something real, and work interdisciplinary, because that is what you're likely to do later in life.
Interviewee U11	Interacting with large companies is a good way to be seen and demonstrate your abilities. Students write on their CV that they have participated in projects. Students welcome the opportunity to interact and learn from each other, it's attractive to do interdisciplinary projects.
Interviewee U9	Students express that they are motivated by the opportunity to work with a company that is genuinely interested, and to be able to help them solve real problems.
Interviewee C6	I believe students get engaged because they want to be associated with an organisation that possesses a strong brand.

Motivational factors for university to facilitate collaboration

Interviewee	Response
Interviewee U1	Student employability is the responsibility of university.
Interviewee U2	Access to resources through external collaboration.
Interviewee U3	Innovation is not siloed, you need to interact across boundaries. Progress today is achieved through pulling not pushing, you need to understand society to be able to affect it.
Interviewee U4	Improved university public image in industry and society.
Interviewee U8	Society needs more creative and driven individuals and academia have a responsibility to nurture these qualities. Enable students to discover and build their creative confidence.
Interviewee U9	Enable students to evolve as individuals.

	Make students stay in the municipality instead of leaving after graduation. If students stay, then companies will stay, a positive spiral. Creating a platform for collaboration across borders, nationally and internationally.
Interviewee U10	Increase exchange of competence across boundaries.
Interviewee U13	There are by far not enough applied sciences at universities. Lund university costs the taxpayers billions of kronors per year, it should be expected to develop with society.
Interviewee U12	Universities can't go about their business as usual, the world is changing.

4.2.2 BARRIERS TO EXTERNAL COLLABORATION

This section presents the interviewees' opinions and perspectives on the barriers that may prevent stakeholders from engaging in external and interdisciplinary collaboration.

Perceived barriers for industry to collaborate with students and university	
Interviewee	**Response**
Interviewee C1	If you are not used to working with outside people, it can be hard to get engaged in projects with outsiders. Spreading the new knowledge within your organisation will always be an uphill battle. Hard to get management support for new projects in large organisations.
Interviewee C2	Having time to engage in this type of collaborative projects. The project that was done required a lot of invested time and effort. (C6) (C7) (C8)
Interviewee U4	One of the hardest things to do is to realize your own restrictions. People in industry are often older people from previous generations who have old mind-sets. They don't get the world.
Interviewee S1	In the corporate world, there is no room for mistakes, avoid risks. Companies don't want to bother their customers.
Interviewee U9	Large companies trust in their innovation processes, see no value in student collaboration for innovation purposes. (C6) (C7) (C8) Smaller companies are too busy running their operations. They are in to their entrepreneurial journey. Companies think they know their customers, but they seldom do. Universities are the most problematic to work with in business.
Interviewee U10	The understanding of the value is equally low among large companies as SMEs. A project can be a big thing for an SME, but just another activity at a large company. Each offers its own set of challenges.
Interviewee U2	Understanding of what can be generated from student collaboration. "Very few problems can be solved by a group of students in a few weeks, especially since they have other courses going on at the same time".

	Companies want to get engaged, but they don't know how; "They come to us, but they don't really understand exactly what it is."
Interviewee C6	Finding the time. There is no organisation today that is not slimmed down, there is no slack to engage in activities outside the core business. (C7) (C8) Commitment is more important than time or money. Once management understand the value you will get all support that is needed. (C7) (C8) Misalignment with university timeframe. Student projects (thesis) are often too long to keep track of development. (C8)
Interviewee C8	Lack of ways to keep track of students' progress in school, to know when and how to interact. Lack of system for communication with university. (C7) Student collaborations generate value, but come at a huge cost, it especially requires a lot of time, which we don't have. Misaligned timeframes. Companies are up and running within weeks from project initiation, getting student on board takes much longer. Corporate recruitment processes are hard to bypass.
Interviewee C7	Lack of integration with school and students. Communication should start much earlier.

Perceived barriers for students to collaborate with companies

Interviewee	Response
Interviewee S2	Short projects offer limited appropriation potential. When you engage in a project you need to spend a lot of time on it to get something out of it.
Interviewee U4	Students can have a hard time working together with people they don't know. Group dynamics is complicated.
Interviewee U5	There must be a period of getting to know each other, as students need to develop mutual trust to collaborate.
Interviewee U1	Ambiguity of classes and project can cause confusion. Students tend to gravitate towards projects and tasks that they are familiar with, rather than following a process.
Observation	Students expressed difficulties in adopting the process and running projects independently.
Interviewee S4	You need some sort of incentive. Credits or other things like opportunity to travel, or a really exciting project.
Interviewee U2	If the projects don't award credits, there must be some other incentive. Only students with the opportunity would be able to participate, some may have other obligations outside regular school program, like part-time job. The multidisciplinary focus restricts students to participate, if it is very popular in their discipline. This is an issue for business students at Stanford.

Interviewee U6	We have experimented with it, and it's a constant battle how to incentivise students in the right way.
Interviewee U8	It is easier to work on something and understand it if you are engaged and committed.
	Traditional course assignments get more attention than your own project, doing something for someone else makes you more motivated, it's a common psychological behaviour.
Interviewee U9	Student awareness. Students live in the university bubble and realize very late that they need to network for their future career.

Perceived barriers for university to facilitate collaboration

Interviewee	Response
Interviewee U1	Companies may have to be pushed back at times, when they focus their expectations too much on product prototyping. They don't understand the purpose of the classes all the time.
	In multidisciplinary projects, there need to be a common language. Design thinking servers that purpose at the d.school.
Interviewee U3	Technology transfer office.
	Companies often look for tangible projects that may not be suited for the capabilities of the students.
Interviewee U4	"Faculties need to see the value in PBL, students come back more competent".
Interviewee U5	You must have buy-in at top of departments, otherwise things are very hard.
	Attracting firms to collaboration is hard. d.school thrives due to the association with Stanford, and the founder David Kelley.
Interviewee U7	The d.school is shunned by both sides, by the design community and academia. It's extremely radical… and still a controversial concept.
	Lack of understanding for Design Thinking. (U8)
Interviewee U11	It's hard to get companies to let go of control. "Being open to crazy ideas is harder said than done".
Interviewee U8	d.school was shot down, until it received a donation. "I am in academia to avoid the barbaric nature of money, we don't talk about it but it but it turns out it's here…"
	Design thinking is unconventional and controversial.
Interviewee U9	These practical courses take a lot of time to schedule and plan, as well as running them (more than one teacher involved in class). It's a high burden. (U1, U2, U5)
Interviewee U2	It can be a challenge to form our teams, since the breadth of applications rarely match the prerequisites for the concept.
	Mental barriers to get going. Often a false belief that there are too many rules or resource requirements to get something done.
	PBL requires a lot more resources and flexibility compared to traditional teaching.

Interviewee U10	Academic institutionalism is hard to work with. University is a "massive blob" that is hard to affect and that moves very slowly. (U9, U11)
	Everyone wants to have their say in faculties.
Interviewee U13	Participants must feel ownership of the space, can't just set it up.
	Hard to rely on university, need independence.

4.2.3 OUTCOMES FROM COLLABORATION

In this section, we present the outcomes from collaboration, as perceived by the involved stakeholders that have participated in the studied cases. The data is divided into outcomes for the participating students and companies. Outcomes to university are not regarded as this is not covered by our research objectives.

Outcomes from collaboration for companies

Interviewee	Response
Interviewee C2	New ideas for marketing. (S2)
	Better awareness of the brand position on the market.
	Deeper understanding of the end user, the customers. (S2)
Interviewee C1	Working outside the "government box".
	Empowering for the participants. An energy boost, revitalizing. (C2)
	Get new ideas. (U2) (U10)
	New perspective on things. Students have provided a deeper understanding of the market and our customers. (U10)
	Future projects were already in the making.
	Student collaborations are going to be pursued more, outside university within the own operations.
	The experience and framework will help our organisation. It "alleviates engagement"
Interviewee C4	This has brought back the creativity and our innovation capability.
Interviewee C5	Methods and way of thinking has been very useful as an entrepreneur.
Interviewee C6	It has become easier to focus on certain processes. In business, we often think about results, and not creativity.
	The potential for finding new talents for hiring. (U2)
Interviewee U10	Stepping out of your comfort zone can be a challenge, but a very rewarding experience. Corporate participants often grasp for frameworks when faced with tasks, this enables them to nurture creativity. (C2) (U8)
Interviewee C3	We often get distracted by running the business, design thinking is a useful framework to find the focus.
Interviewee C6	Students mainly bring new ideas and knowledge, these can be further developed by the company at a later stage.
Interviewee U2	Exposure of the company brand to students.
	Get a new mind-set that can help in regular work life.

Interviewee U10	Opportunity to get access to students outside your core industry. New perspectives on recruiting. Interdisciplinary experience fosters new thinking. The innovative value is far greater for SMEs. The ideas can be vital to future company success. Crucial difference from large companies.
Interviewee U9	The output from projects is mostly of conceptual nature due to the limited time. You can't expect finished solutions, but rather initial prototypes. (U10) Companies that have participated often return, they have discovered the potential value and care less about the cost, they are curious to see what the outcomes might be.

Outcomes from collaboration for students

Interviewee	Response
Interviewee S2	A new way of looking at life. (S4) The knowledge you get is applicable to many other contexts. You can use pieces of the process in different situations. (U4) I'm a more creative person now. (S3) (S4)
Interviewee U1	The tools that students are taught are useful in all aspects of real life.
Interviewee U2	A totally different experience than traditional teaching. What you learn you can apply to your life. A bias toward action. A boost to your CV.
Interviewee U8	Creative confidence. (U9) (U11)
Interviewee S5	You need to exercise your creativity, it's a muscle. (U14) Real projects prepare you for how to work in an industry. (S4) (U11)
Interviewee S7	Experience of group dynamics. Creative projects are like a team sport, very useful to learn and master. (S8) Interdisciplinary experience hard to get anywhere else. (U2)
Interviewee U9	Normally, students aren't provided with a base methodology and are insecure about their abilities to tackle complex problems. Experience from practical real projects make students believe more in themselves.
Interviewee S4	Helping others is a rewarding and fun experience. Short collaborative projects are like doing internships.
Interviewee U4	Students get to know themselves better, and realize they don't know everything. (U2) (U8)
Interviewee U3	Real projects put pressure on students to grow.
Interviewee S1	With this competence and confidence, I will be able to affect my future workplace to the better. New perspectives from working with students with other backgrounds. (U11)
Interviewee U10	Enormous networking opportunities. Students that have taken courses will always shave someone to call after graduation. (U13) It's common that participation in projects result in employment.

4.2.4 *DESIGN OF THE COLLABORATION MODEL*

This section describes our findings regarding the design and operation of the collaboration models that we have studied. Firstly, we provide a description of our observations collected at Stanford University, and secondly, a summary table presenting key data on the studied cases is provided. This table is based on interview data that can be found in appendix G under the respective headings.

4.2.4.1 Observations on design and activities

As mentioned earlier in section 3.4.2, we have adopted micro-ethnography as part of our research methods. This has entailed participant observations when this has been possible, to enrich the data that we have received from interviews. By participating in several different activities, such as university classes and guided tours (Appendix B), we gained further knowledge on to answer our research questions.

What characterizes location and space at d.school, is the focus on adaptability and transformability, in which that all the objects are mobile and easy to move around. Whiteboards, along with their many post-it notes are objects connect to d.school. In every corner, you can always find these two, and when not in use, the whiteboards are stackable thanks to a Z-form design to take up minimal space (Appendix C, picture 3). Furthermore, every couch, table, and chair, have wheels on them (Appendix C, picture 2), and in our guided tour at d.school, we could see how easy it was for our tour guide to structure the layout of the objects easy and quick. She simply rolled them into place within seconds.

When our activity in that specific classroom tour was over, we all helped to put everything back, according to clear descriptions found near each exit. These "reset this space" signs (Appendix C, picture 6 and 7), made it very easy to organise the space so that it was ready for someone else to use, and the process was quick and effortless. In the guided tour, there was also an option to participate in some of the activities they usually perform with their students. One activity was for the group to come up with ideas of how to make it easier to find your way around campus. The group were given free access to the materials at hand, and one group member acted as test subject, so he did not participate in the design activity. The group agreed to go with an idea of having illuminated lines on sidewalks, and to prototype this, different post-it notes were used to form a trail to follow. After the design was completed, the test subject entered the room and was asked to evaluate the solution, without getting any introduction or explanation. Five colours of post-its had been used; purple, yellow, orange, green, and blue, which led the test-person to figure out how the infrastructure of this minor exercise worked. In this activity, the guide did not direct the participants on how to think, or act, she simply only provided the tools, and the diverse group came up with many different ideas on how to properly design the walk-way system. Another activity performed was called "No but, Yes and". The format started out in which one person said something like "I think we should have windows in here", and next person in line answered on this, and said, "No, but we should have mirrors instead". This was done in three rounds and where the follow-up on this assignment was to build on the previous sentence, compared to shooting it down. For example, "I think we should have windows in here" and next person could then say "Yes, and we should have windows in

here, together with mirrors in them". And we observed how different these two approaches were and suddenly people were much more talkative, and outgoing, and after the second exercise the atmosphere in the room was much more joyful. The spaces we did the activities in accommodated all interactions well, and in more complex projects, the whiteboards and post-its make it easy to visualize though processes (Appendix C, picture 4 and 5).

When observing a course which only graduate students could take, we acknowledged that project based learning can be very vague. This class was being held in what they called the d.garage, and the surroundings was just like a garage. Objects lay around everywhere, dust was gathering up in the corner, and machines were stacked along the walls; the room simply had a garage feeling. The class session we attended was a half-way review, and the teaching team aired their frustration over the lack of progress that the project groups had achieved. Despite that this course was being led by some of the most prominent teachers of the d.school, we observed that there was a subdued tension in this class and the students felt restrained and confused on how to move forward with their projects. These 30 students sat in a half-moon shaped circle and paid full attention and listened closely to what the teacher had to say about their development. None of the students lost attention by looking at their phone, or gossiping, they were fully committed to get better, and listen closely to the critique. In this session, they performed a similar activity to the "No but, Yes And", but it was centred around "I wish, and I want" instead. Students said for example "I wish we could have a better focus, and I want you to help us more". When this exercise started, the subdued tension got released and people changed their posture and suddenly felt more confident on how to move forward with their projects.

Throughout campus, we observed how a multi-disciplinary focus was ever present. The walls of buildings were often made of out glass, in which you could easily observe what students, and teachers were working on. Students were very open-minded and encouraged interact with new people, and which also is encouraged. Table settings, parks, sofas and so on are shaped in a coliseum form, and we observed that in this layout, people are constantly facing each other and not turning the back towards each other (Appendix C, picture1 and 8).

Regarding the learning structure, we noticed that several students act as coaches, and d.school has created a system for this. Where once you have finished a coaching course, you will act as a teacher for the students taking the course in the upcoming semester. So, this interaction between students from different years seems to be very common.

When the students are presenting their projects, the teacher records the presentation with a camera and is actively zooming in on the student presenting. Moreover, we observed that in most of the classes we participated in, the atmosphere in the classroom was often very easy going, a lot of laughter, and all the presentations often had some sort of twist in or they were dramatized as a play, and everybody in the classroom had a big smile on their lips.

Next, we present a summary of how the studied cases are designed and how this connects to the goals and challenges.

4.2.4.2 Summary of design features

Summary of the studied concepts

	d.school	**Demola**	**ProLab**
Objectives	Enable students to gain creative confidence Innovators, not innovations	Connect students and industry primarily to provide student with real-world experience Make students stay	Connect students and industry primarily to create innovations and solve problems
Governance	Independent institution within Stanford, staffed and operated by academics and faculty	Owned and operated by the university Concept provided by external company	Initially under university, later run independently
Partnerships	Wide range of partnerships, big and small corporations from the bay area and public organizations	Mostly SMEs and a few large corporate partners, otherwise municipality and public organizations	Large corporations or public organizations
Company involvement	Company primarily acts as sponsor, with exception of d.leadership Clear focus on teaching Mix of company representatives	Companies only act as sponsors, activities may take place at the facilities of the companies Mix of company representatives	Projects conducted on a consultancy basis solving cases for company partners
Typical cases	Consumer research, market analysis, understanding the user	Wide range, mostly business model innovation or product development	Business model innovation, market research, consumer research
Student backgrounds	Undergraduate and graduate students from different disciplines	Undergraduate and graduate students from different disciplines	Undergraduate and graduate students from different disciplines
Student incentives	Credits are awarded	Credits are awarded Students own IP rights	No credits awarded Projects as contests
Process design	PBL structured around a design thinking process Provide framework, let participants do the rest	Fixed framework Emphasis on PBL	Open innovation Facilitating instead of teaching

	Typical course entail three cases	Control of project direction is a balancing act	Parallel training sessions, by students for students
Activities	Short and iterative Follow the creative process Meet with users in real life Force teamwork	Students are introduced to case solving tools and models and are tasked with the real case from the start Try to have a variety of activities	Student groups free to adopt any tools or methods Initiating event and final presentations, some follow-up guidance Tutorial nights
Location	On campus dedicated facilities where classes take place	On campus class rooms and additional working space	Dedicated space on campus, open for drop-in
Space	Purposely designed spaces for collaboration Adaptive multi-spaces Dirty prototyping equipment on site and availability for more advanced prototyping off site	Conventional class- and meeting rooms Basic tools for creative processes Availability to prototype off site	Open space No intentional design, students allowed to transform/rebuild Basic tools for creativity Availability to do all sorts of prototyping
Challenges	Fitting projects to course formats Understanding from external partners, including university Student engagement Pricing	Engaging students, more interest from intl. stud. Working within the university framework Pricing Understanding from companies, not becoming consultancy projects	Battling the university Funding Getting corporate partners Pricing Achieving harmony between groups
Key success factors	Standardized successful format Established reputation Academic independence	Well adapted to university format Suits local business requirements Generating traction	Hugely popular among students Students could influence the format
General context	Entrepreneurial and collaborative business environment	Growing understanding for multidisciplinary forms of education	No support from the university

5 DISCUSSION

In this chapter, the empirical findings are connected to the theoretical framework to find answers to the research question. The chapter is structured according to the previous presented themes.

5.1 THE ROLE OF UIC

As discussed in the introduction to this paper, the need for collaborations between different institutions and actors is driven by numerous forces, such as technological advances, development of markets and societal changes. This growing need for interaction has bene filled through different modes of collaboration to achieve different objectives, and looking at UIC, the common approach has often been to enact collaborations on an institutional level as presented by Viale & Etzkowitz (2010). However, there are those that promote more collaboration on other levels, that can generate additional value. The background to the development of Silicon Valley, and the role that Stanford University has played in that development, can be viewed as an illustration of the view on UIC of Perkmann & Walsh (2007), that it is a concept that is increasingly important for the development of society. The authors posit that UIC can be a channel for generating new innovations, and that it traditionally has been measured in number of patents and start-ups that it generates. But in addition to this, interpersonal collaboration can offer wider contributions. The theory of open innovation, introduced by Chesbrough (2003), states that firms increasingly need to interact and collaborate to generate useful innovations to the world, and it goes without saying that Silicon Valley is a unique phenomenon, exemplifying this way of approaching business and innovation.

The success of Silicon Valley, can through the historical review by Steiber & Alänge, be heavily attributed to the emergence of a tradition of collaboration. This may initially have generated innovations through sharing of resources and codified knowledge, but increasingly, new findings are seen to be a product of closer collaborations. An environment that offers unmatched opportunities for innovation has been created in the region, and from our own observations and historical accounts, the university has played a central role in this development. As we presented in the introduction, several theories point to a changing role of universities in society, where university engage with society and industry in a triple helix approach. From history, and from interview responses, we can see that Stanford has pursued this position successfully. The university has generated several well-known businesses and innovations and continue to do so through close research collaborations. In addition to this, an atmosphere of interpersonal exchanges was palpable throughout the campus of Stanford. Collaborations with industry is not only confined to controlled research projects, but as observed at d.school, and across campus, representatives from industry are frequently visiting and partaking in exchanges of various nature. These exchanges illustrate the emerging role of UIC as not only being a channel for institutional parties to engage in research projects, but a channel for personal exchange of experiences and knowledge.

The purpose of this thesis has not been to understand UIC in general, but this brief analysis of the role that it can play in the collaboration between university and industry provides us with a

confirmed contextual basis for our research. We have established that UIC can encompass multifaceted exchanges, and that Stanford university that is the context where our primary case resides, display these properties. We can, thus, assert that the findings that this case study generates, should be relevant for our research.

5.2 STAKEHOLDER PERCEPTIONS

In this section of the discussion, the perceptions on different aspects of collaboration collected from respondents are contrasted to the theoretical framework. The objective has been to identify any misalignments with theoretical accounts, and when contrasted to our findings on design factors the collected perceptions will enable us to fully answer our research question.

5.2.1 ANALYSIS OF MOTIVES TO ENGAGE IN CO-INNOVATION

5.2.1.1 Motives from an industry perspective

Importance of external collaboration

As we presented in the introduction and the theoretical chapter, innovation has become an imperative for doing business. As explained by Chesbrough (2003), an era of open innovation forces firms to engage in external collaborations to keep up with markets and emerging competition. Given that this is topic that has received massive attention during the last decades, this development should come as a surprise to few. However, to assert ourselves that this view on the competitive landscape is not just a notion shared within academia, we collected perceptions on the topic from industry representatives. As can be seen in the presented data, several respondents agree that external collaborations are increasingly important. Respondents from industry background shared several specific ideas and experiences related to collaboration with students, and in general, a shared notion was that conducting business today require companies to engage externally. Interviewees had different perspectives on the value of the specific collaboration with graduate students, but agreed that acquiring knowledge externally through close relationships are necessary for innovation.

Even though the interviewees may not have expressed the problem in the same terminology as Christensen (2000), his description of the *Innovators Dilemma* that large corporations face, was reflected among several of the responses that we collected. Christensen (2000) explain that the growing corporation will naturally have to create an organisational structure that is adapted to current business conditions of the firm. The main goal for the growing firm is to pursue efficiency, to be able to provide customers with competitive solutions, but this eventually creates an impediment to innovation as the firm will find itself lacking the flexibility that this requires. Several interviewees confirmed this problem, as they frequently referred to time and resource constraints within their organisations as a major issue. Interestingly, this connection that we perceive, that the pursuit of efficiency is a driver of an increasing need for collaboration, was not explicitly shared by corporate respondents, they simply referred to time constraints as an obstacle to engage in external collaborations. The alarming catch-22 illustrated in theory that many managers and organisations may suffer from; firms losing innovation capacity due to a pursuit of efficiency, but refraining from external innovation due to the time constraints they have created for themselves, became evident through our interviews.

Overcoming organizational obstacles

Several respondents referred to the internal organisational climate, and to managers' lack of understanding as impediments to engaging in collaborations and projects outside the core business activities. The theory of Yu & Hang (2010), that organisational issues is an impediment to innovation is, thus, clearly expressed by our corporate respondents. Some corporate respondents even confirmed that external networks are more effective channels for innovation than isolating projects to the internal organisation. Interestingly, university respondents expressed this connection more clearly than the corporate respondents. Perhaps it is more evident to researchers who can observe the phenomena from the outside, than for those who are living in the problem and apparently don't have time for anything else than running their day to day operations. A notion that was widely expressed was that students can offer companies fresh perspectives on things. Most corporate respondents agreed that it can be hard to "think outside the box"; the core business usually require very much attention, and many business decisions can appear risky when you are working on slim margins. Having an outside perspective can help to distinguish what's the best course of action; to avoid myopia. Students working closely with, or even within corporate organisations, can bring new energy and have a revitalizing effect on innovation processes, this is a perception clearly shared by all interviewees. The underlying need appears to be to get an external perspective on internal problems, however, some respondents expressed that students are a very good partner to have since they are perceived to be less risky to collaborate with. Students are also perceived by interviewees to be unburdened by a "business mentality" and are more likely to try new things quicker. Yu & Hang (2010) proposes that firms restructure their organisations into sub-structures to achieve flexibility. This is not a specific aspect that we have been searching for in our interviews, but we believe that managers who express that they value having students come into their organisations to "shake things up" is an expression of the same objective; to achieve organisational change to increase innovation capabilities.

Understanding customers' needs

A major area of importance identified by Yu & Hang (2010) is the need for companies to understand their customers to be able to achieve meaningful innovations. The cognitive perceptions of managers are described to be the core of the issue. Henderson (2006) posit that managers tend to become experts on their current customers, and develop cognitive models for this, that are hard to change when customer behaviour changes. Christensen & Bower (1996) identify the ability to find new markets for new technologies as the most important for innovation success. The topic has been deeply researched, and firms are said to employ a vast variety of methods to gain a better understanding of customers. Our findings on this topic speaks a very clear language; students can be a tremendous source of innovation and customer knowledge. Interviewees confirm that market understanding is critical for business, and that students embody a fresh perspective. This perception appears rather natural as students belong to younger generations and more in tune with our quickly developing society. Furthermore, several interviewees confirm that business today relies heavily on market orientation, the days when firms successfully could push out technology without market adaptation are gone.

Recruitment

A recurring motive to collaborating with students that emerged during our interviews, was the rather obvious opportunity to recruit them. In general, it appears that interviewees from all stakeholder groups perceive this as the biggest benefit of collaboration. The potential innovations that can be achieved were by many perceived to be limited or uncertain, while any collaboration is very likely to enable participants to get to know each other. Joint activities and real projects for industry is perceived as an effective way of overcoming recruitment obstacles. These perceptions of interviewees resonate with the problematics of talent management and graduate recruitment presented by McCracken (2016). Students express that they hope that the projects will generate networking benefits, and companies express that they value the opportunity to expose their company to students. This is also perceived by university respondents to be the major motive for industry. Some corporate respondents even express that they would like to see interpersonal projects to replace current recruitment practices. The current way of recruiting new talent is perceive by several interviewees to be very inefficient and somewhat unreliable. This relates to the position of Gallardo-Gallardo et al 2013 who argue that firms are forced to conduct intricate recruitment processes due to an uncertainty of graduates' skills. The refreshing position of some corporate interviewees; that joint projects can replace current recruitment practices, reflects the findings of Ishengoma and Vaaland (2016) who argues that university-industry links can enforce graduates' acquirement of transferable soft skills.

Final words on the discussion of industry motives

Overall, we find that theory resonates with our findings. We find a shared consensus among our interviewees that firms need to engage more externally to alleviate their innovation impediments, and that students can be a very powerful source for that. Most of the motives found in theory by Ankrah & Al-Tabbaa (2015), have been confirmed by our interviewees, even the potential for cost reduction is expressed by some interviewees. In general, we feel that our interviewees express a good understanding of the benefits for industry to collaborate, so it will be interesting to further see what may be preventing engagement.

5.2.1.2 Motives from a student perspective

The perspective of students appeared to be very consistent among interviewees, and it reiterates what we have seen in theory. Mainly, students want to be associated with companies and interact with them as much as possible. After all, the clear majority of people applying to university do so to get a marketable education that is expected to lead to employment opportunities. Some may be in university to pursue a researcher's career, but most of us hope to further our professional opportunities when we sweat through class after class, year after year. This is our assumption, but we don't expect too many to reject to that view.

On the topic of motives for interacting and collaborating with industry, our interviewees expressed that a key motive is to learn more about companies, and gain a better understanding of future opportunities, reiterated by McCracken et al (2016). Another natural motive is that these interactions can increase the potential for the opportunities to become a reality through

networking and exposing yourself to company representatives. These opinions are reflected by the position of Ishengoma & Vaaland (2016) who hold UIC as a function that can greatly enforce student employability. As our initial quantitative survey revealed, many respondents perceive that university education in Sweden lacks industry links. This issue is reiterated by Pujol-Jover et al (2015), when they identify that students don't receive enough skills in management, adaptability, communication, team working, or entrepreneurship. This gap is confirmed by Holmquist & Håkansson (2010), who promote real projects as part of academic learning. Similarly, interviewees of all backgrounds in our study agree that students could benefit from more action oriented and practical coursework connected to reality. Furthermore, students expressed that working on real projects is more motivational than doing traditional theoretical cases. Student in general want to solve real problems and contribute to real changes and improvements. Those students that had done this kind of projects expressed that it was more fun and engaging, and that they learned more from it.

5.2.1.3 Motives from a university perspective

Motives for university somewhat goes hand in hand with student motives, after all the students leaving university as graduates represent the main link to industry, so unsurprisingly our findings are rather similar. Student employability came up as a core motive among university interviewees. As we have presented, universities around the world are going through an era of change, as they are expected to become more integrated with society. Etzkowitz (2008) describes this new ideal position of the university as an entrepreneurial institution that has a fundamental role for future innovation, job creation, economic growth and sustainability. Some interviewees expressed this development, and confirmed that universities, among other actors, need to engage more externally to be able to achieve progress and affect societal development. This integration with society can be seen in a response from an interviewee that explained that a major motive for conducting UIC with graduate students is to make them stay in the local municipality after graduation. This again, is reflected by the arguments of McCracken et al (2016) and Pujol-Jover et al (2015), that student employability is a key area of concern for modern universities. The university identifies its role in strengthening the local business conditions, for the benefit of society. In contrast, an interviewee at another university expressed a perceived lack of focus on the societal responsibility of the university. The situation appears to vary among institutions, but a consensus that university should play a new role in society is evident. This objective can be achieved through increased exchange of knowledge and competence across boundaries, according to several university interviewees, and a natural channel for this exchange are the students. Theory on the topic of UIC cover aspects like access to industry funding, resources, and equipment, but as this primarily relates to collaborations on a more advanced level, we were not surprised that our respondents didn't mention these things. We have been researching UIC on a graduate level, and this relates more to interpersonal exchanges, on which we have received satisfying responses. Similarly to motives for the other groups, we see that our findings in general resonate with theory. UIC is identified by respondents as an important aspect for the future development of academic education, and student employability is at the centre of this discussion.

5.2.2.1 Perceived barriers for industry to engage in collaboration

We have made our case that university education doesn't offer enough links to industry for students, which we find to be a bit contradictory given the response we have received from external interviewees. We have found such a resounding support for engaging in collaborations, both through our findings and in theory, that it becomes highly interesting to look closer into what may be preventing this from being realized.

When contrasting our findings with the theoretical framework, it becomes apparent that the general description of companies suffering from impeding organisational structures and business models, presented by Christensen (2000), appear to have a firm base in reality. Corporate interviewees refer to organisational factors as obstacles; managerial support is hard to get for projects that lie outside the core operations; organisations have become so efficient that there is no slack whatsoever to engage in other activities; uncertainty of how to work with people outside the organisation; established routines and structures that are impossible to go around. Manager myopia, that Feller et al (2002) and McKelvey (2014) refers to also appear to be a reality. Interviewees blame a lack of managerial insight and understanding; lack of support; over belief in internal capabilities; lack of understanding of the value that collaborations can generate.

On the specific topic of collaborating with university, interviewees express that this is a major obstacle to overcome. Berman (2008) and Hughes (2001) point to a misalignment of incentives and ways of thinking between industry and university, which has appeared during interviews as well. Our respondents refer to university as hard to work with; it is a slow-moving institution and mainly has academic objectives. University hold academic height over all else, whereas industry only care about practical implications and solutions. This creates a conflict in term of projects objectives, and misalignments in timeframes also appear. Corporate interviewees express that they can't stay engaged in projects because they take too long. They can perceive student collaborations as valuable, but claim that they take too much time. Besides this issue, interviewees express that they lack experience of collaborations and they simply don't know where to begin, or who to get in touch with. Many corporate interviewees say that they would like to engage more with students, but they don't have any established communication pathways to accomplish this.

5.2.2.2 Perceived barriers for students to participate in collaboration

On the student side of things, the main barriers are not related to understanding or objectives, but rather awareness, incentives and uncertainty. Students that we have interviewed express that the projects they have participated in has given them much more in return than they expected going into it. Students that are unfamiliar to the opportunity may not be aware of the value that they can get. This reasoning was shared among several student respondents, and a university interviewee put it very well; students live in the university bubble and realize very late that they need to network and prepare for life after school. This can be connected to the findings of Mansor et al (2015) who comments on the motivation and abilities of students.

They argue that uncertainty and mistrust in the process can severely hurt motivation, and that this require intensive guidance from faculty and facilitators. Uncertainty affects students' motivation to engage in activities that may lie outside of their academic program. One interviewee reasoned that students are exposed to a multitude of opportunities to engage in, so they tend to expect something in return, some sort of incentive. And on the same note, the interviewee expressed that it would be unfair to not provide some form of reward, since there are students who might have to compromise with other obligations, like a part time job. Again, this reiterates the findings of Mansor et al (2015), as they perceived that student tend to prioritize their other course works when the projects were too ambiguous. This became evident in some interviews, as it emerged that students tend to prioritize projects or tasks where there is a clear recipient expecting a result, such as a teacher running a traditional course. An observation that a long-time faculty member had noticed is that students don't put enough effort into their own projects and he explained it as a common psychological behaviour. This connects to incentives, it doesn't have to be a reward, a deadline can have the same motivating effects. The interviewees also revealed that engaging in projects with other students can be intimidating and require a period of getting to know each other, which is something that Mansor et al (2015) also recommend.

On another note, students expressed some uncertainty of their abilities to deliver any useful inputs on projects, or how to go about it. Since academic education follows a different format, they are unused to real projects and require some guidance and frameworks to get projects done. From our observations and interviews we found that students can struggle with real projects. When discussing it with faculty, it became clear that this type of projects often requires a lot more time and efforts by teachers and facilitators, as compared to a traditional lecture and that students can be very hesitant and uncertain at times. As Mansor et al (2015) argue, PBL require decidedly more effort from teachers and facilitators, and they need to cater to the needs of students if they are to conduct the projects successfully and optimise the learning effects.

5.2.2.3 Perceived barriers for university to facilitate collaboration

From the university perspective, the apparent barriers are in general mirror images of the issues perceived by industry. The criticism of Hughes (2001) against university mentality resonates with the findings of Perkmann et al (2013); universities have a deep focus on academic height, which is enforced through deeply embedded institutions and principles. The reluctance of academia to engage more closely with industry is explained to stem from a fear that it can impact the academic agenda. The result is that whenever a collaboration is initiated, it is subjected to time-consuming bureaucracy. Technology transfer offices that manages IP rights, is a department that interviewees particularly shun, this is a function that has emerged as an obstacle to collaborations in our literature reviews and it exemplifies the bureaucracy in question. This situation is shared by both university- and corporate interviewees, both groups point to slow-moving processes and reluctance from university as a major obstacle to collaborations. The interviewees we have talked to that are university representatives are individuals who facilitate the collaborations that we have studied, and they are unanimous in their view that their work would be far easier if university would be more open to the concept

of external links. They hope that faculties will eventually gain a deeper understanding for the educational benefits of PBL. Similarly as within corporations, the top departments in the university need to support these initiatives for them to succeed.

University interviewees also point to the cultural misalignment with industry presented by Berman (2008) as a source of problems. Companies that they interact with rarely understand the objectives of the projects, and the potential outcomes. Companies often expect to get valuable insights and almost finished solutions, whereas the educational value is at the centre for the university. The cultural divide also present a communication issue, and respondents at d.school point to the design thinking process as a method of bridging this gap. University interviewees claim, just as industry respondents that it is hard to get in contact with the right people, and hard to attract their sponsorship. Overall, we find that the obstacles to collaboration that we have found in theory are reiterated by our interviewees, so apparently, even though UICs can be a powerful source of innovation it remains a complicated endeavour.

In addition to the misalignments with industry and the difficulties of overcoming academic principles, conducting PBL require a drastically different approach to teaching. As we have already discussed, it primarily requires more resources in terms of time. As Mansor et al (2015) argue, a PBL oriented class needs to be facilitated by several individuals, and they need to spend more time on preparing for the class activities. Projects are action oriented, and for students to be successful, they require close guidance and advice along the way. These limiting factors were reiterated several times by university interviewees. They stress that the projects and classes rely heavily on the preparation and understanding of the process by the facilitators. This understanding can be a problem, if teachers are asked to suddenly hold PBL classes without having received a proper introduction and education on the approach. Again, this is one of the important aspects of managing PBL that Mansor et al (2015) argue can't be overlooked.

5.2.3 ANALYSIS OF OUTCOMES FROM COLLABORATION

In this section, we look at the potential outcomes that collaboration through an interdisciplinary model can generate. This analysis is based on perceptions of the participants in the studied concepts, and these findings will later be contrasted to the design of the concepts to further our understanding of this construct. The analysis is divided into outcomes for companies and for students, as we structured the data.

5.2.3.1 Outcomes from collaboration for companies

The outcomes that we have found through our interviews are closely related to the motives of the participants. On a positive note, this indicates that the collaboration models we have studied appear to be good approaches to UIC on the graduate level. In general terms, our corporate interviewees expressed that the key personal outcomes were; new ideas for marketing; deeper understanding of customers; new perspectives and new ways of thinking; positive experiences of working outside the box and a better understanding of collaborative values; and a revitalizing energy boost from working with students. On the organisational side of things, they expressed that they; value the opportunity it offered to expose their brand to students and that they had

got in contact with potential hires. Several of these outcomes connect to the theoretical views that we have already covered; open innovation, innovators dilemma, overcoming barriers and recruitment issues, so we don't need to get into details on these ones. The more interesting findings that emerged were *appropriability*, *innovation energy*, and *partnership type*.

The first aspect was mentioned by university respondents facilitating the Demola concept. As they engage a variety of companies in partnerships, they have been able to study benefits and outcomes in different scenarios. What they pointed to was that smaller firms, SMEs, displayed a greater appropriability from cooperation. As it appears, the smaller firms have less complicated management models, and are more flexible, and as a result, they are better able to adopt any useful innovative solutions that may emerge from student projects. Large companies did not have the same opportunities, or they didn't identify the same level of useful value, instead they could appropriate general concepts that they could continue working on internally. This finding resonates with the findings of Baker et al (2016) who argues that firms that are less entrepreneurial, like SMEs or large firms with poor social capital, are those that benefit the most from external networks. They may not be the firms that become innovation leaders, but by engaging externally they can become fast followers, instead of falling into trouble when they face disruptive innovation.

The second aspect specifically mentioned by several interviewees, was the boost in innovation energy that they received from participating in collaboration and new ways of thinking. This resonates well with the findings of Sacramento et al (2006) who show that team innovation capacity is notably affected by boundary spanning collaborations. An important note here is that the interviewees who stated these benefits were those that had engaged in actual collaborations with students. Firms that act as a sponsor to a student project mere act in cooperation are unlikely to receive these benefits.

The third aspect that we found partial evidence for was the theory of Hyll and Pippel (2016) who states that innovation projects with customers or public institutes can be more fruitful and easier than compared to joint projects with competitors. A few interviewees stated that a benefit of cooperating with students, as we discussed earlier, is that it's less risky. You don't have to commit a lot of resources, and there are seldom any issues with intellectual property. This opinion expressed by some corporate interviewees, is reflected in the experience of the facilitators who see that firms who discover the value of student projects often want to come back for more. The partnership appears to offer innovative benefits at a lower risk and cost.

An interesting point to note here, is that the outcomes to industry depends highly on the level of participation. External outcomes, or codified knowledge, like brand exposure, talent scouting, new ideas and perspectives, and market understanding were aspects that all respondents could identify. On the other hand, such outcomes as energy boost, and deeper exchanges of knowledge, are aspects that corporate participants only could get from personal participation.

5.2.3.2 Outcomes from collaboration for students

In contrast to the corporate interviewees in this study, all the student respondents have experienced the full benefits of multidisciplinary collaboration. The projects have not been in close interaction with company representatives in all cases, but student have experienced collaborations with other students. The perceptions that student express, are thus, of significant relevance for our study.

Firstly, as Salter & Martin (2001) argue, UIC can generate more multifaceted knowledge flows and education of students, aspects that were evident from our interviews with students and industry respondents. The interviewees stated that cooperations have enabled them to exchange knowledge and understanding across boundaries. Students express that they have received networking benefits and that they feel more prepared for their future professional careers. So far this reflects their motives to engage in the projects, so again, this further confirms the viability of this mode of cooperation and collaboration.

On a second note, a major benefit from the projects appears to be the multidisciplinary and collaborative aspects. Students shared that they have gained a new way of looking at themselves and a new way of looking at life. They feel more competent and confident, not only related to school or their careers, but on a personal level as well. Some express that the experiences of group projects and team dynamics have strengthened them, and that they have gained "creative confidence". In this regard, it appears that d.school and Demola achieve their core goal, to strengthen the students, and this is a testament to the benefits that PBL promoters argue for. According to Dym et al (2005), PBL has gained credibility and implementation in many faculties and schools and their description of this approach to learning is very well depicted in the cases of d.school and Demola. The creative freedom that the approach provides is appreciated by our student respondents, and they reiterate the benefits that Meredith & Burkle (2008) point to; increased learning through real-life projects and experiences and greater provided career preparation.

5.2.4 SYNTHESIS OF STAKEHOLDER PERSPECTIVES

In this section, we provide a summary of our findings regarding motives, barriers and outcomes. The empirical findings have been contrasted to our theoretical framework and as we have seen so far, our findings have confirmed previous knowledge on the researched topics. Table 5-1 illustrate our findings related to the different groups and the perceived aspects of collaboration.

Table 5-1. Synthesis of findings on motives, barriers and outcomes.

Empirical findings / Theory	Motives to engage in collaboration	Barriers preventing collaboration	Outcomes from collaboration
Industry	Increased need for external channels for innovation Organisational inertia Customer understanding Recruitment	Organisational inertia Understanding and urgency Time constraints Misalignment with academia Communication	Range of external insights Innovation energy Appropriation favours SMEs Rewarding and low risk
Students	Career opportunities Gain competence and experiences Do "real" projects	Awareness Incentives Need of guidance	Increased competence and self-awareness PBL and multidisciplinary collaboration key
University	Increase societal responsibility Produce skilled graduates	Academic principles Misalignment with industry Understanding form top departments Time requirements	

5.3 FACILITATING COLLABORATION BETWEEN STUDENTS AND INDUSTRY

In this section, we analyse how the studied collaboration models are designed. What we are looking for is if they are modelled according to theory and how this might be connected to the barriers and outcomes that we have identified.

5.3.1 ANALYSIS OF THE DESIGN OF CASES

As we have seen by now, cooperation and collaboration across disciplines can entail several barriers but also fruitful outcomes. To understand how these outcomes are achieved we look more closely at the design of the studied concepts. In this analysis, the three studied cases are merged, as the purpose is to generate generalizable findings and not evaluate the initiatives.

5.3.1.1 Objectives, partnerships and involvement

From our interviews and secondary data, we can conclude that all three initiatives essentially approach collaboration from a standpoint similar to traditional approaches identified in literature by Wallin et al (2014). The objective of the initiatives varies to some degree, from educating students to facilitating co-innovation, but the partnerships that are created appear to be arm-length relationships that more resembles cooperation. As with traditional approaches to UIC, participant involvement appears to be imbalanced. A range of corporate partners are

partnering with the initiatives, but to an overwhelming degree they act as sponsors and not actual participants in collaboration activities. This can be explained by the barriers that we have previously identified; companies and industry representatives don't have the time nor the understanding as to why they should engage personally in the facilitated activities, and on the other hand, even if companies would seek closer interactions, academic principles and misalignments in culture and timeframes would prevent this. The fact that companies mostly act as external sponsors might not be an issue in some regards, as the cooperations do result in some valuable outcomes anyway, but in terms of innovation output we believe that a great potential is lost, which we will further discuss later.

5.3.1.2 Knowledge transfer in the studied concepts

As we described in the theoretical chapter, collaborations across boundaries depend on what type of knowledge that is intended to be transferred, what the purpose of the collaboration is, and what the backgrounds of the participants are. As theory describes, projects that mainly involve students can't be expected to generate advanced results, but should be viewed as a source of conceptual knowledge creation. As such, knowledge creation processes in such projects often revolve around the early stages of NPD processes; idea generation, searching for insights, brainstorming activities and so on. Contrasted to theory on creation and sharing of knowledge, we see that student projects often relate mostly to the socialization phase of the SECI model of Nonaka & Takeuchi (1995). Naturally, everyone participating in knowledge intensive activities will go through the SECI spiral several times, we all do so all the time, but looking at the group and the activities it's the early phases that are most relevant. This rather abstract description is better illustrated by the typical cases that we can observe in the studied concepts. The cases revolve around consumer and market research, generating understanding of behaviours and drivers, business model innovations and early stage prototyping. What we see is that the intended purposes of the concepts have been adapted to the ruling conditions; time limitations and student capabilities. In other words, the concepts appear to match theory closely in terms of purpose and participant backgrounds.

If we take this discussion one step further, we get into the type of knowledge that is intended to be transferred and how this connects to the collaboration concepts. What our literature study revealed was that that knowledge transfer in UICs can be distinguished through five features (Viale 2010); knowledge that is being transferred is of general nature, meaning that it's not highly context specific; the knowledge is of such complexity that it extends beyond the cognitive capacity of any one individual, meaning that interpersonal collaborations are necessary; complete knowledge transfer requires transfer of tacit aspects, which is achieved through interpersonal exchanges; shared background knowledge is important, meaning that people from different disciplines can have a hard time interacting on a distance; and finally, cognitive styles can hinder collaboration. So how does this apply to our studied cases? Well we can see that these general guidelines for knowledge transfer do describe the concepts well, even though these are collaborations concepts on a lower level than traditional UIC. As we already established, cases revolve around generalizable findings, not very technical or specific knowledge, and the level of complexity is such that it requires teamwork. In addition to this, the nature of knowledge that is created and transferred is highly tacit as students learn about

how to manage real problems through interpersonal projects. Meanwhile the concepts are open to a variety of students, coming from different backgrounds, and in all cases, industry is involved to various degrees.

On the face of things, it appears that the cases are deigned according to knowledge transfer theory, and adapted to the participating students. As such, we consider them to fulfil the criteria of a general UIC typology. Next, we will consider how they compare to the *Ba* framework that gauges how well they facilitate co-innovation.

5.3.1.3 Applying the Ba framework

An extension of the SECI model that we introduced in the theory chapter, is the Ba framework developed by Nonaka et al (1998). This describes how a model for UIC on a conceptual level should be designed, to enable optimal knowledge exchange and unleash potential innovation capabilities. Huhtelin & Nenonen (2016) explains that the first stage in the knowledge spiral, the socializing stage enable the type of knowledge sharing that is of most relevance for this type of collaboration, and that when combined with the context this can be labelled as the Originating Ba. The description of this conceptual space, and the prerequisites described through the framework, again appear to compare well with the studied concepts. The studied concepts focus on interpersonal activities, providing the necessary space for trust to be generated between participants, and the concepts pursue appropriate objectives with the projects as we have already covered. Doing so, the basis for fruitful co-innovation between students and external parties have been established.

Next, we can see that the location of the initiatives and the designated spaces fulfil the necessary requirements according to Originating Ba. Facilities are located near to participants, openly accessible to everyone, and invite to creative activities. The spaces are transformable to enable a variety of activities, spaces are organised but not too much, to give way to creativity. The primary tool is post-its and activities and processes are highly visual. Furthermore, participants are offered guidance by facilitators to get everyone in the right mind-set. Without going into too much detail, we can conclude that the studied concepts in general fulfil the requirements of originating Ba, especially the main case, d.school. By so doing, the concepts provide a space where participants can socialize, build trust, and innovate together.

Table 5-2. Analysis of concept designs.

Theory \ Empirical findings	d.school	Demola	ProLab
Enables collaboration	√	√	√
Enables knowledge creation	√	√	√
Enables knowledge transfer	√	√	√
Enables co-innovation	√	√	√

5.4 SUMMARY OF DISCUSSION

As we have reached this point in our analysis, we can attempt to combine our findings in terms of concept designs and outcomes. As we have found, the concepts that we have studied are designed purposely to enable the creation and transfer of knowledge. The main areas in which the projects can generate insights are the early phases of innovation processes, and this is an area that large firms particularly struggle with. As such, the collaboration model capitalizes on the abilities of students, and the insights that they possess can greatly benefit companies that chose to engage in cooperation or collaboration. This connects very well to the identified motives of the different stakeholders and their perceived outcomes. Students gain in terms of experience and career preparation, which indirectly benefits the image of the university, and industry can appropriate several returns even at a limited investment in time. However, the true innovation potential of this collaboration model is only achieved if industry invests time and participates fully in the innovation activities alongside students. This commitment will also enforce every output already mentioned and is the ideal state that the collaborators should be striving for.

As a final note to the discussion, we would like to comment on environmental and cultural factors that might affect the potential for initiating a multidisciplinary collaboration model. The main case in our study is situated in a highly collaborative region, so environmental factors may prove to be important, however, the data that we have been able to collect on the other cases has not been substantial enough to merit a deeper comparison. As such, although we believe the findings to be highly valid and reliable, the limited contextual analysis imposes some limitations on generalizability.

6 CONCLUSION

In this final chapter, we present our conclusions by providing a summary model describing the key findings from our research. The model illustrates the most important barriers to overcome and design factors, as well as the potential outcomes that it can generate for the participants.

6.1 RESEARCH OBJECTIVE

Collaborations between university and industry can take many forms, and one area that is perceived to be less explored is the collaboration between graduate students and companies. These are two groups that eventually will interact, as most students pursue professional careers, so it appears natural that they could benefit from interacting during the ongoing education. When we embarked on this thesis project, we did so together with a group of corporate partners that expressed a desire to interact more with graduate students. We found this confounding, as we perceived the same thing among students. Clearly this was a topic that deserved to be researched and we set out to find how this could be achieved. The purpose of this study has been to examine the potential of multidisciplinary collaboration on the graduate level. With that purpose in mind, the following research question has guided the project:

How can multidisciplinary collaboration generate value for students and firms?

The literature review revealed that university-industry collaboration is a wide topic and that much of previous research has focused on explicit knowledge transfer, as most links are centred on advanced research collaborations. Interactions on a less institutional level can encompass transfer of other knowledge aspects, and a multiple case study approach was chosen to focus on collaboration between students and industry through co-innovation concepts geared toward the early phases of innovation processes. In lack of better wording, these have been referred to as multidisciplinary collaboration models. In general, the studied cases share many attributes, and diverge in some areas. However, the purpose of this study has not been to compare these concepts to evaluate them against each other. The reason we included more than one concept was to have a more reliable basis to evaluate this type of concept in more general terms. In doing so, we have been able to identify generic key design- and contextual factors that can provide a basis for those who would want to engage in this mode of interdisciplinary collaboration.

6.2 RESEARCH FINDINGS

Having analysed the studied concepts in terms of design, we find that they appear to be set up appropriately to enable co-innovation. The question of *how* a model can generate value, can be divided into two general factors, the first being how participants perceive value and how they appropriate this value, and the second relates to the necessary conditions for this to be realized. Our study has revealed key aspects that helps answering our research question, these are illustrated in the conceptual model seen below and then described in more detail.
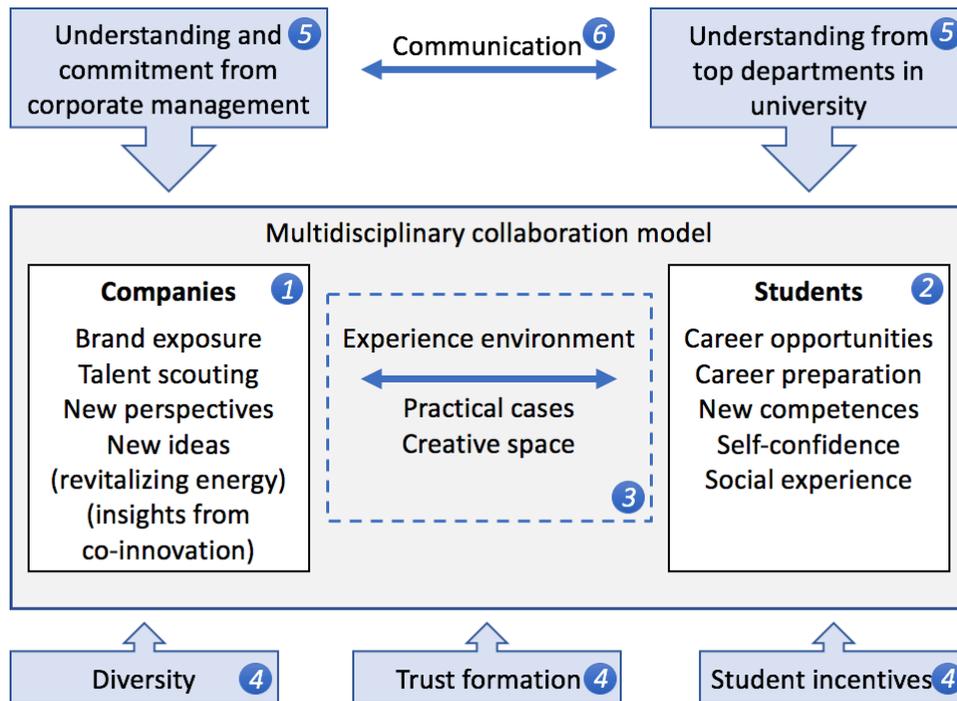
Figure 6-1. Conceptual model of research findings.

By participating in collaborative projects with graduate students, companies can receive valuable outcomes that alleviates some of the issues that many organisations struggle with. As we have seen (1), companies perceive that they receive benefits of being exposed to students, and the talent scouting benefits this entail. Talent management is an area of concern for many companies, and interacting with student, and seeing how they perform in real projects, can alleviate the process of finding the right talent. Besides this, companies can benefit from the perspectives of students, it can help thinking "outside the box", as many interviewees described it. Value appropriation varies depending on cases and involvement. In terms of innovation output, it appears that if the company acts as an external sponsor, only SMEs can appropriate the output from projects to a satisfying degree. Large organisations find less value and usefulness for the conceptual solutions that the student projects generate. The knowledge creation and sharing that the concepts enable can be appropriated by companies too, but this requires a physical presence and participation in activities and projects. By participating, companies can gain deeper insights and understanding of their business environment, and working with students can be a valuable source of innovation energy.

Regarding value to students, we have been able to establish that students can appropriate value (2), regardless of if the projects are done only between students for a company, or in actual collaboration with corporate representatives. In either case, they will benefit from the interactions with industry, as this generates career opportunities. Doing the practical oriented projects, based on real problems, prepare students for their future careers. Students tend to lack "soft" skills like self-confidence to manage ambiguous projects and the social skills to interact

confidently in a diverse environment. Doing the real projects and going through the whole process enable students to develop skills that companies are looking for in graduate employees.

These real cases require an appropriate space to be successful, a place that we can refer to as the experience environment (3). To enable creative processes, the space should be in proximity to actors, preferably on university campus, and be designed to allow for a variety of activities. In so, the space will become a natural centre for meeting, collaborating and innovating. The findings indicate that activities need to emphasize teamwork and be action oriented, with facilitators as guides instead of teachers, and the space requirements are an open and transformable space that alleviates creativity and visualization of thought processes. Through personal interactions between participants, innovations could be achieved, since these exchanges enable all necessary elements of creation and transfer of both explicit and tacit knowledge. As a result, and as we posited regarding company appropriation, when companies only participate as sponsors, aspects of tacit knowledge will not be transferred, resulting in a lower output of potential innovation.

We have also covered the importance of having multidisciplinary participants (4), if people from the same background would engage in the same projects, the outcomes would certainly not be as valuable. Primarily students, but also corporate respondents, emphasized the value of collaborating with people from various backgrounds, as this enforces the whole process and the innovation potential. This diversity does present some challenges for students to overcome (4); due to the unfamiliarity of the concept and inexperience of working with other students, the initial sessions need to emphasize interactions that builds trust. The actual real case or main project can be addressed when a growing community of trust has been generated. Finally, on the topic of participating students, these have been found to require some form of incentive to engage in projects (4). On one hand, they may not value the opportunity high enough, and on the other hand they may have to manage many other obligations in school and privately. Providing an incentive will initially attract students, before they can experience the potential value for themselves.

These obstacles can be considered minor, so from the perspective of students, the opportunity for initiating a collaborative model appear very favourable. However, when considering the perspectives of university and industry, we have found more critical barriers hindering collaboration. Both university and industry suffer from the problem that engaging in this type of projects require support from top levels of their respective organisations (5). In terms of industry, it appears that businesses in general are so streamlined and geared toward efficiency, that there is no slack for managers to engage in additional activities. To have time to engage in UIC, managers need to have management support and allocation of resources. On the university side, the barrier appears to be that collaborations with industry, and PBL in particular, is often perceived to lie too far outside of the academic agenda. It can be perceived as a threat to academic principles, and is therefore often thwarted.

In addition to this, university and industry experience a misalignment of cultures and value systems (5). This means that even if internal obstacles are overcome, the two parties will face issues with timeframes and objectives as they attempt to collaborate. As often is the case when

two parties are misaligned, communication is key (6). Our findings indicate that both university and industry experience it difficult to get in contact, and to understand each other. Regardless of the barriers that exist, the will to collaborate is evident among all the groups we have interacted with. Through increased communication, internally in companies and universities, and between these stakeholders, we believe that the opportunities for successful collaborations are very favourable. Graduate level industry-student collaborations can be a tremendous source of insights and experiences for both parties, and it comes as no surprise, that the potential value it can generate depends largely on the input from the stakeholders.

This thesis project has provided and overall picture of how students and industry can create value for each other through collaboration, whereas previous studies have targeted UIC on a higher level in university. The findings are largely consistent with previous research on the topic of UIC, but it does contribute to research in so that this study has explored this subject from the specific perspective of graduate students. This study has connected relevant pieces of dispersed research and completed this with empirical findings, and in doing so, contributes to research concerning university-industry collaborations.

6.3 FUTURE RESEARCH

Since the purpose of the study has been to research the gap between academia and industry, the focus has been on co-innovation with external stakeholders, and not internal co-creation within universities. As a critical barrier to this collaboration approach is the misalignment between industry and academia, and as the study has revealed that students gain several benefits from the multidisciplinary projects regardless of industry involvement, a primary area of future research should be to examine the opportunities for increased internal multidisciplinary exchanges in university. Preparing students for their future careers could benefit society and industry even without explicit collaboration from industry.

Furthermore, this study has revealed interesting aspects of knowledge creation and sharing that has received less attention in the specific research of UIC. As this study has been oriented around the specific demographic group of graduate students an area that could be further researched in the light of these findings, are interpersonal exchanges on other levels of UIC.

Finally, the focus of the study has been to identify collaboration focused on idea generation, idea sharing, and co-creation of new concepts. As these areas have been found to generate value to the participating actors, it could be of further value to research student-industry collaborations in later stages of the creative process.

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APPENDIX A. QUANTITATIVE PILOT SURVEY

The pilot survey was designed to assess graduate student's perceptions of collaborations with industry. The context of writing a master thesis was chosen as a survey topic, as this is a concept that would be familiar to the respondents, and thus provide a more reliable indication of opinions on UIC, rather than asking about more unfamiliar collaboration modes. The survey was conducted online between 2017-01-21 and 2017-01-24 and 74 respondents completed it during this time. Survey responses from non-Swedish respondents were excluded in the analysis.

Survey regarding links to industry during university education   <u>Showing 74 respondents of total 74</u>

1. Your age.

Number of respondents: 74

Age	Count
18	0
19	0
20	1
21	0
22	0
23	3
24	12
25	19
26	10
27	13
28	4
29	3
30	1
31	2
32	2
33	1
34	2
35	1
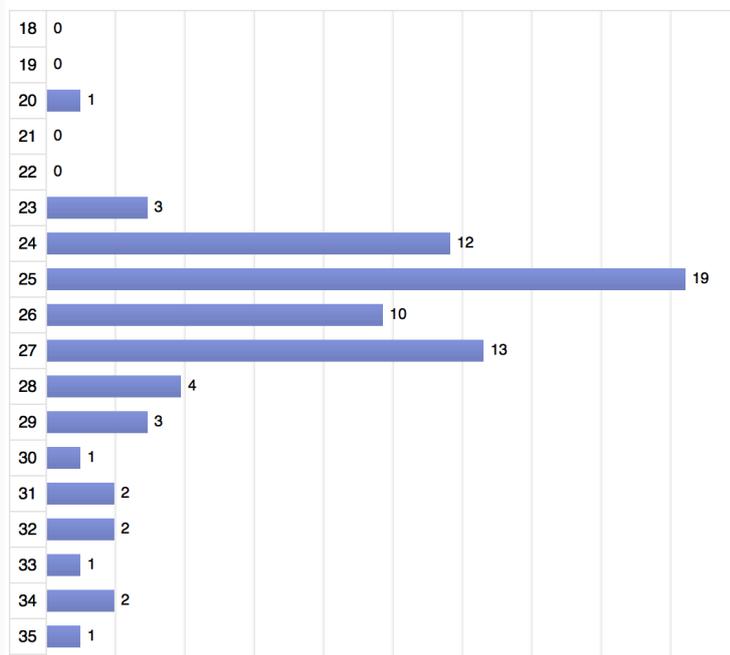
2. Gender:

Number of respondents: 74

Gender	Count
Male	~52
Female	~22
Prefer not to answer	0
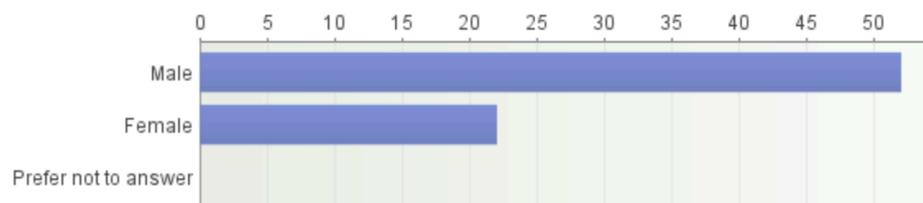
3. Country of residence:

Number of respondents: 74

Country	Count
Sweden	71
Norway	1

4. Place of residence

Number of respondents: 74
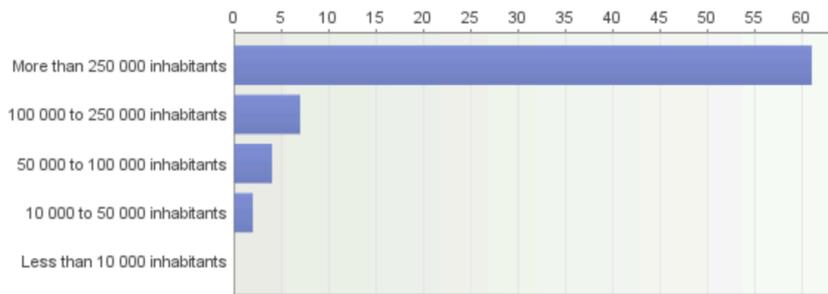
5. Occupation

Number of respondents: 74
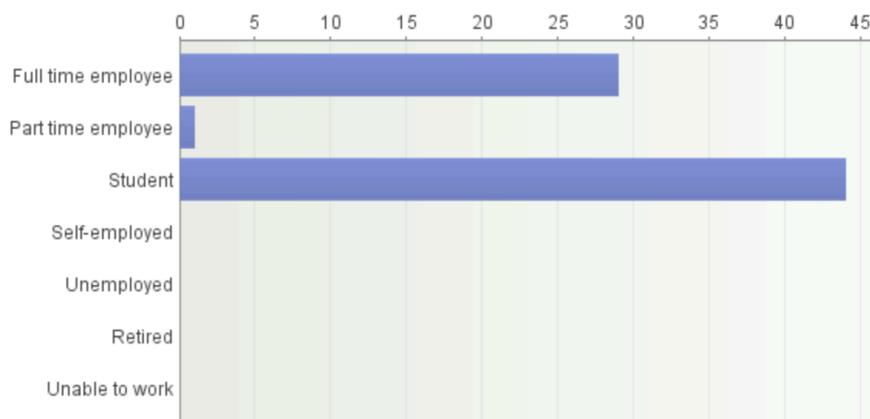
6. Education

Number of respondents: 74
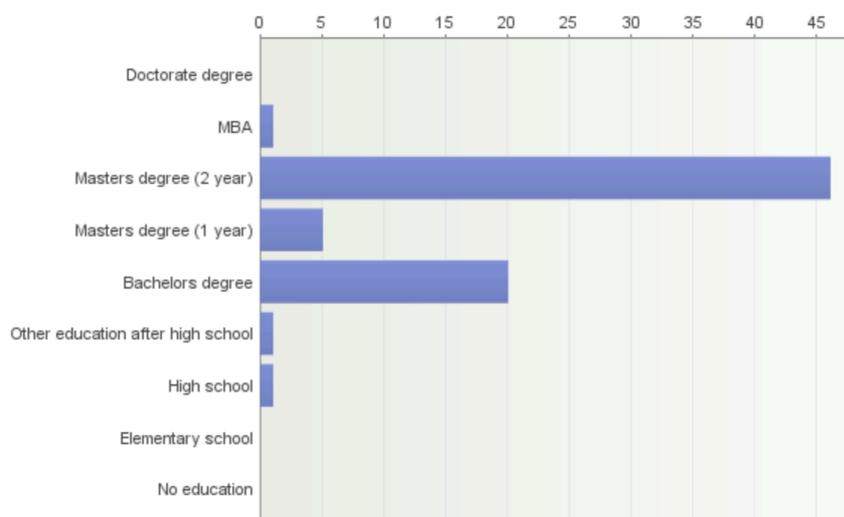
8. Writing a thesis

Number of respondents: 74
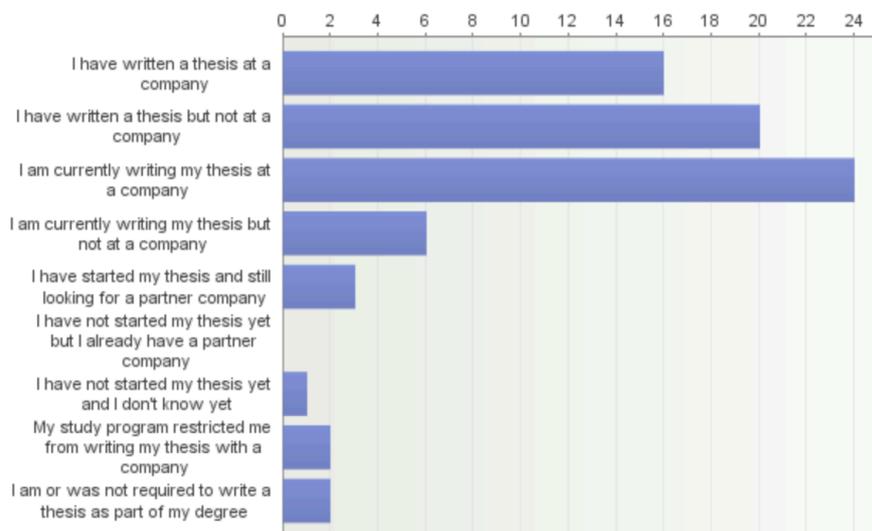
9. Since you have written a thesis at a company...

Number of respondents: 16

	Yes	No	Total	Average
Did the thesis project match your expectations?	12	4	16	1.25
Do you feel that the project was a success?	12	4	16	1.25
Did you get a job offer during or after your thesis from the partner company?	3	13	16	1.81
Did you start working at the company after the thesis project?	2	14	16	1.88
Total	**29**	**35**	**64**	**1.55**

10. Since you are currently writing a thesis at a company, or plan to do so...

Number of respondents: 24

	Yes	No	Don't know	Total	Average
Is the topic of your thesis exiting and interesting to you?	23	0	1	24	1.08
Would you consider working for the company if offered a job?	16	4	3	23	1.43
Do you expect the thesis project to generate a job offer?	9	8	6	23	1.87
Total	**48**	**12**	**10**	**70**	**1.46**

11. Since you answered that you did not, will not, or don't know if you will, write your thesis at a company...

Number of respondents: 27

	Yes	No	Total	Average
Did you want to write a thesis at a company?	13	14	27	1.52
Did you apply for thesis projects at companies?	6	20	26	1.77
Did you receive any offers for writing a thesis from a company?	1	25	26	1.96
Total	**20**	**59**	**79**	**1.75**

12. Your opinions regarding thesis projects at companies

Number of respondents: 74

	1	2	3	4	5	Total	Average
Writing a thesis at a company is a good way to improve job opportunities in general	1	3	9	29	32	74	4.19
A thesis well done should result in a job offer from the partner company	2	13	20	22	17	74	3.53
Writing a thesis at a company is a good way to establish business contacts	0	1	7	21	45	74	4.49
I would prefer writing a thesis at a company rather than doing it independently	1	5	16	21	31	74	4.03
Writing a thesis at a company limits research possibilities in a negative way	9	21	27	14	3	74	2.74
A thesis project at a company is less likely to generate findings that are useful to others	7	23	26	13	5	74	2.81
There is a risk that the company can influence the researcher, making him/her less critical and biased	1	8	20	36	9	74	3.59
Total	**21**	**74**	**125**	**156**	**142**	**518**	**3.63**

13. Your opinions regarding finding and getting a thesis project with a company

Number of respondents: 74

	1	2	3	4	5	Total	Average
It is hard to get in touch with companies for thesis projects	7	10	26	22	9	74	3.22
It is hard to get an overview of opportunities for thesis projects	2	6	26	27	13	74	3.58
I am uncertain about what thesis projects I am qualified to apply for	9	11	27	22	5	74	3.04
It is very competitive to get a thesis project with a company	2	9	26	17	20	74	3.59
The school is good at assisting in contacting companies for thesis projects	18	22	24	7	3	74	2.39
You need to establish contacts with companies on your own	1	2	13	27	30	73	4.14
Getting a thesis project with a company requires a bit of luck	0	7	23	33	11	74	3.65
If I would apply for a thesis with a company, I would apply to whatever I am eligible for	8	19	23	19	5	74	2.92
If I would apply for a thesis with a company, I would only apply to those that really interest me	0	5	15	31	23	74	3.97
Total	**47**	**91**	**203**	**205**	**119**	**665**	**3.39**

14. Your opinions regarding companys' involvement in education

Number of respondents: 74

	1	2	3	4	5	Total	Average
Education should be independent from business to protect the academic integrity	27	24	17	5	1	74	2.04
Education benefits from partnerships with companies	0	0	11	22	41	74	4.41
Courses at school should include more real cases with companies	0	0	3	21	50	74	4.64
Internships is a good way of gaining experience of companies and job positions	0	1	6	19	48	74	4.54
Internships should be an optional part of university programs	5	3	6	26	34	74	4.09
Internships should be a mandatory part of university programs	11	16	17	14	14	72	3.06
Internships is only necessary for practical professions	31	29	4	6	4	74	1.96
It is the responsibility of schools to prepare students for the business environment (work life)	3	11	16	19	24	73	3.68
Total	**77**	**84**	**80**	**132**	**216**	**589**	**3.55**

APPENDIX B. LIST OF OBSERVATION SETTINGS

Monday March 6, Leadership class (class 1)

Class where the students acted like leaders for the organisations. Students had already taken design classes and were now assigned to coaching corporate teams in solving issues internal to the businesses.

Tuesday March 7, Guided tour Stanford Campus

Tour of the campus. The tour was adapted to our interests and very informative.

Wednesday March 8, Need-finding class (class 2)

This was a class, where alumni students came back to act as coaches to other students. It was interesting to see that there is a ladder in the learning process, where just because you ended a class, it was not over, design thinking is an iterative process where d.School encourages students to both practice it themselves, but also to teach others.

Friday March 10, Guided tour d.school

Tour of the d.school facilities. This was an interactive tour including several activities to introduce the concept of design thinking to the visitors.

Monday March 13, Law policy class (class 3)

This was a design thinking class inserted in a law program. These students had no previous experience of d.school classes and they had been assigned to evaluate bicycle safety on campus through a design thinking process. All the groups were encouraged (almost forced) to go out and practice their ideas immediately in the process.

Tuesday March 14, Design garage (class 4)

This was a senior class, where the students were in their final semester and had participated in several of d.school classes before. They had a midterm review on how the projects were going. The objective of this class was that the groups conducted entrepreneurial projects using the design thinking process, based on any ideas each group might have.

Wednesday March 15, Coaching class (class 5)

The students gave their final presentations, regarding different subjects they were being assigned. The students involved ranged a lot, from first time d.school takers to fellowship members of the program that took the course just for the fun of it, and to practice design thinking. The presentations here were video recorded by the professors for assessment, a practice we had observed in other classes as well.

Wednesday March 15, Design for extreme affordability (class 6)

This class was a halfway seminar session in one of the longer classes taught at d.school. The student groups in this class were seasoned in design thinking and were tasked to solve pressing issues in third world countries. As part of the course half of each group were going to spend a few weeks in the field in Africa to test and implement their solutions.

APPENDIX C. VISUAL ETHNOGRAPHY PHOTOGRAPHS

Picture 1. Arrangement of sofas in a public space within one of the engineering buildings on Stanford Campus.

Picture 2. Creative space at d.school.

Picture 3. Creative space at d.school.

Picture 4. Creative space at d.school.

Picture 5. Illustration of creative space. This picture is from the Hasso Plattner website, available at: https://hpi.de/fileadmin/user_upload/fachgebiete/d-school/images/Studenten_ High_Five.JPG.

Picture 6. Instructions for managing the creative space.

Picture 7. Instructions for using the creative space.

Picture 8. Photo of park on campus.

APPENDIX D. INTERVIEW GUIDE CO-INNOVATION CONCEPTS

(d.School, Demola, ProLab)

Concept background

What is your background? What is your role in the organisation?

What was the purpose of creating the concept, and where did the inspiration come from?

Who are involved, who took the initiative?

What are the long-term goals?

What are the most important cornerstones of the model?

What are the key objectives?

What do you think attracted students to the concept?

How is the interest from students?

Barriers

Which processes / activities do not work well? And what are the obstacles?

What are the main difficulties with the projects? What are the reasons for this do you think? (funding, academic constraints, marketing, operations, participation, partnerships)

How do you rate your external collaborative environment for student-industry co-innovations?

Can you compare it to any other examples? What are the main distinguishing differences?

To Prolab: Why did it close? (is it due to the idea is not suitable, or was it primarily funding problems?)

How would you do it differently if you would do it again?

Partnerships

How do you get partner companies?

How are they involved in the concept?

What are normally their expectations?

Is it hard to attain partnerships? If so, why?

is it hard to manage the partnerships? If so, why?

How much involvement from the companies are expected? Do they follow up on it?

How much collaboration is it between students and firms?

Design

What is the objective of the concept?

How is the governance structure?

If innovative ideas become reality, who is the owner and who can take part of the innovation?

Do involved partners sign contracts?

Who can enter the Arena? Everyone, or solely students?

What are the fundamental blocks to make it successful?

Do you have a dedicated place for the platform? If yes, what characterizes the layout?
How much company involvement is expected?
Who initiates the projects? Students, school, firms?

Activities in the concept

What are the typical projects targeted at?
What process design do you follow?
What is the structure of the projects / Activities?
Are their projects simultaneously or focused on one at a time, and how is the dispersion of the students? (Is a lot of projects involving few students, or few projects involving many students)
Do all courses/projects follow the same methodology?
Do the partnering companies have specific intentions with the projects?

Outcomes

What are the outcomes from the projects?
Do you consider the initiative a success? And how would you measure success?
Does the platform help the overall innovation in companies? And how would you measure the success?
How does the model provide value Students?
How does the model provide value for Companies or other organisations involved?
Does the platform work as a recruitment tool for companies to find attractive candidates for jobs? Do you know if students who continued in their careers as a result of participating in the initiative?

APPENDIX E. INTERVIEW GUIDE STUDENTS

Motivation

What is your background?

What motivated you to engage in this type of collaboration?

Do you have experience of other type of projects or collaborations? If so, how would you compare it to what you are engaged in now?

Would you want to work more with students from other disciplines? If so, why?

How is the interest from students?

What do you think are the reasons for the popularity of these projects?

From your perspective as a student, why should companies engage with students?

Barriers

What type of compensation are you expecting?

What are you sacrificing to be involved in a concept like this?

How important is it to get credits in these courses?

have you experienced any difficulties or problems?

Which process / activities do not work well? What are the obstacles?

What are the main difficulties with the projects?

(funding, academic constraints, marketing, operations management, participation)

Design (Multidisciplinary Collaboration opportunity)

What are your thoughts on having a multidisciplinary background as a basis for the collaboration?

Do you think the results would be different if projects were done by student with the same background? If so, different how?

Do you think the "messy" environment enhances creativity?

How would you compare this to a traditional class?

How much collaboration is it between students and firms?

Activities in the concept

What sort of activities are often encouraged?

Do the companies have an area they usually want to explore more?

What are the projects usually targeted at?

What activities work well?

What is the structure of the projects/Activities?

Are the projects simultaneously, or focused on one at a time, and how is the dispersion of the students? (a lot of projects involving few students, or few projects involving many students)

What do you think is the best approach?

Who initiates the projects?

What type of guidance do you get?

<u>Outcomes</u>

What value does a multi-disciplinary atmosphere provide for students?

Do you believe it enhances your understanding of other disciplines and what they are doing?

Regarding the different design thinking process, or project based learning; is this something you can use in the future, and if so, in what context and how?

Are you becoming more creative through these collaborations?

Which company interactions / collaborations would you say are more beneficial for your chances of getting a job at that company? Internships, participating in this type of project, be part of NPO, thesis work or other? And why?

Do you get something out of these projects that you think you can't get somewhere else? If so, what?

Which processes / activities work very well? What are the results?

Does the platform work as a recruitment tool for companies to find attractive candidates for jobs? Do you know of students who have continued in their careers because of participating in the initiative?

What is the value for students to engage in this type of activities?

What have you experienced or what do you do think that companies or other organisations involved get out of doing these projects?

APPENDIX F. INTERVIEW GUIDE TO EXTERNAL COMPANIES (CGI, Stena, Volvo Cars, SKF)

Initiating questions on student collaboration

What is your background?

What is your experience from collaborating with students?

Have you done something outside than regular master thesis projects?

Does your company currently work with students?

Why should organisations collaborate with students?

Do you believe that there is a synergy effect on collaboration with students, or is it mostly a marketing tool for companies?

How do you value collaboration with students?

Having described the intended collaboration concept

What do you think these projects can generate, that cannot be achieved in other type of collaboration?

What do you believe your company get out of participating in a collaboration as such?

What do you think about these collaboration platforms?

Does your company have the resources to participate in this type of collaborations?

What do you think would attract students to participate in those projects?

What do you believe would attract students to engage in a concept like this, compared to other options available?

Barriers / Challenges.

What (if any) would you say are the internal obstacles related to collaborating with students? (Budget/Economy, not sharing the same vision, vague outcomes, resources, scheduling etc.)

How can you overcome these obstacles?

What (if any) would you say are the external obstacles? (University institutionalism?)

What would be required to overcome these?

Collaboration does not only require money, but it also comprises a lot of time, what is your perception on that?

There are problems from the university, and company inertia from larger organisations, how does your company handle that, how are the internal possibilities to deal with that?

How do you rate the external collaborative environment in Sweden for student-industry co-innovations? How would you compare it to other countries? What are the main distinguishing differences that you perceive?

Other collaboration opportunities

If you have done projects outside of the master thesis context, how were they designed?

What were the timeframes for the projects?

What were the typical projects targeted at?

What was the structure of the projects/Activities?

Where their projects simultaneously or focused on one at a time, and how was the dispersion of the students? (a lot of projects involving few students, or few projects involving many students)

How much involvement from the companies are expected in the collaboration? Do you follow up on it?

Outcomes

What would you say is the greatest value with collaborating with students, and what can they contribute the most with? Is it solely that they are cheap labour?

Do you think your company value collaborating with students differently than yourself?

What is the main thing you got out from the collaboration with students?

In collaboration projects with students, what can you get out of this that you cannot attain otherwise?

Regarding master theses, how were they designed? Do you have experience from practical and theoretical designs? What is most valuable to you?

To what degree do you use the master theses, and in that case how?

What other value do collaborations with students create?

Do you believe that your company can directly benefit from working with students?

Do you believe that your company can directly benefit from working with students that have different backgrounds?

Via collaborating with students, have that facilitated to find possible candidates for a position at your company?

APPENDIX D. EMPIRICAL DATA IN TEXT

DRIVERS AND MOTIVES

INDUSTRY

The organization that interviewee C1 comes from is a large public transport agency. In so, "it is an organizational behemoth!" (C1). "Getting anything done will really challenge your perseverance and dedication." (C1). The interviewee described that the greater organisation consists of more than 25 different agencies that are interconnected. This inevitably creates issues for any traveller that need to cross several connections, as timetables seldom are harmonized. The issue is not new and has been a concern for a long time, and the interviewee expressed great frustration over the fact that nothing seemed to be happening to solve it. "Given our situation, we felt that getting a new grip on things is what we need, so getting in on this project with Stanford seemed like a promising option" (C1).

The interviewee stated that learning from others and establishing connections are seen as important sources of new ideas and opportunities. The main perceived issue appeared to be that the organization was too large to work efficiently, and the idea that interviewee C1 had, was to create a cult within, by forming a core team of managers across departments. Doing so required and agenda, and him and his colleagues felt short of ideas in how to start, and what to focus on. "In that kind of situation, an outside perspective can be really helpful" (C1). Regarding why they opted to engage in the collaboration, interviewee C1 stated that "Getting in the same room helps get going".

Interviewee U3 was one of the faculty representatives that was involved from the very beginning of the d.school. he stated that the initiative started because people realized that the changing world required more efforts into gaining new perspectives, from talking to new people. There is no point in developing products for people if there is no actual need for them. And getting to know these needs is a pull process, not a push process. The ideas came from the design field, and there was a growing notion that innovation can't be siloed. "Innovation happens in the meeting between people" (U3).

Interviewee C2 participated in a joint class of students and industry representatives at d.school. She is a business leader in charge of setting the plan for the business. She had founded it and now it had been acquired by a larger retailer, but it is still indeåendently operated within the corporate group. On the topic of motivation, Interviewee C2 expressed that as a business leader in a fast changing market, it is imperative to keep up with competition and customer expectations. In their industry it is highly important to adapt to trends, as the core customer segment is healthy women, a group that is very trend sensitive.

Getting new perspectives is important, and working with an external organisation, as d.school in this case, is perceived as very helpful and valuable. interviewee C2 expressed that social

media is an important channel for their business and that; "Students are younger and more in tune with what's happening". Understanding the customer is key for their success, and getting the viewpoints of students on their business is seen as even more valuable than market statistics, "you get to know more real information when you go out there and connect with users".

Interviewee C5 stated that "Everyone thinks differently", and what he meant was that collaborating with people from different backgrounds enable exponentially greater output. You can really learn from others, especially if they don't come from your "world".

On the same topic, did interviewee C4 emphasize that firms need to collaborate with students, because these guys (referring to students) are the "creative juices", that the wll bring new ideas, new concept, and think outside the box, which is hard for a company to do.

They (referring to companies) are incumbent! They are constantly struggling with distractions of the broader vision of the company, they (students) have a fresh perspective. They (students) are not burdened by what we "falsely" believe, are the reasons why we can't innovate, or push forward. (C3)

"you have to integrate the power of becoming more innovative and make money" Furthermore, incremental innovation and radical innovation are both important, because they have to co-exists" Otherwise there will not be a development unit (U12)

Another reason why companies should engage in University Industry collaboration touches bases on that students do not feel restrained, when efficiency is everything, we (corporation) don't have the slack that is necessary to creative. Bringing students in, will bring the different level of energy, and they are not restrained by the corporate, so they can bring different ideas, thoughts and energy to the companies that brings in new dimension that helps companies be more innovative and creative. And this is not possible in corporations. (C4)

Their (students) value to work in a big company, and understand how things get done, because they have a lot of resources. And students have a lot of talent and bringing these guys together will be a good synergi.(C4). "For students it's really important to understand all the different frictions that are in a company" that it is just not about implementing it right away. (C4). Furthermore on the same topic. Students are very creative and are always learning, always thinking about how to change the world. And always want to learn more. In the real world there are different limitations, corporate politics, different interest within a company... good for students to understand them. And understand how to influence an organisation to move it into another directions. (C5)

On the topic of collaboration, interviewee U3 referred to graduate students as "free electrons", they are the ones that can bring new ideas to collaborations. "Graduate students make things happen!"

Industry is attracted to collaborations with d.school due to the opportunity to expose students to the firm brand, and since it is a low risk option for conducting experiments or market research (U3). "one of the reasons many companies engage in the processes at ProLab were for recruiting future employees. (U13)

Interviewee S2 believed that more firms are realizing the power or value of user empathy, for business development and product design purposes. The collaborative aspect of d.school is also a factor that she believed is very important. Especially working with people from drastically different backgrounds.

On the topic of motivation for industry, respondents from Demola (U9, 10, 11) pointed to getting access to students and employing students locally. The connection to students is what attracts companies to Demola. Another KSP is to increase interdisciplinary thinking within organisations. Tech companies only recruit within tech disciplines. Companies lack the abilities to gain value from different disciplines.

Letting students into the operations of the company can help managers to get new insights and perspectives. "It provides a fantastic breadth of ideas and thinking" (U10). It can be of great value to work with students, if there is a multidisciplinary diverse group, then you will get a lot of different perspectives, which can be useful. (C8).

"Students offer new perspective, and have knowledge about new technologies coming up. Employees don't really understand them completely, and then students can come in and facilitate for them. (U6) Also give a fresh perspective of a school mentality "trying things quicker" get out of the firm culture. And really apply innovation." (C2)

"For something to develop, you need a good mixture of people, from different backgrounds, and also different ages" (U12).

"Despite that it requires a lot of resources from our side, the collaboration is worth it, because we (companies) have responsibilities to also foster the new generation, and for students it is of high value, so we may not benefit from it directly, but indirectly, in the future we get better educated students, that hopefully will work at our company" (C2). Furthermore, what students really can help companies with, is the phase where insight collection happens (C2).

Another greater motivation to collaborate with students, is the access to large quantities of literature, which is something we as companies do not have time to engage ourselves with, it's just a shame that we are not better att capitalized opportunity and actually utilize all the information we have gotten. (C8).

"since I am working for a consultancy firm, it is not that important for me to justify where I get the knowledge from, there are plenty of idéas at our company that were initiated by students" (C6)

"I would like to delete the original hiring process, and find a new way to recruit students my organisation have collaborated with" (C7)

Students are great at making things happen, they are not triggered by the internal complications we companies possess, which is why they are a good source of energy, and I have never seen things come to reality based on an in depth planning" (C6)

On the topic of motivations, interviewee S1 stated that the main reason for her to engage in industry collaboration projects was to learn more about how companies work, and to get to know an industry of interest. Another major objective is to be able to network and create connections that might lead to future career opportunities. This networking was something that she did mostly after classes at d.school. For companies, students can offer fresh perspectives on marketing and emerging cultures. This statement was furthermore iterated by student S2, S4, and S8.

Student S1 also emphasised that regular classes do not excel on translating the business cases into the reality, which the collaboration with organisations actually does to the full extent. Student 7, along with student 8, discussed that it is easier to put in the time, energy and efforts on a project you are doing for someone else, which is one reason why these types of collaboration are highly attractive. I Signed up for this class due to three reasons, first, signing up for just a quarter was not enough, and this course runs over three quarters, second I wanted to work on something that had an output and third, I wanted to work on a team that was interdisciplinary, because that is what you most likely will do later in life. (S7)

I don't want to be presumptuous, but the projects we do in school, does not really matter, a presentation, paper. And that is less motivating, than actually help people. "It is very different to it for someone else" (S7).

On the topic of why companies, and organisations should engage in University-Industry collaborations the interviewee S3 stated that: They (companies) get a fresh perspective: they are often "too close to the company, and then think in an already setf way" thinking about more of a closed universe potential solutions, students can shake that up. "Students can imagine those things that are too much out there" but students can push the company. Students furthermore is also another burst of energy, which is also very valuable to them (companies).

Interviewee U4 believed that credits play a major role in motivating students. At least form most of them. This is something that was reiterated by interviewees U1, U2, U9 & U11. "Credits affect commitment!" (U4). D.school has experimented with classes taught in joint collaboration with chinese universities. in that setting the credits awarded for classes was not harmonized, and it became apparent that this affected the motivations of students.

Interviewee U1 sees ambiguity as a great benefit, since real life often can be very ambiguous. The tools that the students are taught will help them get out when they are stuck.

Attractive for students to get involved with large companies. It is a good way to be "seen" and an opportunity to demonstrate your abilities. Students definitely write on their CV that they have taken a demola course, valuable for companies that know about it. (U11). It is also very attractive to take courses and do projects with students from other disciplines. Opportunities for

that are very limited otherwise. Students welcome the opportunity to learn from each other and get to know each other more. (U11)

Students express that they are motivated by the opportunity to work with a company that is genuinely interested, and to be able to help them solve real problems. (U9)

" I believe one reason why students engage in collaboration with companies, regards the company's brand, they would like to be associated with an organisation that possess a strong market share" (C6).

Several of studies that regards to idea generation and implementation demonstrates that project that is developed in an external environment outside of the line of operations, generate better competence development than internal. (C9)

"the greatest value for a company to collaborate with students, is the student's fresh perspective they bring on to solving the problems, they are nut burden by company culture" (C9)

UNIVERSITY

One of the major motivations for university, and what should be a core objective, is to enable students to evolve as individuals. (U9)

School is responsible for creating employable individuals, students have to be taught how to deal with challenges they will face in their upcoming careers. (U1)

Make students stay in the municipality. 60-70% of students come from other places regionally, and after their education they leave. If we get student to say, then the companies will stay as well. A platform to engage in collaborations with other universities, nationally and internationally (U9). Increasing exchanges of competence across borders. "There exists a clear incentive to increase collaborations between university and industry" (U10).

When we talked about developments in different areas, and why the academia has been somewhat stagnated, interviewee U12 said "there is by far not enough applied sciences at the universities, Lund University costs all the taxpayers seven billion SEK each year, there is no reason that the universities shouldn't have to develop with the society.

Enable students to discover their "creative confidence". Traditional academic classes can be very demoralizing for creativity, it's so structured and stringent. What society needs are more creative individuals who can drive change and development. (U8)

By opening up to external collaboration, university should be able to benefit from exchange of resources. (U2)

The image of Stanford has definitely been improved through the growing awareness and popularity of the d.school. (U4)

The world is changing quickly, universities can't go about their business as they always have. These things (collaboration projects) need to happen, but as it seems, many are reluctant to acknowledging it. (12)

BARRIERS

INDUSTRY

Regarding obstacles to external collaboration, interviewee C2 expressed that this type of project based collaborations can take a lot of time. The project that C2 was engaged in required her and her team to actively participate and drive the project, so a great deal of time had to be put into the project. However, she did express that she felt that it was well worth it, given the results that they got. "Universities are the most problematic to work with in business" (U9). "Even if we direct employees that are available, and have the time, that is not the solution, it is the commitment that is decisive (U6).

"I wish our communication with students could start much earlier, maybe even during high school" (C7)

Interviewee C6 expressed that a major problem for firms is that there simply is no time to spend on projects outside the budgeted business operations. "There is no organisation today that is not slimmed down, there is no slack to engage in activities outside the core business." However, as soon as you get something into the budget, the situation is different, so it's not really a lack of resources, money is not really an issue, it's about getting the idea on the agenda of management. If management understand the value, you are sure to get support. Reiterated by C7 and C8.

"We are walking a thin red line between academia and industry, and it can be hard to get both sides to understand that they need each other". "Students run along in their safe bubble for three to five years and then they realize that they need to look for a job, and likewise, companies realize way too late that they need to market themselves to attract competent students". "Companies think they know what their customers want, but they seldom know what they actually need".(U9)

"if there was an easy way to find students, while simultaneously keep track on what they (students) are currently studying, we could integrate a collaboration much better, and I am actively thinking about it". (C8).

"I am currently supervising a PhD student that compiles her thesis, but her time frame is much longer than mine, which is why I am sometimes losing track of her thesis development" (C6).

Interviewee C1 stated that working with outside parties on internal issues can be risky, in that sense, working with university is more convenient. But he emphasized that it is still an important thing to think about, that information doesn't get spread around too much. however,

this was not a major issue, since interviewee C1 was from a public organisation. Working with external parties, like other public agencies, was not perceived as without its complications though. "It can still be hard to get people to engage with others, and share their ideas freely. often most of us get inhibited when we are working with people we don't know very well, especially if we are not used to that way of working" (C1). The interviewee also stated that even if they had done this project, he knew very well that it would not be easy to inspire other persons in the organisation, that had not experienced the design thinking project. "They are still set on their old ways of thinking and working" (C1). "It's hard to get support for new ideas or projects in large organisations" (C1).

Even though the innovative power of collaborations, like those offered at d.school, should be apparent to everyone, a major barrier is often that someone in a company needs to sell it internally to the organisation, before the company gets engaged (U4). Very often, executives in organisations are from older generation, and they can have a hard time "getting the world", their mindsets are from another era. They could benefit from external views, but a problem is that they often need to face a crisis to become aware that they need to reach out for help. "One of the hardest things is to realize your own restrictions" (U4).

Interviewee S1 elaborated on some of the activities they did together with companies, and one barrier was that in the corporate world, there are no room for mistakes, and that it was a struggle to get them to do the same thing we did at d.school (the project itself) and they were very hesitant about it. They are very assure about making right, and they don't want to bother the customers or the guests. And getting them through that was really challenging. (S1).

In terms of project objectives, interviewee U3 perceive that companies often want very tangible problems, however this might come in conflict with the intended activities. "Running a project on designing a door handle wouldn't work in the d.school context" (U3).

This opinion is shared by interviewee U1 who expressed that a project she facilitated tended to gravitate towards product development. The customer wanted to introduce a new product, and students were tasked to explore the pain points of the users, however, during the project many started to work on the product features anyways. It appears to interviewee U1 that it may be easier to think in terms of products, rather than following the intended process of learning about the user needs.

Respondents from Demola (U9, 10, 11) reiterated some of the challenges other companies face, that no matter of the size of the company, there are still obstacles to encounter. Large corporations have experience from larger innovation processes, and do not believe that another perspective will be as much of a value, "What can students in reality add that we haven't tried already?", while smaller organisations / companies are so busy with their internal "They are so into their own entrepreneurial journey, that they have difficulties to engage in other activities that lie outside of their core business. So nobody feels an aversion, but the companies are so busy with their own tracks, and different steps in their own business trip, so it's hard to consider something new.

Understanding of the value is equally low among large corporations as well as SMEs (U10). "They come to us, but they don't really understand exactly what it is." (U2).

If a company that comes to d.school and expect a good solutions to come out of the project, then it is not a good fit. Because, practically, these students are on their first, or second design challenge, you would never hire them for that. "When you talk to companies about it, we tell them to hire consultancies firms". What you get out, is students that can practice on real cases… and secondary effects, in terms that students eventually want to work there. (6) "Very few problems are solved by a group of students in a few weeks, especially since they have four other courses going on at the same time." And this can sometimes be an issue that companies do not understand that philosophy. (U2)

"I know that companies can benefit from collaborating with students, however, it is not for free on our side, it is actually a huge cost. It requires a lot of resources, and especially time that we companies don't have."(C8).

Furthermore, the interviewee C8 stated that the complications of time dispersion, and stated that "when there is a discussion in regards to a project at our company, we are already up and running two weeks after that", and in those cases we are not sure of if we can find any students that can help us, because they might have another agenda, and second, how do I find them?". She furthered emphasized that the gap between academia and industry could be solved: "there should be a platform for us companies to find the students' schedule, all connected onto one platform" (C8)

Respondent C8 further stated a recruitment obstacle: "In my position, I am not allowed to recruit students outside of our graduate programs"

STUDENTS

Interviewee S2 believes that short projects offer limited appropriation. To really get something out of a collaborative project like those offered at d.school, you need to spend time on participating fully, and in the best of worlds you should take more than one class. Even if the longest classes are one term, they are still only held on one occasion a week, it should be more intensive. When discussing the incentives to participate in student-company collaboration the interviewee S4, stated that the without getting credits that counts towards his major, he stated that the project would definately have to be something special. When asking the same interviewee what type of incentives, or rewards he would appreciate, he mentioned that traveling to another country to help them there, would be highly satisfactory, and something he would expect.

On the topic of barriers, interviewee U4 stated that team working across boundaries can be a challenge for students. Teaching teams sometimes see that groups can have issues collaborating. Mostly they get over it together, but sometimes the teaching teams need to step

in. It is an important part of the concept that you are forced to work with people you wouldn't normally. This is something the students will face in their future careers, and group dynamics is a complex subject, if you are skilled at it you will be successful.

Interviewee U1, a teaching fellow, explained that the varying structure of classes can sometimes be confusing for students, but that it teaches them to live in ambiguity. This was further iterated by our own observations when participating in a halfway seminare, where many students seemed to have difficulties on understanding the context, which would be one reason for the low engagement. (Observation)

"It is easier to work on something you are engaged in"(U8).

On the topic regarding rewards for students to participate in projects as such, interviewee U2 pushed on the importance for students to get credits that count towards their major. "It would not work, or it would be very different". Same respondent elaborated on this issue, and stated that he believes it is a wrong philosophy to create a lot of opportunities, build ones resume, that could lead to something in the future, but for the moment only would be a burden. "Those kind of activities (referring to participate in d.school courses without receiving credits) can only students that already have great support. Either no difficulties in school, or great monetary backup, which means no part-time job. Thereby is it crucial that students receive credits for their participation. (U2).

A director of the d.school elaborated on the same topic, where she explained that they have experimented a lot in regards to have the correct "currency" (incentives for students), and said that is a constant battle on how to reward the students in the right way. (U6)

When discussing to what degree her company is using master theses projects, interviewee C2 answered, "it is not.

 Despite that students attending Stanford University, are hard working and intelligent, Interviewee U8 said "no groups worked hard enough" "other course assignment get more attention than your own project, because when you are doing something for someone else, you are more motivated, it is a weird psychological behaviour. (U8)

UNIVERSITY

"We often imagine that there are so many rules and equipment necessary to start something like this, but is there a power of will, and knowledge, it will work" (U2)

Several interviewees reiterated that one of the major impediments to this kind of UIC concepts is a lack of understanding in university. "Faculties need to see the value in project based learning, the students come back more competent!" (U4). "You got to have buy-in at top of departments, things are so hard otherwise… hard fights, scientific methods and institutions you know…" (U5). Another major obstacles is to get management from companies to let go of

control. "Being open to crazy ideas is harder said than done!" (U11). This reluctance to let go of control is most evident among SMEs. To a small company, a Demola course can be a big thing, but at a large company only another activity.

Attracting industry into collaboration is perceived as a major barrier among university representatives. Interviewee U5 stated that d.school attracts companies due to the Stanford association. in addition to that, the fame of the founder, David kelley, also attracts company interest in the specific context of the design industry. Without these aspects, interviewee U5 is sceptical to if d.school would be the success it is today.

Proposing design thinking to Stanford was a big thing, that was not very welcome. As it turns out, once Kelley received the donation from Hasso Plattner, the university was more open to the idea. "I am in academia to avoid the barbaric nature of money, we don't talk so much about it but it turns out it's here". (U8)

Interviewee U3 expressed a great deal of frustration over technology transfer practices typical in UIC. "Technology transfer people are the biggest roadblocks!" (U3). He meant that they can spend years on discussing patents and IP-rigths in court, and can slow down relationship establishment between university and industry.

Respondents from Demola states that one of the greater challenges, that they constantly have to consider, is the academic institutionalism. That "this massive blob" is hard to encounter, and Demola must follow their rules. (U9). Along with this goes managing courses, can take a lot of time for scheduling and planning activities, high burden. Would like to try "shitty prototyping". (U9)

Interviewee U1 explained that a common issue in collaborations that are very diverse, covering many disciplines, is that there often lacks a common language. Misunderstandings, or misalignment of objectives and approaches to problems can emerge and hinder innovation. At d.school, the design thinking framework serves the purpose of bringing a common language. Regardless of background or previous knowledge, everyone can get in on the process and co-innovate.

On the question of barriers, interviewee U7 who has been around since the start of d.school, expressed that the concept is not very liked in certain camps. Academics perceive it as diluting the rigor of university education, and the design community perceives it as diluting the discipline of design. Design thinking is a concept that transcends boundaries, and is a totally different way of thinking, interviewee U7 means that naturally some won't understand it. "d.school is not just unconventional; it's extremely radical... and still a controversial concept." (U7).

"Design thinking is still unconventional and controversial" (U8)

Interviewee U2 described that running a d.school course is very different from normal classes. "We constantly have to adapt the courses to fit in with current themes and methods, and that takes a lot of time and resources". He also said that "I would never want to take a d.school class in a normal lecture classroom, with equipment that is not mobile". So the physical space is not

the barrier itself, because you can run it anywhere there is an open space, but all the other factors make it become more time consuming". "In a typical class I will talk for 15 minutes, and then it's 2 hours of activities, so you have to prepare all that in advance, which also takes a lot of time".

Since the main focus of these multi-interdisciplinary platforms is to form groups that have a great diversity, it becomes harder for some groups to be chosen than others. Interviewee U2 stated that at d.school, it is very popular amongst business graduate students to be involved in d.school courses, but the acceptance rate is only one out of five, but it can almost be the opposite from other disciplines. This can sometimes be a challenge when we form our teams. (U2).

Working closely with university offer its own set of challenges. "Try changing the mind of a giant blob (Heffaklump)" "Universities have done their way they do things for a thousand years..." "We are continuously working with the dean to solve issues, but it takes time, everyone want's to have their say…" (U10)

On the topic of geographically context, and how we would rate the opportunities for these co-innovation models in Sweden, the interviewee U13 said that "Can definitely say that the Nordic countries have a disadvantage. There is a greater tradition in US of these kind of spaces and activities on a voluntary basis, so there is a easier way to find drivers in US. You can not create a successful place of just planning. The participants reality must feel the ownership of the space" (U13).

"Most makerspaces, are non-profit, and that is really interesting but sometimes very problematizing, because then they rely on donations. That is why Demola is a good model of this" (U13) .

OUTCOMES

INDUSTRY

Interviewee C2 expressed that she had received a great deal of valuable output from working with students at d.school. In the joint project, students have worked together with businesses to adopt the design thinking framework to their perceived problems. "Going through the process gave us new perspectives, and a lot of new ideas!" (C2). The project has resulted in several tangible outputs; "We found that we could benefit from rebranding our product lines, to fit better with the target customers, we have experienced some negative feedback in social media, and from learning more about the users we found that the brand needs to become more authentic" (C2).

Interviewee C6 stated that his experience from collaborating with students is mostly positive, and that it has help him to focus on some of his processes, and also the potential of finding talents for recruitment purposes.

In terms of working in an external project, interviewee C1 expressed that it had been very good to have a predetermined framework to work from. He felt that the organisation that he works in have struggled for a long time to get engaged with each other. "The organisation is very siloed, unfortunately" (C1). So getting into a project with the d.school had helped them a lot. The framework had "alleviated engagement", as the interviewee expressed it, and he felt that the methods of working had steered the group to achieve valuable results. "If we had got into this without the guidance and the tools, I'm certain that we wouldn't have ended up in the same place" (C1).

Being here today brings back our innovation and creativity in us, i usually say "think like a child". Often we have lost that thoughts when we go into the corporate roles, we often just think about results and not about being creative process. (C4). This statement was also reiterated by (C6) where he stated that companies have the resources, the commitment, and the frastructure, and students are then the core of the processes. (C6).

In some cases staff from companies have been more involved in projects. We have tested the "we have done this before" mentality. but "by participating in demola projects, the employees are stripped of all the things that they normally rely on. when faced with the task of "solving the problem" they tend to start grasping for frameworks to adhere to". (U10)

In terms of outcomes from collaboration, interviewee C1 expressed that it had been a very positive experience. The main takeaway was the experience of working outside "the government box". The interviewee had mentioned several times that one of the major issues they were facing was the inertia of their organisation. Getting things moving required major efforts, and often things were never seen through to the end. The opportunity to work with outside parties, and without any major risks, had empowered the team. The project had helped the team to break practices and as the interviewee stated, they were now ready to get back "home" to get other people on board. The major outcomes from the project were, according to the interviewee, new ideas for branding the services offered to travellers, and new ideas on how to perhaps get travellers involved and engaged more. The DT process had revealed that you can achieve a lot with very little resources, so the team had developed an idea about how to enable travellers to help each others, instead of the agency operating and serving everything. A solution that connected well with financial and business conditions for the organisation, being publicly funded. The team that interviewee C1 belonged to, also learned that collaboration is a key to success. They were determined to work hard to interact more with other departments and other agencies, to alleviate the issues that travellers are facing on a daily basis. A project that they had decided to initiate, to remodel transit maps, was intended to be done with further collaboration with students, as the experience from d.school had been very positive.

Interviewee C5 stated that he has greatly benefited from what he learned doing d.school classes. he had used the methods and approaches in his career as an entrepreneur.

When discussing what the company got out from collaborating with d.school, interviewee C3 said they got a new focus at the company, that they started to adopt design thinking.

"We get frequently distracted about how to run a business, and by participating in this class it brings us back to our focus… some of the things that are really important, which is the innovation and by having a platform like this, really zooms in on the problem" (C3).

When discussing different types of UIC in swedish context, the interviewee C6 mentioned that he mainly possess experience from supervising master theses, both practical and theoretical focus driven. In these contexts he believes that students definitely can bring new ideas to companies. Many thesis projects have been further developed within the organisation.

Working out of a framework, or process that is so different from normal business routines was perceived as very empowering by interviewee C2. The process of design thinking forces participants to step out of their comfort zones and really get into the process of understanding the user, this enabled the team to finally get some really valuable insights on the company brand. "It has been a new and exciting experience that I hope everyone gets to do at some point" (C2).

Interviewee U2 elaborated on different values that organisations get out of the collaboration and said that the companies just want to be exposed to students, and fresh them (companies) up, and get invigorated. He further stated that branding is one major reason why the companies engage in the projects. That you are exposed to intelligent students that work on your project during a couple of weeks. And this is good for two reasons, they can actually generate an idea that the company later on can build upon, and secondary, companies can find attractive candidates for future work positions.

Interviewee U2 described how his experience from d.school has helped him in the corporate life, where it is very common that his colleagues often discuss the problem and solution, without putting much into reality. "By still having the design thinking mindset, I have another mindset where I go out and talk to the users, because much of the information can not we assessed, or gathered by reading, it is so much about interaction. It has really helped me in the working life. (U2).

One of the greater value, connected to objective of the foundation of Demola, is related to companies getting access to students. This is demonstrated in two different ways, where the first one touches basis on recruitment opportunities. Tech companies often only recruit within tech disciplines, where the collaborating in a Demola project has opened up new perspective on where, and how to recruit. (U10). Bringing in interdisciplinary thinking enhances the company's' ability to widen their perspective. (U10) Letting students into the operations of the company can help managers to get new insights and perspectives. "It provides a fantastic breadth of ideas and thinking" (U10)

To a SME the ideas that students generate can be very valuable. "It can be a big thing for a small company to engage students in a project" Their ideas can be vital to the company, this is a crucial difference from large companies.(U10)

"Output from courses are mostly of general or conceptual nature, due to the limited time that students have for the projects." (U9).

"What student can really help companies with are conceptual visions, or thinking differently." (U10) "You can't expect the solutions to be finished concepts, but rather initial prototypes..."

"The commitment and engagement from companies tend to increase at the late stages of Demola projects when they start to see what the students are working on". (U10)

Large companies that have participated before are much more interested the second time and so on. "They have seen what it can generate and they don't care what it costs, they are curious to see what the outcomes may be". (U9)

"The creative process is an amazing experience. It's a place where you and like minded people can get together and hash out new ideas, and learn how to make new ideas." C4

Everyone are creative, but somewhere they get shot down and then it might happen again, and eventually they simply accept that they might not be creative. (U8) We see a lot of this, when we are working with clients, we eventually get to a point when things get fuzzy and unconventional. At around this time is when many executives pull out their phones and say they have to make an important call… They uncomfortably head for the exit and when asked afterwards they say "I'm just not the creative type." but this isn't true, if they would stick to the process they would eventually achieve amazing things.

STUDENTS

Having taken d.school classes has changed her way of looking at life, stated interviewee S2. The framework and methods she learned has substantially helped her in goal-setting, both in school and privately. For companies she stated that the biggest value firms get out of the collaboration is to learn more about their customers and product users.

Interviewee S4 stated that d.school has changed his perception of his own life, and how to make good choices, and 5-10 years, and how to actually reach them. When discussing design thinking, interviewee S1 said that each piece of is applicable in different situations. It can be applied to different aspects, maybe not all of it at once,but you can grab different pieces of it, brainstorming, testing, and the iterative process: You can take any pieces of that to any project. I have definitely used it in other parts of my life. Like reframing, is just think on a question and always go with it. Like "here is a problem we are trying to solve, just go out there and do it". (S1).

"Teaching follows completely different methods, and apply to different things. Transformative design is insightful and what you learn you can apply to your life." (U2)

Interviewee S1 expressed that she thinks of herself as more creative now that she has taken d.school classes.

We furthermore discussed the main vision of the d.school, and asked the same interviewee if she is becoming more creative via d.school. She answered yeah, i think so, at the very beginning of the D.leadership class, the organisations came in and got like a crash course in design thinking over two days, and preached that "you are not born creative or not, you can learn tools, and skills to become more creative". "And hearing that was very powerful" You are not fixed. "Its cool to learn rules, because i am a rule follower". and if you have the structure, it will help you with these things. (S1).

Exercise your creativity. Because it is a muscle, and you need to continuously work on it, and d.school has institutionalized it, and always working on it. (S5)

This processes forces you to interact with real users, in the way that business school is a lot about learning from past cases, and this is more experiential learning, which is really different, and it forces you to learn at the same time, and figuring out the ambiguity, working part as a team, how do you figure it out when someone is slacking, or someone that isn't very good at interviewing users, or one 4 people think one thing, and one think something different, so you get to practice what you will do in real time. That is why it is very different. "It is like a team sport , yeah 110%" (S7, S8).

"The normal situation for students seem to be that you have a bunch of random things where you don't have any base methodology, and so you are kind of insecure about your ability to do something unusual, or complex... If you get students to get confident, and make them believe that they can achieve what they want to do in life, and that they are capable of doing something important, that is so much better, and that is something Demola is actively promoting. (U9)

For students collaborating with a company is of huge value, It prepares you how to work in an industry, understanding and how to bring design thinking into the workplace. (S5).

Collaborating with firms provides a deeper understanding that will enable you to be better prepared to eventually tackle challenges when you join the ranks of professionals. (S4)

A bias toward action - is probably the biggest thing I have gained from d.school. (U2).

Interviewee U2 described that students write on their resume that they have a certificate from d.school, "but comically we don't offer that"

Interviewee S7 stated that the reason why she came to Stanford, was because of the d.school. Interviewee S4 explained that participating in these type of collaborations, is like an internship experience. Furthermore did he mention that he is currently (at that time) participating in several of classes that does not give him credit, because as he stated "helping other people is so much fun". (S4)

Interviewee S7 discussed that the overhaul view over d.school and said that "it is about making that real into practice, this interdisciplinary team dynamic, that you don't get outside of d.school. Which i think is a very cool part of this class. "Otherwise i would not be here" , it's a really cool thing to be able to unpack an experience you otherwise would not get, or have time to" (S7). This was also reiterated by interviewee U2 and said that it is invaluable for students to be

exposed to interact with people from other disciplines, something they otherwise would never do in the university atmosphere, but something that happens in the future on daily bases (U2).

Interviewee U4 stated that one of the benefits of going through the DT process is that it enables you to realize assumptions about yourself. You get to know yourself better. it appears that students using DT come back in new guises. The Tools they learn are useful in so many other settings as well. She also shared that she often see students realize that they don't know everything. They often come back with questions after classes. "It almost undermines the confidence of the students! (U4)"

Interviewee U3 stated on the topic of student outcomes, that the process puts pressure on participants to grow. greater challenges entail greater learning.

Elaborating on the design thinking process, we asked if she believes she will encounter problems in work life, by having that questionable mindset."as an entry person, I am entitled to questions, like "why are we doing this" That will help me in that sense. That grace period when i am starting the job will let me do that, but not sure how long it will last. It will be really tough.(S1).

Interviewee U2 described that students often rediscover many of the "lost" abilities. Especially those they do not practice in their current education. Students usually excel in being analytical, critical thinking and be persuasive, but in d.school, do they discover other equally important characteristics. Such as being creative, generative, listening skills, empathy. In other words, they get another perspective that is user focused, and not corporate focused. (U2)

An ongoing value that keeps being reiterated by students, are the value of working on real cases. Whereas in school, you constantly learn different methods and framework, but you never get to practice it in real context, and that is exactly what you do in d.school. And it is so much more fun, and i learned so much more, and quicker" (U2).

The value students get out of the collaboration regards open for future working opportunities, where students emphasize on their resumé that they have participated in demola courses. A internal outcome from the students is that they get more work related experience, in which they later on get practice, and assess their current knowledge on real cases. (U11) "It's amazing all the perspectives you can get from working with different people!" Students can take on problems, and are allowed to fail, this creates confidence. (U11)

"The networking opportunities are enormous, every student that has taken a course will have someone to call after they have graduated, that's a difference from doing an individual project with a company". (U10) "you're not forced into a model, you can grow at your own pace, and towards what you want".

It is relatively common that students are employed through participation in demola projects. (U10)

"There is no innovation, unless you let it become an innovation" (U14)

"The main benefit to students, and a tremendous one at that, is creative confidence."(8) It's a catchier acronym to self efficacy. Self efficacy is a term introduced by psychologist Bandara, describing how an individual gains the confidence and conviction that they are able to do whatever they want; the feeling that you can change the world and that you can achieve what you set out to do.

"We see at d.school how people think that they are only analytical, and then they go through the process and end up seeing themselves in a totally different way." (U8) "And they are totally excited about the fact that they can walk around a think of themselves as creative a person."

DESIGN

D.SCHOOL

Objectives

Both interviewees U3 and U4 stated that the purpose of the d.school is not to teach designers, but to teaching a new mind-set. This was reiterated by several respondents and is reflected in the public slogan of d.school; Innovators, not Innovations.

"The goal of d.school is not that all students should become designers, neither is the objective to "solve problems", but that each student should grow their creative confidence." (U2) "We don't create innovations, we create innovators."

Interviewee U3 stated that design is the "glue" between schools on Stanford campus. It is a discipline that transcends all other fields. he meant that the focus on design, of the d.school, was a deeply purposeful approach. On the topic of design, he also stated that d.school was just a room and some chairs from the beginning, but that this is something that has not changed that much.

"The focus is on teaching and practicing design thinking, even if course designs may differ, it's always at the core of all activities." (U2)

As a teaching fellow, you are not actually expected to "teach", that was according to interviewee U1. The focus is on facilitating creativity. "If you get more creative you can apply that to whatever context you are in, we want students to be able to do that in their future careers, wherever they may find themselves." (U2)

Governance

Founder of the d.school recieved a large donation, in the amount of 40 million US dollars from Hasso Plattner, to found the d.school. The interest on that money goes to fund the operational expenses of the disciplin. (U8) Furthermore, collaborating companies / organisations give a donation as a thank you, the amount ranges but 40-50 thousands of US dollars is usual.(U2).

Interviewee U2: d.school employs around 30 persons who are mostly administrative staff. The majority of teaching teams are employed elsewhere.

Partnerships

"Sometimes the d.school will reach out to specific companies or organizations, but with the popularity that d.school has attained it is not very hard to get corporate sponsors, many companies get in touch with d.school to get involved." (U2).

When an organization is to be part of a course, the teaching team get in touch and does an assessment of the fit. "It's important that there is potential for a fruitful cooperation and that the company or organisation has the abilities to implement changes." (U2).

Companies that get involved as sponsors pay a fee in the form of a donation. (U2) The amount varies from case to case depending on the nature of the partnering organisation and the purpose of the class. By receiving donations instead of charging a fee, a lot of legal and administrative issues are avoided. However, the donations are considerably less than what firms pay to do a dedicated corporate course at the d.school (instead of partnering on a student class).

Company involvement

On a typical class, according to interviewee U1, the sponsoring firm will be present on the first day when students are briefed on the project. After that they will normally only return for a halfway seminar (or not even then) and at the end of the course for final presentations.

One clear exception to this format is the d.leadership class, where sponsoring firms participate with entire teams of representatives. The students play a different role, as they are the facilitators, and the firm representatives are those carrying out the project. Interviewee S1 expressed a great deal of appreciation of this class, and thought this was a form of collaboration that was very successful.

On the topic of partnerships with companies, interviewee U2 stated that; "We are very clear towards sponsors that this primarily is a course and that the first aim is that students learn, the second is that everyone are treated with respect and thirdly that the sponsors gain insights and new ideas that may help them perceive their internal problems in a new light.", "It's possible that there are ideas that emerge that could be implemented directly, but it's unlikely."

"We always want students to be able to work on real cases, so corporations are mostly involved as project sponsors." (U2).

D.leadership is one of the classes where students get to interact more closely with corporate representatives. The student has experience of the process, and they get to do the project together, with the student as a coach. (U2). The purpose is for the student to train and teach the company people how the process is done.

Typical cases

When interviewee U3 discussed typical cases, he talked about the underlying objective of the projects. Since the projects are short term, and run by graduate students often without any actual design education, it is important that the projects are appropriate. A good example was a project for Chrysler, where the DT process revealed unexpected information on their drivers. The issue was that old drivers eventually lost their license, and the insight was that this customer segment essentially displayed the same properties as young driver, who still hadn't gotten their driving license. This type of market research cases, with user empathy in focus, symbolises the typical cases done at d.school.

The theme of cases and classes is set by the teaching teams. (U2). But the student get an opportunity to vote and provide ideas each semester, however, for quality reasons a lot of them are denied.

When a case is done for a corporate partner, the objective is never to provide a finished solution. "The aim is to provide the sponsor with new ideas and perspectives on how they might change their products or services to better fit the needs of their customers." (U2) "By applying the design thinking framework, the student gain deep understanding of the users, something that companies tend to miss sometimes." (U2)

Design thinking is the framework for d.school and for all classes (U2).

Student background

Forming student teams can be a tedious process, as expressed by interviewee U4. "Sometimes it works, and sometimes it doesn't". Groups are formed based on a mix of backgrounds. Not only the background i important, a mix of personalities is important as well; "A team with only introverts worked very well together, but they were afraid to get out and interview people" (U4).

Teaching teams form the groups in each course. The objective is always to form diverse groups. Sometimes this can become a problem. "The process can be quite intricate, teachers can vote for who they would like to include, and sometimes students can suggest who they would like to do a project with." (U1).

Student incentives

Regarding incentives, interviewee U3 stated that the majority of classes at d.school offer credits, around 1-3 credits per class.

The d.school is independent from the university and has freedom to design their own curricula. Courses are designed to fit the academic model, so that students can take elective courses at d.school and be credited these as part of their major. (U2).

Process design

On the topic of guidance and control, interviewee U4 stated that "people are not static, people can self diagnose. you only need to nudge them in a direction for self correction".

Instead of the traditional approach in teaching, to go through 20 slides and then get into activities, the approach at d.school is flipped; You do first, then you go through facts with the students, according to interviewee U1. "this enables more embedded learning, which is more powerful." (U1).

When a case is done for a corporate partner, the objective is never to provide a finished solution. "The aim is to provide the sponsor with new ideas and perspectives on how they might change their products or services to better fit the needs of their customers." "By applying the design thinking framework, the student gain deep understanding of the users, something that companies tend to miss sometimes." (U2)

I took one pop up class centered around education, and so we came in the morning, and there were different organisations, and we were assigned to teams to work with each of the organisation. Mine was looking at after school programs and mentorships, in really not good school districts. The partner were given an introduction to the design thinking, but then decomposed so we could work on ex, 20 minutes on a specific design cycle process. Flip back and forth… learning real time, and not just being lectured. Go out there and apply it to a real situation. (S1).

A typical course usually consist of three cases, one initial small fictional trial case, then a little bigger one and finally a real and advanced case. (U1)

"All classes follow the same philosophy, but can adopt different methodologies, at some point they all diverge" (U2).

Interviewee S1, who did a d.leadership class stated that they interacted with the targeted users 3 or 4 times during a 10 week project, on different days.

d.school class compared to other project based course? Interviewee S1: In d.school we have weekly meetings, like this week you try this new activity. Whereas the other class was driven by the team, and how the analysis was going, so we were not guided that much.

Activities

Interviewee described a situation where the students were in charge of the brainstorming session, and she mentioned that They (company representatives) are really good rule followers! They were very excited about what the brainstorming turned out like. "They had done a brainstorming with students from Harvard before, but that was horrible". Everybody was sitting down, and next person had to say something completely new, and the atmosphere was very stale, but they they really liked ours more, which could be due to the design thinking aspect, because "If you can get everybody in the same mindset, you can get way more creative". (S1)

The problems that people are asked to solve should also be such that no one can do on their own, in that way you have to collaborate. And pre-framing the problem provides a nice start to projects (U3).

As a teaching fellow, interviewee U1 described that class sessions are very ad-hoc, she hadn't gotten that much guidelines or support in the form of materials when she was tasked to hold a class. tools and methods can be different, depending on the taste and interests of the teacher.

The structure of many courses are often divided into three different projects. Where the first one is fictitious case where students can practice the design thinking, and the other two projects are real cases with an increasing depth. (U2).

Interviewee U2 described a case where they traveled to Nepal, Asia, to help hospitals that encountered problems with newborn babies, and by help of the design thinking process, the students were able to solve the problem.

Location

Interviewee U2 mentioned that it is hard to do a project if you are not on the same location. They have tried to do projects on distance. Where they had courses uploaded online, and where the participants could follow the directions via their smartphone, it worked but was extremely difficult. And despite the advanced technology of today, there is something special with collaborating in a physically manner, that you can not achieve in another way. (U2).

Activities in design projects, and practical projects in general, need to be conducted face to face according to interviewee U5, among many others. Some elements may be done on a distance, but there must be an initial grace period where participants can get to know each other. For the project to be a success, there must be a shared trust within the group. The first stage of projects is always targeted at "cementing teams", bridging cultural understanding and sharing responsibilities. "The group needs to be able to hold together throughout the project" (U4).

Regarding the question if these collaborations can be done on a distance, interviewee U2 stated that he had done a project on that actual topic last year. "What we found was that the courses had to be broken down into micro activities, from a 5-week activity, down to 15-minute activities that could be done over video-link. We tested the concept with people connected from all around the world. It worked somewhat, but it was a struggle. It's hard to collaborate on a project if you're not together, at the very least you must have met a few times before. You have to build a personal connection, otherwise it won't work".

Space

When discussing the layout of the d.school she stated: Yes, it super helpful to have the space designed as it is, and the more you can get people standing up, get them in bigger rooms, and make them to not feel constrained will enhance our/their creativity. I definitely believe that physical space changes the way you think.(S1). She furthermore stated that the messy environment enhances creativity because it allows you to put random things, that don't belong together, forces you to actually think "what would actually happen if you put them together". If everything would have been clean… it would be a lot of pressure on you to come up ideas in your mind…I am visible person, and I like to touch and feel things… if only you and the chairs, it forces you to be in your mind… and not everybody things that way. (S1).

Interviewee S7 further reiterated this and added that it's a way to lowering the bar, and that helps people be more creative. We also discussed how important it is to have physical prototyping opportunities, and she stated that: "I Believe it is important to have low fidelity low physical objects, but what they are does not really matter". (S1). The interviewers asked "this class ended like an hour ago, why are you still here" Well we have a physical space here where we can hang out" (S7)

I would never want to hold a d.school class in a traditional classroom, with stationary furniture. It doesn't provide the necessary flexibility in the environment that the interactions require. But that's not so hard, just find a gymnasium or similar open space and you are good to go" (U2).

Design processes require creative freedom, and that is enabled by a simple and transformable space (U3).

Challenges

It can be a challenge to engage students and companies, given the restrictions in time and resources. (U1).

A solution to attracting people could be to have classes during the summertime, as a summer internship (U2).

From our observations in class 4, groups presented in front of a jury that later rated them and overall the ratings were pretty low. We could sense the frustration of these stanford students, that perceive themselves as are smart, bright, and ambitious, and they did not get the best grade. Our observations were that despite that putting these bright students together to apply the design thinking, they struggled with the process and the outcomes.

"When something is cheap we tend to undervalue it, and vice versa. It's important to find the right price, and to connect with good partners! A price model is important for controlling commitment and relationships, if we would have charged a higher price, perhaps they (companies) would have prioritized us more…" (U2).

Key Success Factors

Interviewee U3 further stated that the innovative power doesn't only come from getting different people together, the process is important, and by going through the process with a diverse team is when you learn from each other.

Interviewee U3 stated that one of the key aspects of the success of d.school is that it is a non-degree granting institution. This means it's no threat to the academic framework. d.school faculty don't do research that is published, and they are good at fundraising, so the institution is left on its own in the university realm.

Highly multidisciplinary, both students and teaching teams come from a great variety of backgrounds. The goal is to always have diversity in teaching teams. Project based courses totally focused on learning by doing. (U2).

General context

From our observations, as is also described in the introduction of Stanford, we found that there is a deep culture of interdisciplinary thinking at Stanford, and among surrounding businesses.

DEMOLA

Objectives

The main vision with Demola is to connect students and industry, primarily to provide students with real-world experience, and on top of that mitigate recruitment possibilities for local companies, that will prevent students from leaving the cities. (U12) Furthermore, it also touches on the basis of letting students into the operations of the company can help managers to get new insights and perspectives. "It provides a fantastic breadth of ideas and thinking" (U10). Making sure that students stay in the municipality is thereby a goal. 60-70% of students come from other places regionally, and after their education they leave. If we get student to say, then the companies will stay as well.

A platform to engage in collaborations with other universities, nationally and internationally. Increasing exchanges of competence across borders. "There exists a clear incentive to increase collaborations between university and industry".(U9).

Governance

Universities pay a fixed fee to acquire the concept from demola, and is also responsible for the facilitator's salary. Companies only pay for the output that they purchase, the process is free of charge. (U9). After that the university owns and operates the courses.

"Demanding a higher price would probably create more engagement from companies, but then we would not be able to attract smaller companies. Or if they do pay a higher price they will have much higher expectations and interfere with the creative process".'' (U9)

Partnerships

The makeup of partnerships looks similar to the corporate landscape in sweden. Very few large companies, a lot of SMEs and a few public organisations. This is a mix that we have intentionally. For students it is more attractive to get involved with larger companies. however, with smaller companies the technology can be more exciting. partners are screened, they are approached through traditional sales process and only those that seem excited are involved further. (U9).

The partnerships varies a lot. Naturally Demola want to engage companies as much as possible, but there needs to be a balance. When companies get more involved they tend to impose more control over the process, and this is why it is important to consider which company representatives that are involved. Smaller companies often send owners, or CEO, while the larger companies often different types of managers. "it is not a rule, but we try to stay away from the "normal" employee, because we want to work with people that later can influence the organisation as such" (U10).

Company involvement

The involvement from companies varies a lot. "In Sweden it's hard to pull company representatives away from their operations for 2h a week". Companies agree to engage on average one to two hours per week. that is usually one whole day for kick-off and half a day for presentations, that leaves about one hour per week during the the projects. (U10) . In some cases, staff from companies have been more involved in projects. We have tested the "we have done this before" mentality. but "by participating in demola projects, the employees are stripped of all the things that they normally rely on. When faced with the task of "solving the problem" they tend to start grasping for frameworks to adhere to".

Tammerfors are experimenting with engaging corporations to a higher degree. Projects are more like education for employees, and then the company want to have more control over the processes and the outcomes. (U9)

For small companies it usually is the CEO that participates in projects. For large companies it's a head of a department or RnD executives, or middle manger at some development department. Seldomly companies send employees from operations. An objective is to engage people that are involved in similar projects, often it can be alumni at companies The Demola concept builds on selling the output of projects to companies, so they want to engage people from the organisation with the authority to buy the IP rights. (U10)

Typical cases

Good to have a breadth of cases. "Anything from solving integration of newly arrived immigrants to designing a new coffee maker". "it's important to us that there is a wide range of projects, so that it doesn't only become a tech-course which easily happens". (U11).

"The projects that companies propose can't be too close to their core business, because then it becomes too hard for them to let go of control" (U10).

Student background

Initially there was a requirement to have at least 150 university credits,, but this just created administrative problems. Now we have a mix of grads and undergrads. (U11) Students can apply for courses but also have to motivate why they want to do it and what they are interested

in, as well as supplying their CV. A short recruitment process is conducted and groups are formed to be multidisciplinary.

We have a hope of increasing exchanges of competence across borders. (U9) Currently there are not very much exchanges other than through the erasmus network. Even though Demola exists in several countries and universities. There is no ecosystem for conducting cases internationally yet, it's something that they are working on haven't found a good solution. Not really clear if it is needed. There are collaborations across universities in Finland. (U9). "we get more applications from international students, than swedish students" (U11)

Student incentives

Students get credits by participating in a Demola course, it furthers enables students to evolve as individuals.(U9) Attraction for students lies also in the spectrum of getting involved with large companies. It is a good way to be "seen" and an opportunity to demonstrate your abilities. (U11). Students definitely write on their CV that they have taken a demola course, which is also valuable for companies that know about it. (C11).

It is relatively common that students are employed through participation in demola projects, which also functions as an incentives for students. (U10). Students indulge in the opportunity to take courses and do projects with students from other disciplines, which helps them work on their team work abilities for future challenges. (U11).

Demola acts on the behalf of students. If the company doesn't buy the IP then it belongs to the students. The fundamental idea is that companies should pay, but they are entitled not to if they are not at all satisfied.Prices vary across regions and depending on the partner.

Process Design

Fixed framework that is the same across all demola units. Less emphasis on lectures, more emphasis on engaging elements like video, pods, idea generation, tools: lean BM canvas etc. Adapted to competence level of students. 30% course, 25% individual rest groupwork. assessed on presentations and hand-ins.(U11)

When it comes to which degree of monitoring, and collaboration from companies, it is something that is somewhat of an ambiguity. That you must steer the students in the right way, but to much that in hinders their creativity. It is all about letting control, be open and crazy" (U11).

When students engage in real problems at companies the innovation potential is greatest when students are free to do their own projects and come with their own solutions. (U11) If management tries to interfere and guide projects, it hurts the innovative thinking. "If you control the process too much then the students will just go ahead and do the things that you would have done yourself anyways".

Activities

The most common method i Project based learning, where we try to engage students in different activities as much as possible (U11). We try to stay away from the normal course agenda, and encourage students to actively learn. "The agenda is also based on the individuals themselves, what they feel they need to work on" (U11)

Location

Course seldom take place at companies to limit the risk of them interfering, likewise students are encouraged to do their work outside of the university in new environments.Students should be able to move around. Don't think it's an issue for the projects, once they get going. However, there are designated places for demola students, where they can work on their projects, and this at the University area. Moreover do we offer a complimentary bus going between campuses, so it's easy for students to get there. Facilities are open 24h. (U11). "one person that did not get enough credits for the work she put in, was one of the librarians, she knew how facilities functions, and how to create good group dynamics" (U12) "She knew how to make order in a kaos". (U12)

Space

Demola is inspired by d.School, and has thereby copied a lot of their tools, which include workstations consisting of tables and chairs, whiteboards, post-its and pens, Free wifi, and coffee. There is a cooperation with a makerspace where students can utilize the rather technical equipment for prototype, such as 3d printers, scanners, etc. (U9)

Challenges

Some of the challenges are connected to that 90% of demola centers are publicly financed, owned by the universities and operated by faculty paid by the university. And that forces the courses to be the core part of the model, this to make it fit with the academic model. "that's just how it is, and that mean wrestling with all the pretty details that it entails…" "It is critical that there is a close partnership with university, otherwise it wouldn't attract students. They need to get credits". (U9) (U10)

Interest from students vary, this is something that they are working on to recruit more students.Interest from companies is actually the least of the problems. International students show much greater interest than swedish students. "students, especially swedish, are a bit lazy and comfortable". "Recruiting students is a challenge, once they are engaged in projects it's no problem". (U11)

Students have a lot of opportunities to choose from and you need to be visible in many channels. Demola is just one of many activities students can engage in. "We have not been diligent enough to get assistance from people who have already taken a demola course, we have simply overestimated the attractiveness of the concept". "We have thought that this will sell itself… but there are so many other things around." (U11)

"Companies usually expect value for their efforts, if they put in more time they expect another result, in that case it becomes more of a consulting project". (U10)

Since demola is a company and operated under university, there are a lot of restrictions to follow.There needs to be an academic height. "We are trying to break away from it, but it's hard." "It needs to be assessable in the university framework, so you have to take the good with the bad." (U10)

"In United States is it almost impossible to become a great scientist, if you do not have great external backups from companies" (U12)

In regards to which corporate representatives that should be involved, is also somewhat of an battle, because it is crucial that the companies / organisations that are involved have the ability let go of the control. And that might be tough for a CEO, or an owner. "people that are close to the organisation, are often the ones that have the hardest time to let go", however, those are the ones that need it the most" (U10)

Key Success Factors

Demola has managed to attract students through an established partnership with university, and there is a growing vision and understanding within LIU for multidisciplinarity. "Even though you really need to tear down the university and rebuild it, there is a shared interest in closer collaborations." (U9). "the strength of Demola is the mixture of an economy student, a behavioral scientist, an engineer etc.It proved to be awesome by the students, they did not even know that it was an organization involved in this. "Great fun to meet them" became so much fun and better ... they also liked the companies, for the solutions they worked during these 3 months as they worked. (U12)

"To manage a place like this, you have to be present, it is not a normal nine to five job, you have to be there when the students are there, meaning late nights and on weekends" (U12)

"I think innovation contests are just one in a bunch, but the Concept of Demola is much more potent." (U12)

Companies that have been involved in Demola projects, often come back for more. It is great motivation, and also a proof that we are doing something right. (U10).

Companies furthermore the economic value out of the collaboration in the sense that 85% of the projects are purchased "back" to the companies, which is another indicator that Demolas business model is correct. (U10) (U9).

General context

There is a growing vision at LIU that facilitates things like Demola.

"Collaboration and multidisciplinarity are two key pillars at LIU." (U9)

Objectives

Vision was to create an open space meeting space between all faculties and external partners, we believe to solve world problems, must have an open space for medical, and engineering students to get together. (U13) Furthermore, the objectives were "challenging driven innovation", meaning what problems are their outside of the university context, and young people see things different, and have another perspective" (U12). It was to create an ecosystem, where we connected companies to students, regular people, scientists, and then build up large processes where you could achieve something" In other words, a real meeting with scientists, students, people, companies etc, kind of like a triple-helix structure, but in reality. (U14)

Governance

Our vision was that industry companies collaboration should have 24/7 access to the facility, and they would help finance the model. (U13)

"It is all about creating room for flexibility. Minimum fixed cost. Having an organisation where you can scale up and down is an advantage, because when you have a high burn rate you are very dependent" (U13)

When discussing different financial model, and who should manage it respondent U13 stated that: "The most important thing is to become financial sustainable. Because all the basic elements; university, companies etc, change all the time, and being independent gives you a freedom, that is really really important in my opinion. (U13). "you can apply for vinnova, and grants, but if you do not have a business model, then you will ultimately be depending on other people's decision" (U13)

Partnerships

Partners of ProLab were mainly large corporations. THe concept only ran for one year, and during that that time they conducted two projects, where the corporate partners were Ikano and Trafikverket. (U13)

It is crucial to say to the partnering companies, "we do not want donations, we need to think of you as buying us a service" you have an agreement where they have to specify what they want from you. If not, they might forget why they give you money. (U13) "Create an environment where the business partners buy from you, that will change the perception of it".

Company involvement

From our interview (U13) and from secondary data provided to us, we learned that companies got engaged as sponsors, similar to the other concepts. The difference was that they bought the service, instead of giving donations.

"It is a really hard sell to go to a company and make them engaged, but if you use a formula that is known, it is a good starting point. Then you can develop it along the way". (U13). The same respondent talked about how difficult it was to engage companies more in the processes. "The people that we engaged from the companies, were very busy, and did not have the time". ""The more they can participate the better". (U13)

Typical cases

On the topic of typical cases, and how many people that were involved simultaneously, the respondent U13 said they had about 20-30 students that were actively engaged in a week.

The cases that were run were centered around finding out about market developments in the future, based on societal developments and consumer behavior and needs. (U13)

Student background

In the project where students worked on the challenge of creating a the future of living, the winning team was highly diverse. The winning team consisted of students from, finance/Economics, law, design/architecture, sustainable studies, engineering, social sciences, and global studies. Along with this, did this group have a large variety of nationalities represented by Sweden, China, Iran, Canada, Greece, Germany, Holland, and Russia. (U13)

Student incentives

ProLab distinguishes from the other concept, in the sense that the students to not get credit for participating in the projects. (U14) Instead, students were incentivized based on the opportunity to do real projects, the opportunity to interact with others and networking benefits. The cases were held in a contest format, where the winning group received a prize from the partnering company.

Process design

No given framework was used for the projects. They were structured as open innovation contests. No connection to teaching, only facilitating innovation. (U13) We at Prolab decided to go with innovation contests, because we knew they worked. And because the students knew what it was about, and I just read innovation contests at universities are becoming more and more popular. So it's a concept that people know, which is a great advantage, especially for the companies that are engaged, because it will make them easier to engage in the process. (U13) Moreover on this topic, did the same respondent say they activites that worked really well, were the innovation contests, however, he also said they were very time consuming, and were only sold at 40 000 SEK, which is not a lot.

Some of the activities at Prolab were often held in training sessions, where they were lead by the initiating students. The activities did have a wide range from getting more knowledgeable within 3d-printing, business modeling innovation, and how to arrange a big festival. (U13). All events att BP were initiated, and run by students. (U13)

We made open innovation contests into products that we sold to companies. (U13)

Activities

We often did a weekend thing, and that during monday and tuesday there was more of a check up, and looking out and, guiding the students. Following saturday did they presented for the partnering company. (U13).

"Innovation contests does not create something spectacular, it's a good, and cheap way for companies to find talents they want to recruit in the future, but Hackathons in a week, is much more interesting and inspiring" (U12) .

"our most popular events were the tutorial nights, where the idea was simple, people should learn something they did not already know bout" They were a great success, that is what you want to accomplish". (U14)

Location

Respondent U13 discussed the importance of the space to be near students. "A place where students drop by easily". And not near the companies, because the students are the core driving force of the activities that are happening there, and they may be colored by the company at hand, which hinders the flow of imagination" (U13). ProLab was located on campus.

Space

When we discussed the layout, structure, and equipment needed, the respondent U13 answered "that is an easy question to answer". You should always have lots of whiteboard" And we thought about making it into a fablab (fabrication laboratorium). And it is super easy to acquire, you can just go to that page and buy everything on the list, and I think it costed 1 or 6 million, can remember how much exactly, but it was not more than that. The idéa behind the list is that if you buy equipment on their list, you can get guest speakers coming in and using the same equipment that fab-lab uses at every fablab around the world. "It is an easy shortcut to define who you are in sense of a fab-lab culture" (U13)

"The spaces was divided into two different lungs, each 500 square meters" Where one section focused on these crazy ideas, while the other one focused more on these traditional projects" (U12).

"I am strongly against hierarchy models, because they are very handicapped, you put a lot of pressure on one single individual, and if he or she quits, it is hard to replace that person, that is why I like the sociocratic structure (U14).

Challenges

When i started at LU open, activities had decreased a lot, because no one had taken care of it. One of my task was to get a flow in there. (U13). My primary focus was to find industry partners to collaborate, the task was to "finance for my own salary".(U13).

I would say that from my experience i would highly recommend that platforms like this functions similar to a business model, because when you depend of funding, you depend on example Dean, which can change, partners involved will change, and if you depend on companies pay to give you money, if they someday say, hey i don't want to give you money. (U13)

LU Open did consider to create demola again, but, Demola includes teachers, and demola is set up in a way that is a part of a course, when you create a course at university you need to plan at least one year ahead of time, which makes the process slower. (U13)

"We did not succeed because we were told it had to be shut down" (U13).

It was further a challenge to balance the different groups in the model, where there were "total do-gooders", total rebels, and also those who thought business". To merge these groups were a big challenge. (U13)

Some of the challenges, were bigger than others, but "many small brooks, make a strong river". (U12)

"concepts like this, you not be pushed through if it does not have partnering companies that actually care, and are willing to be involved"., this is connected to Hawthorne effect" (U12)

" it is hard to accommodate an innovation and you do not have a long-term power in it, and be aware of it" (U12)

Key Success Factors

"Headline, it is the engagement and co-creation, don't plan it, co-create it, that is the absolute most important part. (U13).

The concept was very popular among students, unfortunately it had to close down. (U13)

The popularity was reflected by student reviews that were showed to us during the interview. (U13) In a review of the case project with trafikverket, all participating students stated that they would like to partake in similar projects again. On top of this they had left nothing but positive remarks, with the exception of some comments on issues of practical nature, such as food that was provided and scheduling issues.

General context

The concept had to battle the university for approval. No real environment of support. (U12)