Enabling student-driven innovation through interdisciplinary initiatives within Danish vocational education

Examining interdisciplinary project-based workshops as a means of cultivating and applying innovation capacity among students in compliance with the national educational innovation strategy

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BY
CHRISTIAN RAVN HASLAM

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Christian Haslam is a Ph.D. candidate from Department of Communication and Psychology at Aalborg University in Denmark. His research is mainly focused on student-driven innovation. In that capacity, he spends a lot of time designing and running various innovation workshops targeting students at all levels; from primary school to university, spanning many fields of study.

His work is co-financed by Tech College Aalborg where he has been employed for the past 10 years as an educator, teaching software development in vocational programmes and developing curricula. During this time, he has developed a special interest in the Scandinavian forms of vocational training and education, which is reflected in his research. He will return to Tech College in a new capacity once his Ph.D. is completed.

Prior to becoming interested in education Christian worked in the private sector for over 10 years. Most of this time was spent leading a development team that de-signed and implemented customised software solutions for quality assurance in the offshore industry. However, he also has experience as a network administrator, software developer, IT consultant and has been involved in various entrepreneur-ship ventures in the IT industry.

Christian holds a Master's degree in Computer Science and Humanities from Aalborg University

ENGLISH SUMMARY

This project has grown out of a fundamental desire, as an educator at a Danish vocational college, to understand the role of vocational education in an age of increased focus on, and demand for, innovation.

It is motivated in part by being involved in several educational initiatives at university and university college level. Initiatives specifically designed to promote innovation through creative problem-solving, interdisciplinary collaboration and close interaction with professional practices along with the real problems with which they are concerned.

However, it is also motivated by the fact that until 2013 no comparable initiatives existed in the vocational domain. Since vocational education and the enterprises whose employees mainly consist of workers with a vocational education make up a significant part of the Danish corporate landscape, it seems there should be more attention paid to this demographic.

While the 2012 national innovation strategy does mention vocational education, along with all other levels of education as important, comprising what is called in-novation capacity, not much attention is given to what this implies. Neither for the educational institutions who are tasked with generating this capacity, nor the enterprises who are to benefit from it.

This thesis addresses the concept of student-driven innovation from the perspective of vocational education by experimenting with interdisciplinary problem-based workshops as a tool for generating and applying innovation capacity. These workshops are adapted from university and university college level initiatives to learn how experience generated through use of these methods and principles can be applied within the vocational domain. The research is guided by the main question:

> How do interdisciplinary educational initiatives affect the cultivation and application of students' innovation capacity, and what are the organisational implications of these types of initiatives for educational institutions?

This is addressed through a theoretical, methodological, technical and organisational perspective on innovation capacity which make up the idea of student-driven innovation.

The primary method of research is by gathering experience through participation in university-level initiatives and simultaneously using this experience to design and

implement an experimental workshop between two vocational colleges. Thereby gathering comparable experience within this educational domain.

The empirical work is supplemented by a theoretical investigation towards a practical understanding of innovation capacity and by extension, how it could be cultivated, applied and not least, its effects evaluated. This understanding has been gradually incorporated into the experimental workshops as they have progressed through several iterations.

The core findings presented include a highly dynamic understanding of innovation which is specific to each professional practice (theoretical). This is combined with a strategic design inspired approach to working with innovation processes; both from the perspective of professional but also educational practice. This understanding of innovation is, due to its dynamic nature, equally applicable within enterprises of all sizes and vocations.

This understanding is complemented with a framework for evaluating innovation processes (methodological), including but not limited to student-driven processes, such as the generation and application of innovation capacity. This framework is built around an understanding of the relationship between professional, educational, research and government practices, the different rationales giving meaning to actions and effects within each and the necessity for translation between them.

Experiences gathered through experimentation with interdisciplinary problem-based workshops in a vocational context (technical) are presented as a foundation for further development of innovation initiatives within this educational domain.

Finally, all three perspectives, theoretical, methodological and technical are brought together to discuss potential challenges and opportunities implied if vocational colleges were to integrate student-driven innovation more closely (organisational) into their practices.

DANSK RESUME

Min interesse for emnet bag denne afhandling er opstået på basis af et ønske om at forstå erhvervsskolernes rolle i en tid præget af øget fokus og efterspørgsel på innovation.

Dette med udgangspunkt i mit eget virke som underviser på en erhvervsskole, samt mit engagement i forskellige tværfaglige uddannelsesforløb på universitets og professionshøjskole niveau. Forløb specifikt designet til at udvikle de studerendes innovationskompetencer gennem kreativ problemløsning, tværfagligt samarbejde og et tæt samspil med fagpraksis omkring løsning af reelle problemstillinger.

Undersøgelsen er yderligere motiveret af, at der indtil 2013 ikke fandtes tilsvarende forløb indenfor erhvervsuddannelserne. Siden erhvervsuddannelser og de virksomheder der typisk aftager erhvervsuddannet arbejdskraft, udgør en væsentlig del af dansk erhverv, synes der at være behov for øget fokus på dette område.

Den nationale innovationsstrategi fra 2012 omtaler studerende, på alle uddannelsesniveauer, som en innovationskapacitet og tillægger dermed uddannelserne ansvaret for at styrke denne kapacitet. Implikationerne af dette uddybes ikke. Hverken i forhold til hvordan uddannelsesinstitutionerne tænkes at styrke denne innovationskapaciteten eller i forhold til virksomhederne der skal være klar til at benytte den. Udfoldelsen af dette tilfalder således undervisningsinstitutionerne at præcisere.

I denne afhandling udfoldes konceptet studenter-dreven innovation fra et erhvervsuddannelsesperspektiv gennem et empirisk arbejde med tværfaglige problem-baserede workshops som et redskab til at opbygge og anvende innovationskapacitet. Disse workshops er tilpassede erhvervsuddannelser ud fra erfaringer med tilsvarende universitets- og professionshøjskoleforløb og søger at belyse hvorvidt de samme metoder og principper kan benyttes i arbejdet med studenter-dreven innovation indenfor erhvervsskoleområdet. Undersøgelsen er styret af følgende forskningsspørgsmål:

> Hvilken rolle spiller tværfaglighed i opbyggelsen og anvendelsen af innovationskapacitet blandt studerende; herunder organiseringen af de tilhørende uddannelsesinstitutionelle rammer?

Til besvarelse af dette spørgsmål, anlægges et teoretisk, metodisk, teknisk og organisatorisk perspektiv på innovationskapacitet som tilsammen udgør konceptet studenter-dreven innovation.

Undersøgelsen er bygget op om to overordnede processer. Den ene, en erfaringsindsamling gennem deltagende observation af forskellige tværfaglige forløb på universitetsniveau. Den anden, eksperimenterende i forhold til design, implementering og evaluering af tilsvarende forløb i samarbejde med to erhvervsskoler.

Det empiriske arbejde suppleres af et teoretisk studie med det formål at etablere en praktisk forståelse af innovationskapacitet; herunder, hvordan det kan opbygges, anvendes og ikke mindst, evalueres. Denne forståelse er løbende blevet inkorporeret ind i nye iterationer af erhvervsskole forsøget.

Resultatet af dette arbejde er et dynamisk perspektiv på innovation som målrettes de enkelte fagpraksis (teoretisk). En tilgang til det praktiske arbejde med innovationsprocesser inspireret af strategisk design, som kan benyttes af både fagpraksis og uddannelsespraksis. Grundet dens dynamiske natur er denne innovationsforståelse anvendelig for alle typer virksomheder; store såvel som små.

Dernæst, en rammemodel for evaluering af innovationsprocesser (metodisk), herunder studenter-drevne innovationsprocesser som eksempelvis opbyggelsen og anvendelsen af innovationskapacitet. Rammemodellen bygger på et grundlæggende perspektiv på forholdet mellem fagpraksis, uddannelsespraksis, forskningspraksis og regerings-/ samfundspraksis samt en skelnen mellem de forskellige rationaler der definerer disse og tilskriver handling og effekt mening inden for hver. Et forhold der nødvendiggør oversættelse mellem dem i forbindelse med meningsfuld evaluering af innovationskapacitet.

Erfaringer indsamlet gennem det empiriske arbejdet med det tværfaglige problem-baserede undervisningsforløb hos erhvervsskolerne (teknisk) præsenteres som platform for den fortsatte udvikling af innovationstiltag inden for dette uddannelsesområde.

Slutteligt, bringes alle tre perspektiver, teoretisk, metodisk og teknisk, sammen i en diskussion af hvordan studenter-dreven innovation kan integreres (organisatorisk) i erhvervsfaglig uddannelsesparksis, samt de muligheder og begrænsninger dette formodes at indebære.

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Everyone at ITE in Singapore for taking time to show me how they do things, answering all my questions and allowing me to experiment on some of their classes. Although my visit was not directly related to my research it was still very inspiring and helped to shape my perspective.

Everyone I have had the pleasure of working with on the weird, wonderful and extremely cool interdisciplinary education projects described in this thesis. You know who you are!

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Last, but not least, my wife Trine and our children Anna and Sara for being extremely patient and supportive throughout this long, and often intense, process. Without you I wouldn't stand a chance!

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PREFACE

This thesis consists of two main parts. Firstly, a selection of publications which I have either authored or co-authored, and which have been published or submitted for publication during my three years as a Ph.D. Student. Secondly, this summary article which purpose is to describe the research, of which these publications are a central part, in its entirety. Binding the publications together in the context of my research questions and Ph.D. research process.

There are four publications in total, three papers and one book manuscript. They are all included in the exact format which they have been published or submitted for publication. They can be found at the end of the summary article in the section titled Publications. Since two of the included articles are originally written and published in Danish, an English translation of each is also included under in the publications section.

The summary article itself can be divided into four sections, each concerned with a specific aspect of the project. These are as follows:

- Part 1- Introduction & Area of Interest
    - Chapters 1 & 2
- Part 2 – Design, Method & Process
    - Chapters 3, 4 & 5
- Part 3 – Addressing the Research Questions
    - Chapters 6, 7, 8 & 9
- Part 4 –Findings and Contribution & Conclusions
    - Chapters 10 & 11

They are intended to be read consecutively, however, the publications should be read before part 3 & 4 since they are referenced extensively during the second half of the summary article. The publications are included at the end of the summary article to avoid disrupting its flow and hindering readability.

The first part comprises the first two chapters of the summary article. Together, these describe the area of interest, the research projects background and an overview of the relevant state of the art. These make up the point of departure, and frame the project.

The second part is made up of the following three chapters, which concern the project's overall design. The specific research questions examined which publications address various aspects of these questions, methodological considerations and a brief description of the actual process as it unfolded.

The following four chapters each address one of the specific sub-questions listed in part two. In most cases, these chapters summarise and expand on theoretical and

empirical work presented in the publications included as part of this thesis. This is the reason for the recommendation to read the papers associated with a specific sub-question before, or in concert with, reading the relevant chapter. An overview of the papers themselves is listed in part two under *publication design,* and cross-referenced with each sub-question (see section 4.1).

Part four consists of the final two chapters, which is a discussion of the findings from each of the four sub-questions in relation to the main research question along with conclusions, perspectives for further inquiry and a summary of this project's main findings and contributions to the field of student-driven innovation.

References to literature listed at the end of this summary article include all references from included publications to give a convenient overview of the literature used in this thesis. References made in the included publications, are also listed as part of these publications and have also been duplicated in the main list, regardless of if they are directly referenced in the summary article itself.

Publications are referenced in the summary article in the following way. The first reference in every chapter has the format: Publication#1: *Full title of paper*. Further references to the same paper in the same chapter are simply: Publication#1.

All data gathered and used during the course of this Ph.D. project is supplied to The Faculty og Humanities at Aalborg University, my Ph.D. Supervisor and all members of the Ph.D. Committee on a companion USB drive. This drive serves as a digital appendix to the thesis and is referenced directly in throughout the summary article.

References to data on the companion USB drive are made as follows: (Data: *Folder*, *File*, *Timestamp or Page#*). For example: (Data: nKnowation 2015, Evaluation #1, P.3) and (Data: Author Declarations). Note, that the top-level folders named: *Background Empirical Process* and *Foreground Empirical Process* are not included in the data references. These folders have been added to clarify which empirical process the data belongs to (see sections 5.3 & 5.4 for more detail) but are excluded from references in the interest of brevity.

This Ph.D. research project has been completed and submitted within the nominated period of three years, and in accordance with all contractual obligations to both Tech College Aalborg and Aalborg University.

CHAPTER 1. STUDENT-DRIVEN INNOVATION

As the title implies, this thesis area of interest, is the concept of student-driven innovation; specifically, within the Danish educational system. The main purpose being to uncover what student-driven innovation might be in a useful and realistic sense of the term. In this introduction, I will try to clarify what I mean by realistic and useful along with why it is a relevant contribution to an already substantial body of knowledge surrounding the many and various forms of innovation.

The reason for my interest is grounded in the increased focus on innovation as a means of attaining and maintaining a competitive edge as a company, and by extension, a nation. Although this idea is not new, it is seen increasingly in political rhetoric all around the world; particularly since the OECD published its innovation strategy six years ago, and which opens with this statement:

> In the post-crisis world, and with a still fragile recovery, we are facing significant economic, environmental and societal challenges. While no single policy instrument holds all the answers, innovation is the key ingredient of any effort to improve quality of people's life. It is also essential for addressing some of society's most pressing issues, such as climate change, health and poverty. (Organisation for Economic Co-operation and Development, 2010, p. 3).

In Denmark, the then government published a national innovation strategy two years after the OECD (The Danish Government, 2012), which outlined the following general goals, along with descriptions of the specific initiatives the government was implementing in response to the OECD recommendations:

> 1) Innovation is to be driven by societal challenges: Demands for solutions to specific societal challenges must be given higher priority in the public innovation policy.
>
> 2) More knowledge is to be translated into value: Focus on mutual knowledge exchange between enterprises and knowledge institutions, and more efficient innovation schemes.
>
> 3) Education is to increase innovation capacity: A change of culture in the educational system focusing more on innovation
>
> (The Danish Government, 2012, p. 8).

From the perspective of this thesis, the main point in the Danish innovation strategy was the use of the term innovation capacity in an educational context. Implying that the nation's entire student body, although they mainly go into detail regarding higher education, could and should be considered as innovation capacity at any given time. In other words, some of the specific initiatives should: a) transform students into an innovation capacity, and b) to find some way of utilising this capacity to create value for Danish businesses. The latter both in the traditional sense of students leaving the educational system to pursue jobs in the public and private sector and, more importantly, while they *are still part of the educational system* (The Danish Government, 2012, pp. 23–24); presumably through some form of collaboration between education and industry.

These goals do not appear to be unique to Denmark. Many countries in and outside Europe have voiced similar ideas. Conceivably, because of increased globalization, leading to a situation where many countries find they are competing either directly or indirectly with cheap and plentiful foreign labour The OECD mentions innovation capacity as a competitive resource several times in its innovation strategy (Organisation for Economic Co-operation and Development, 2010, pp. 58, 177, 203). The difference, compared to the Danish version is that it does not do so directly in an educational context, but attributes it to entrepreneurs, technological advancements and policy. None the less, research in this field is still relevant beyond Denmark; in a broader international context.

Despite the apparent acceptance among OECD countries that innovation capacity is vital and something which should be actively developed, there is little in the form of proposals for how this should or could be achieved. The OECD does, however, make several suggestions of varying specificity about focus areas. Moreover, most of the direct political focus about innovation is directed at companies and organisations that play key roles in developing new technologies; typically, larger companies along with both private and public research facilities. Most notably, from an educational perspective, Universities, although Danish University Colleges are gradually gaining attention in concert with initiatives to make them more research oriented.

Conversely, Denmark's national bureau of statistics indicates, that the majority of Danish companies are micro and sub-micro, sized by current EU definitions (EU, n.d.; Statistics Denmark, 2014). And the majority of Danes in the workforce have not attended university[1] but instead have some form of vocational education (Jacobsen, 2004, pp. 11, 21, 26–27). This is interesting because it suggests that many of the goals and initiatives mentioned in the national innovation strategy do not, in fact, target the

[1] Although, the percentage of the Danish adult population with a mid- to high-level degree of some description is still relatively high. Denmark currently (2015) ranks 14 in the EU with 30.7 percent of the adult population (15-64) holding a tertiary (ISCED 2011 levels 5-8) level degree.

majority of the nation's active workforce or businesses, despite being put in place to help ensure their (collective) competitive advantage.

Vocational education is included in the innovation strategies' educational initiatives with the following statement:

> Innovation within upper secondary school and vocational education programmes should largely be a natural part of student culture and competencies. Students in vocational education programmes should also develop their ability to create specific solutions in relation to their relevant business fields. (The Danish Government, 2012, p. 26)

But it does not go into detail about what form such integration into its culture could or should take. It also acknowledges small companies, which are not necessarily start-ups, and recognises vocational colleges as a potential platform for engaging them in the following:

> Others, such as business academies and vocational colleges have insight into SME's. It provides a good basis for transforming knowledge into practice in enterprises in cooperation with ATS[2] institutes among others. (The Danish Government, 2012, p. 23)

Again, it does not go into further detail about how vocational colleges could bridge the gap between what are deemed knowledge producing research facilities, and professional practice except from this in some way being facilitated by a set of Approved Technological Service Institutes, which are independent companies or institutions appointed by the Minister for Higher Education for three years at a time (See the Technology and Innovation Act of November 2014 at www.ufm.dk).

This does not necessarily indicate an oversight in the strategy. It may be due to technological research and development being the innovation drivers with the greatest potential, thus representing the best investment. Historically, the advent of new technologies has been seen as probably the most significant innovation driver, and even the economist Joseph A. Schumpeter who was credited, at the turn of last century with coining the phrase in a modern, business context (Joseph A. Schumpeter, 2011; Joseph A Schumpeter, 1994) did so during the rise of automated production in the wake of the industrial revolution. Similarly, many of our greatest and most prevalent narratives of innovation since then have been told around the advent of some form of new technology allowing a smaller, more agile, business to suddenly outperform or displace the current, and often unsuspecting market leaders. In other words, it is not unlikely that the Danish innovation strategy is designed specifically with this perspective on innovation in mind.

[2] Approved Technological Service Institutes

If this is the case, it still does not mean that technological innovation is the only viable form of innovation through which we can gain the competitive advantage we need. It simply provides some of the greatest and most compelling examples. Therefore, it becomes interesting to ask what we could or should *also* be doing to attempt to engage most of our corporate landscape (total number of businesses and size of workforce). Don't people with a vocational education, employed in small, local, businesses also have the potential to innovate? While this project does not seek to document the extent to which this may or may not be the case, it has been a working hypothesis of sorts. This has been in the back of my mind throughout, and has been gradually confirmed by examples I have come across during my work.

A good example is the story of a metal worker called Lasse Thomsen who, after working with industrial robots for many years decided to start his own company; LT Automation (www.lt-automation.dk), where he continues independently to build industrial robots for metal working.

One day his wife, a nurse, told him that many of her colleges in physiotherapy were sustaining injuries while working with their patients. The problem is that they were required to train patients' muscles by manually moving their limbs through a series of repetitive exercises; often several times a day and with as many as 15 to 20 patients pr. day. This is necessary to ensure that the exercises are performed correctly and to maximum effect, however, ironically, the strain resulted in injuries among the physiotherapists themselves.

In Lasse's mind the solution was obvious; a robot should be doing the manual, repetitive work for the physiotherapists, who in turn should be using their knowledge and expertise to program the robots and monitor the patients' progress. From a technical point of view such a robot is simple so Lasse did not see it as anything particularly difficult or challenging. As it turned out, the difficulty with such a solution had nothing to do with the technical design, but more with the fact that much legislation surrounding the use of industrial robots is meant to protect people by keeping them away from the robot's operational area. Getting an industrial robot approved for direct human contact and interaction was much more complicated, and ended up taking approximately five years.

Lasse maintains that had he known what he was getting into he probably would not have bothered. Fortunately, he had no idea, and the result is the world's first medical robot approved for direct human interaction, and creatively named Robert (www.myrobert.com). Apart from creating a new and useful product this has opened up two new markets for LT-Automation. The first is for new robots to the medical and health-care sectors (of which several are already underway), and the second is consulting with other, international, suppliers of medical equipment about to the approval process for automated solutions.

To me, stories like this demonstrate that the potential is there, and not just in the form of energetic start-ups that have arisen because of a new idea. How to better engage and cultivate that potential in a broad sense strikes me as an interesting and relevant avenue of inquiry; one which has been explored relatively little in proportion to the potential it seems to represent.

Within innovation literature, there is a shift from a mostly (modern) top-down perspective towards something more bottom-up (post-modern) in nature. User-driven innovation (Smed et al., 2010) being one example of this; e.g. focusing on letting user needs drive development cycles and identify new markets. It becomes even more curious that the vocational level does not receive more attention, since this in many areas of business represents a level of practical and direct interaction with the end-users of a product or service. This is mentioned in the above quote from the national innovation strategy. However, the story of LT-Automation also demonstrates that interaction between domains of knowledge and expertise is an effective way to drive these processes. Something new or different must be introduced as, for example, relying solely on existing users of existing products probably will not be the most effective way of identifying entirely new markets or products.

In this thesis, I maintain, as does the Danish innovation strategy, that education plays a central role in the cultivation and development of innovation capacity. I also agree, that this capacity could and should be used during a person's formal education; whatever the type. I would also argue, that the application of this capacity, and the close industry-educational relationship it implies, is necessary to the cultivation of innovation capacity among our students.

In other words, the Danish government argues, that innovation capacity should be a key focus area for our educational system. However, I would like to add that it should be a much larger part of the entire educational system. Targeting primary, secondary, vocational, professional and academic levels of education equally and directly to promote innovation among all trades and in all types and sizes of companies.

From a personal perspective, I have chosen to focus my work on vocational education, extending the idea of innovation capacity from purely contending with higher education, to also encompassing what seems to be the single largest part of the Danish corporate landscape. I do this by drawing on experience with innovation and entrepreneurship programmes in higher education to design, develop, implement and evaluate a similar initiative targeting students at vocational education institutions.

Hopefully, I am not the only person who feels this is a relevant area in which to attempt to contribute some knowledge and experience. To clarify what form such a contribution could take for me to consider it both realistic and useful, however, requires deeper insight into the origins of this project and the state of the related fields of research at the beginning of this project.

1.1. BACKGROUND

The narrative of this thesis has two beginnings, at two different moments in time. The first goes back to 2008 when Aalborg University first began experimenting with large-scale interdisciplinary entrepreneurship workshops. This was due to a contract between the Ministry of Research and Higher Education and Aalborg University stating that every student at Aalborg University should have the *opportunity* to take an entrepreneurship course as an elective during their education. The second is in 2012 when the Danish Government published its innovation strategy in response to the OECD innovation strategy of two years earlier.

During both these events I was employed as an educator teaching software design and computer programing to students in 5-year vocational education programmes and had become involved in the interdisciplinary workshops while doing some academic counselling for Bachelor students at the university on the side. By the time the Danish innovation strategy was published, I was deeply fascinated by the interdisciplinary workshops of which I had become a regular part, and was interested to see if the same principles could be applied to vocational education.

These workshops had opened my eyes to different approaches to education. Focus was on collaboration towards solving real-world problems rather than isolated tasks within a single discipline: A more intense form of problem-based learning (PBL) bridging faculties and departments. Thus, there was a massive amount of synergy between students from different disciplines and with different perspectives. It seemed more free-flowing and natural, more creative and a whole lot more fun than anything I was seeing or doing within the vocational areas. Not only that, but the solutions students were coming up with in relatively short periods of time were often rather impressive.

This form of intense collaboration also forced students to reflect more on what they were bringing to the table as individuals and budding professionals in their respective fields, simply by being bombarded with so many different perspectives and opinions besides their own. This approach seemed to be have so much potential, and certainly sparked my interest in experimenting with similar aspects of interdisciplinary problem-based workshops in different educational settings. When the national innovation strategy was published, we began discussing how to introduce innovation as *a natural part of student culture and competencies* at the vocational college where I am employed, and I was convinced that integrating similar interdisciplinary, problem-based elements throughout our educational programmes held much more potential than simply teaching a 32-hour course on innovation theory once during a 5-year programme.

However, I had no real experience with this type of initiative in a vocational setting, and no idea how to integrate such a thing into the rigid educational structure dictated by the Ministry of Education along with various industrial advisory boards.

At the time, most of the educational initiatives concerned with developing innovation skills and promoting entrepreneurship were usually found in higher levels of academic learning. Primarily, at post-graduate level. In these programmes, a lot of effort went, and still goes, into engaging local businesses to participate and provide students with the opportunity to work on solutions to real problems in some type of industry-education collaboration. This takes many different forms but they are all attempts to cross the divide and utilise the students' unencumbered, free-thinking to generate original solutions to real problems, thereby creating value for participating businesses.

The vocational education programmes where I teach are apprenticeship-based which means that students are technically at work while they participate in school-based activities. Thus, much of the basic framework necessary for cultivating close industry-educational collaboration already exists. Unfortunately, it also means that anything not part of the pre-determined (by the government) curriculum is subject to approval by the individual employers since they are paying for the students' time.

On one hand this is a great strength of these educational programmes because students get real world work experience while also gaining the relevant theoretical knowledge and training through regular in-school periods (known in Denmark as the sandwich model). Also, the educational institutions already have an ongoing dialog with their student's employers. On the other hand, the students' status as employees rather than simply as students makes planning extra-curricular activities extremely impractical since the employers of an entire class (between 16 and 30 students) would need to agree on the relevance of the activity to their respective areas of business. Although far from impossible it can be a challenge, and at best a time-consuming activity; time being a resource of which there is seldom a surplus.

Aalborg University solved one aspect of the resource problem by having all participating programmes supply one educator per given number of students. Thus, dispersing the cost by letting each department bear its own share relative to how many of its students were participating. This principle is easily adapted to the vocational colleges if entire classes and not individual students participate, and their educators are willing to do so as well.

However, many of our students' employers do not see the value of participating in a university workshop that does not offer any direct credit towards their own curriculum. Furthermore, the nature of the sandwich model makes it particularly challenging to coordinate one or more classes of vocational students with the pre-determined placement of a week-long university course. For these reasons the notion of integrating vocational students in a purely academic course was abandoned in

favour of creating a separate course specifically designed to suit the needs of different vocational programmes. In many ways, this turned out to be a more interesting solution, since it presented an opportunity to reflect on, and re-think the course goals and methods to better suit the types of businesses in which our vocational students were employed.

The argument that secured support and funding for realising this idea was the newly published Innovation Strategy which, among other things, introduced mandatory innovation courses in almost all educational programmes. Luckily, these were usually so loosely defined that an interdisciplinary workshop could easily be designed to fulfil the curricula of most vocational programmes. On top of that, the vocational colleges with which I have had contact were now in a situation where they were being presented with policy-based demands for teaching innovation and entrepreneurship for which they were not prepared, and had no real ideas on how to fulfil.

By happy coincidence, the timing was just right and during early 2013 funding from Tech College Aalborg and Aalborg University was secured and a research proposal for this project was written and approved. Thereby turning a professional side-interest into a formalised research project, and presenting me with the opportunity to pursue a Ph.D. at the same time.

The main idea was, and still is, simple. Based on my experience and involvement in the university-level courses I was to reflect upon how they could be translated to suit the new demands facing vocational education programmes and perform a series of experiments demonstrating their effects / usefulness. The term *translated* used in the sense best described by Douglas Hoffstadter in his book Le Ton Beau de Marot (Hofstadter, 1997, pp. 171–179) using chessboard layout and movement rules as a visual example of attempting to capture the essence or intention they convey, rather than simply translating them literally.

Guiding this process of translation, the term *usefulness* is key and takes on two meanings: Firstly, useful in the sense that the courses could be used to make sure the vocational students, and thereby the institutions educating them, meet the new demands put in place through policy. Secondly, useful in the sense that the companies employing these students, during their education but also in future, could somehow use the skills the students acquired, gain insight from participating in the courses themselves or both, to become more innovative and gain a competitive advantage.

This raises quite a few initial questions that have been formalised as research questions below (see section 3.1). However, they can be summarised roughly as follows:

- What is it that characterises the organisations that employ vocational education students? (See Publication #4: *Enabling consistent innovation in*

micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective)

- What exactly does it mean for these types of companies to be innovative, and is it the same as for companies that typically employ university students? (See Publication #1: *Evaluating innovation capacity in vocational education*)
- Can these definitions of innovation be broken down to a specific set of skills or body of knowledge, and if so, how? (See Chapter 8)
- How can we, from an organisational perspective, design and implement courses that support this, and how do we document that what we are doing works? (See Chapter 8 & Chapter 9)

Apart from the fact, that these questions represent enough for several Ph.D's and thus need to be focused more sharply, they describe rather well the imperative behind my employer's interest in funding the project. Answering these questions is meant to serve a practical purpose for the institution as well as, and in addition to, the larger societal goals of the innovation strategy. This is where the term realistic comes in as a supplement or qualifier to the above notion of usefulness. Quite simply, if the findings of this project are not practically applicable from an institutional point of view, they are less useful to the institution. Similarly, if the findings are not applicable to the companies employing our students, they are not useful to them. Preferably, the findings will be useful to both in some way. However, this is most certainly a matter of opinion and for debate.

CHAPTER 2. STATE OF THE ART

Since this thesis is concerned with aspects from several different fields of study, and the field of student-driven innovation is not yet particularly well developed, a description of its state of the art must be deconstructed into several parts.

Searching for research on the overall subject of student-driven innovation currently yields very little in the way of search results. Searches for *"student driven innovation"* and variations on Google Scholar and Primo, the Aalborg University Library's meta-engine connecting to hundreds of major academic databases, yields under 30 results in total (an extra 10 if Primo can include unverified sources, albeit none of consequence). Most of which consist of attempts by Microsoft to promote student summer-camps and competitions or passing references to the notion of student-driven innovation. Only five results are directly concerned with cultivating and applying student-driven innovation and three of these have the same author and are concerned

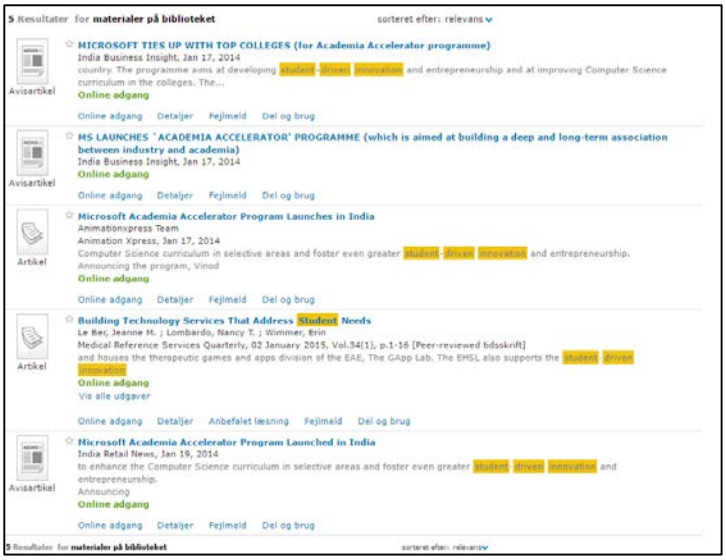


Figure 1: Primo search results (verified sources)

with engaging students in the design of a university library and promoting empathy in design thinking (Culén & Gasparini, n.d.; Gasparini, 2015a, 2015b). One is written by five of my colleges at Aalborg University and University College North Jutland (Vetner, Lund, Dahlgaard, Boelsmand, & Stavnskær Pedersen, 2015) and concerns a project that is part of my background empirical process described in section 5.4.1. These four papers are relevant to my research, but cover the same perspectives on which most of the background empirical projects with which I am involved, are based. As mentioned, one is entirely based on one of these projects. As such, their

perspectives are also represented in this project. It is also of note, that these publications are quite recent and have only been published during the final year of my research.

The final paper of note, is concerned with an institution *"[…] with a vison to become a world class research platform, but as a result of series events was forced to narrow down its research activities and focusing on students through education and a student driven innovation space […]"*(Roine, Artto, Siltaloppi, & Ahola, 2015, p. 5). Although its findings are not negative on the subject of student driven innovation, this was never the main focus of the research and student-driven innovation is mainly viewed as a research management tool in the face of budgetary limitations. While this could be useful in relation to exploring potential financial arguments for promoting student-driven innovation, it falls outside the focus of this project.

The reason for such sparse results is likely due to several factors. The non-use of the term *student-driven innovation* is not necessarily an indicator that there is a lack of research within this field. Presumably, variance in the terminology used to describe the concept of student-driven innovation is making it hard to uncover in a single coordinated search. Unfortunately, there are no clear alternative terms that can be used to expand the search without broadening it enormously. Apart from this making it difficult to perform useful structured searches within the field, it would also suggest that we are not dealing with a fully established field.

For this reason, I choose to look at the particular fields which I, based on my experience with university courses of this nature, happen to associate with student-driven innovation, to gain an understanding of the state of the art. Drawing on the formulation of the research questions in sections 3.1 and 3.1.1. I choose to see the concept of student-driven innovation as a combination of Interdisciplinary Learning; Innovation & Entrepreneurship Theory (particularly regarding its practical application) and Education to Industry Collaboration. Each of these can be summarised briefly as follows in relation to student-driven innovation.

2.1. INTERDISCIPLINARY LEARNING

Before focusing specifically on the field of interdisciplinary learning it is necessary to have a clear definition of the base concept of interdisciplinary collaboration, thereby, untangling the host of related terms and categories associated with it.

The idea of interdisciplinary collaboration as a method of discovery is nothing new, and likely as old as the need for dividing knowledge into distinct disciplines, which can be traced back to antiquity (Walker & Benson, 2011). Authors like Steven Johnson even propose, that the rise of social venues such as coffee houses and salons can be linked to the Age of Enlightenment and the rise of Modernism (Johnson, 2010) simply because they provided an environmental setting for ideas to be exchanged and

allowed to incubate. While it is probably hard to support such a claim empirically the idea is certainly compelling. It speaks to a fundamental sense that we, as humans, are social beings capable of high level communication and that, as such, we can achieve much more together than as individuals, which is also reflected in the fundamental humanism within the communication paradigm of which I am a part (Pahuus, 1989). Moreover, it also seems to be supported in the academic literature on the subject of interdisciplinarity itself (Nissani, 1997) although there are also studies which point out that collaboration need not be interdisciplinary to have this effect (Jacobs & Frickel, 2009, pp. 54–57).

This leads to an interesting question regarding the relation to formalised disciplines in an educational or research context, and the concept of collaboration with regard to certain tasks; be they learning, problem solving or any manner of other activities.

Much research into interdisciplinarity[3] focuses on the mechanics of how different perspectives or bodies of knowledge can be combined in a collaborative effort. This is illustrated in the various distinct terms and definitions used to describe these mechanics: Interdisciplinary, Multidisciplinary, Cross-disciplinary, Pluradisciplinary and Transdisciplinary being the most common distinctions (Manolescu, 1984; Nissani, 1997; Van der Panne, van Beers, & Kleinknecht, 2003; Vintergaard Christian, Stolt, IDEA København, & Øresund Entrepreneurship Academy, 2009; Weinberg & Harding, 2004).

This differentiation is, of course, useful in describing and analysing the precise composition of a collaboration. For example, the relation between actual didactic methodology used in the courses studied in this thesis, and the intended epistemological outcome among participating students. However, a detailed discussion of this categorisation and its implications within the field of interdisciplinary study is outside the scope of this thesis and, from a personal perspective, not the most interesting aspect of this distinction.

It seems that the concept of formal disciplines simply makes it easier to quantify the broad differences in perspectives that various participants in a collaboration represent. Formal schooling, job experience etc. are examples of general labels we can apply to individuals to make it easier to identify with them; or sometimes providing a convenient way of applying pre-conceptions and prejudices.

I would argue, in the context of interdisciplinary education, that disciplines or subjects often play the same role. They are convenient and recognised labels for grouping difference. The interesting element is the idea of ensuring multiple perspectives by bringing together these differences, be they formal, informal or otherwise. This is not

[3] I use the term *interdisciplinarity* for convenience to refer broadly to any research concerned with aspects of collaboration between disciplines.

to say that formal distinctions are redundant. On the contrary, they are extremely useful, but mainly from an organisational or administrative point of view. In an educational context where we wish to ensure as much difference as possible, or the presence of a certain set of skills in a particular group, these general labels have proved very effective (Haslam, Bach, & Thomsen, 2016; Poulsen & Rosenstand, 2012; Rosenstand & Tribler, 2012). My point being, that it is the bringing together of different experiences, perspectives, knowledge and information that is central (Rosenstand, 2008). While still relevant, the way we differentiate between them is secondary, and often more of a practical measure in the context of educational initiatives. However, the mechanics, mentioned above, of how these different perspectives are brought together is still relevant to consider.

In this thesis, I use the following definitions all based on generalised interpretations of uses in the texts referenced above, to distinguish between the combinatory mechanics of collaboration:

Interdisciplinary collaboration
The integration of knowledge from multiple disciplines into the process of working on a single problem that may or may not be related to one or more of the disciplines drawn upon.

Multidisciplinary collaboration
Representatives from multiple disciplines working together as a team towards solving a single common problem which is usually related in some way to all disciplines drawn upon.

Cross-disciplinary collaboration
Applying knowledge from different domains to expand the one within which work is being done on a specific problem.

Pluradisciplinary collaboration
Contributing to more than a single disciplines body of knowledge through work on a specific problem.

Transdisciplinary collaboration
Moving towards a single holistic view of a problem or field of study that transcends (and replaces to some extent) multiple ‘traditional’ disciplines.

Thus, when referring to interdisciplinary workshops I am referring to the epistemological traits the educators wish to cultivate within the participating students. This contrasts with the didactic design of the workshops, which is usually multidisciplinary according to the definitions above. In other words, the student’s ability to think and work in an interdisciplinary manner is trained through Problem Based Learning (PBL) scenarios based on a multidisciplinary didactic design. The

consensus across workshops (Rosenstand, 2008; Vetner et al., 2015) is that the interdisciplinary mind-set in turn forms a foundation for cross-, plura- and transdisciplinary knowledge creation. Combined with the common problem-based focus in the above definitions of disciplinary combinations, the workshop format seems especially well suited for this purpose; possibly giving rise to a sub-set of PBL especially suited to innovation which I choose to call Problem-Based Workshops (PBW).

Moreover, the concept of expanding a disciplined body of knowledge by drawing from other disciplines is often directly related to the concept of innovation (See publication #4: *Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective*, Chapter 3). Interdisciplinary processes under various names are frequently considered as innovation drivers, although, I would argue that, in this context, the term interdisciplinary is often used in a way that covers all the above definitions. An example of this is the term Cross-Pollination (T. Kelley & Littman, 2004, pp. 68–89).

As mentioned above, the focus here is the bringing together of multiple perspectives in relation to a common problem rather than distinguishing between specific modes of managing disciplinary combinations. The latter mainly being of interest in regards the didactics of workshop design. Therefore, the term *interdisciplinary* will henceforth be used in a more common, general sense, covering all the above definitions unless otherwise stated. This is primarily for the sake of readability.

2.1.1. FROM INTERDISCIPLINARY COLLABORATION TO INTERDISCIPLINARY LEARNING

In this regard, combining multiple disciplines within a problem-centric format appears to be a viable method, supported in the literature, of training skills useful, or related to, innovation processes. This is supported empirically by several of the workshops listed as part of this project's background process which is described in more detail in section 5.4.1. All, are based on this fundamental idea, and most have produced results which can be innovative solutions to the problems with which they were concerned. While interdisciplinarity is not the goal there does seem to be some merit to the notion of it being a means to cultivate innovation capacity among students.

The notion of interdisciplinary learning is not new, nor is it limited to the field of innovation (Barry, Born, & Weszkalnys, 2008, p. 23). Educational programmes designed around an element of interdisciplinarity are not uncommon, however, there do not seem to be many general or guiding principles apart from the interdisciplinarity itself. That said, many seem to focus on higher education based on the assumption that some degree of professional identity and *deep knowledge* is advantageous to the interdisciplinary learning process. To what degree this is the case is not given much attention in a general or structured form within the literature, although a meta-study

from 2009 does suggest that acquiring new knowledge may become easier for students, the more they already possess (Spelt, Biemans, Tobi, Luning, & Mulder, 2009, p. 373). From a practical perspective, educational level seems to be largely based on a common-sense assessment of the purpose and design of the specific educational programme.

Most of the combinatory mechanics of bringing disciplines together mentioned in the previous section are used to effect across different fields, purposes and durations (Nissani, 1995). What is interesting, is that meta-studies within interdisciplinary education indicate that they generate many of the same results despite these many differences. These include, but are not limited to, Students acquiring knowledge from disciplines other than their own, positive attitudes towards collaboration, increased understanding and respect for professional roles and competencies (their own and others), increased patience and openness and increased understanding of the need for communication skills (Cooper, Carlisle, Gibbs, & Watkins, 2001; Ivanitskaya, Clark, Montgomery, & Primeau, 2002; Spelt et al., 2009).

Another aspect of interdisciplinary learning is that it, in many ways, mimics the professional practice most formal educations supposedly prepare their students for. According to the Danish Minister for Education and Research at the time, increased interdisciplinary collaboration across industries and professions is central to the nation's economic growth and should be actively promoted (S. C. Nielsen, 2015).

Although there are many exceptions, it is not unreasonable to assume that many students will, at some point, be required to work as part of a team consisting of participants with different skills relevant to the task in hand. Interdisciplinary learning certainly mimics this, and by developing the base skills mentioned above, it can be reasonably assumed, helps prepare them for this eventuality.

It is also worth noting, that many established disciplines have arisen from interdisciplinary enquiries, gradually gaining popularity and general acceptance, to eventually become disciplines in their own right. Since the society, we live in is constantly evolving, it stands to reason that academic and professional disciplines will also evolve in response to them, and possibly, to some extent, causing them. It is reasonable to assume, that some of today's interdisciplinary initiatives will develop into the established disciplines of tomorrow.

2.2. INNOVATION AND ENTREPRENEURSHIP THEORY

The field of innovation and entrepreneurship theory is described in some detail in chapter 3 of publication #4.

However, to summarise the state of the art I will start by illustrating the scope of this venture by quoting Jan Fagerberg as follows:

> Today, the literature on innovation is so large and diverse that even keeping up-to-date with one specific field of research is very challenging. (Jan Fagerberg, 2005)

The point being, that innovation and entrepreneurship research is not simply innovation and entrepreneurship research. It has expanded - even exploded - into a multitude of genres and sub-genres varying from general theories to extremely specific case analysis.

That being said, this thesis is concerned with teaching innovation to students in vocational education programmes and in this regard, is focused on the understanding of innovation presented in the Danish Innovation Strategy which says:

> Innovation is specifically about competencies. The innovation strategy must therefore ensure a closer link between research, education, and innovation in enterprises. The point of departure is that individuals are innovative and that enterprises are translating innovation to growth and job creation. (The Danish Government, 2012, p. 5).

This is reminiscent of Josef Schumpeter's early 20th century notion of the entrepreneur being an individual with the ability to grasp ideas or inventions and realise them in such a way that they generate value for the business in which they are employed (Joseph A. Schumpeter, 2011). Thereby making the entrepreneur key to any innovation process.

This also demonstrates, that the core understanding of innovation represented in the national strategy has not necessarily changed much over the past century, and is still very much rooted in a capitalistic rationale (see publication #4, chapters 3, 4 & 6). However, it also suggests that developing and nurturing the entrepreneurial spirit is of great importance to the success of this strategy; not only among students, but also within existing enterprises.

This is very much reflected in the literature, of which a large amount is concerned with how enterprises can create and manage organisational environments that will attract entrepreneurial types, nurture them and allow for the incubation and development of their ideas (T. Kelley & Littman, 2008; Phillips, Noke, Bessant, & Lamming, 2006, p. 189). While this is theoretically applicable to enterprises of all shapes and sizes, there seems to be a tendency to focus on the larger variety.

This is presumably due to the fact, that larger companies tend to have more resources available to them to experiment, naturally making them the empirical foundation for many studies. This does not mean that there are no small, medium enterprises, or even the very small sub-micro enterprises involved. It simply recognises that the distribution seems to be somewhat skewed in favour of larger enterprises.

Regarding state of the art, this would also suggest that there could be a need for more research that focuses specifically on this rather large segment of very small enterprises.

A key point in this is the focus on how enterprises can attract and nurture the entrepreneur, whereas this thesis focuses more on how we ensure there are enough entrepreneurs to go around by cultivating the entrepreneurial impulse within the educational system.

While there are studies attempting to link specific skills with the entrepreneurial impulse and, by extension, innovation (Yams, 2016) connecting specific didactic methods to indicators of entrepreneurial ability and impulse, along with similar humanistic avenues of inquiry regarding innovation, they are much less prevalent than those which stem from the fields business school and economics legacy.

Going back to the Fagerberg quote at the beginning of this section, the field of innovation research is indeed large and ever growing. However, it is still dominated by a business-centric perspective leaving the human-centric ones less explored.

2.2.1. PERSPECTIVES ON TEACHING INNOVATION

Several of the workshops included as part of the background empirical process of this project were developed before this research began. They were, at least in part, developed around the idea that teaching innovation required more than theoretical knowledge of innovation processes and principles; to be truly effective there needed to be a practical element (Blenker, Dreisler, Færgeman, & Kjeldsen, 2006, pp. 21–24).

This was, and in many ways still is, a break with typical innovation classes that tend to rely mainly on theoretical knowledge *about* innovation. There are potentially many reasons for this, but the way in which we currently tend to measure and evaluate students' skills through standardised testing is almost certainly a contributory factor (Dahler-Larsen, 2006, pp. 53–58). Quite simply, it is much easier within the current evaluation culture to perform uniform evaluation and comparison of a theory-based curriculum. It therefore makes perfect sense to teach innovation in this way if standardised measurement remains a central goal. This problem of evaluation in relation to teaching innovation is discussed in more detail in Publication #1: *Evaluating innovation capacity in vocational education*.

Regarding the state of the art, there is certainly a shift towards the more practical workshop-based learning approaches mentioned above; not only in Aalborg, but around the world. The Hasso-Plattner institute, or *d.school*, at Stanford University is probably one of the most well-known and successful examples of this. However, there

are still several challenges associated with integrating these approaches into existing curricula; not least regarding the purpose and perspective of evaluation.

2.3. EDUCATION – INDUSTRY COLLABORATION

Collaboration between industry and education is neither new, nor particularly surprising. One of the primary goals of education, besides general education, is to provide a steady supply of relevant knowledge and skills to industry and society. This is the main reason that the government, universities and colleges engage with industry representatives and advisory boards when updating and reforming educational programmes.

While this is also true for vocational colleges, which are the primary focus of this project, this mode of collaboration tends to take place at management level; separated from the students, and their learning activities.

At university-level there are several initiatives that take a more direct approach to education – industry collaboration by allowing students to work directly with businesses in various degrees and constellations (Poulsen & Rosenstand, 2009, 2012; Rosenstand & Tribler, 2012; Vetner et al., 2015).

By comparison, the Danish *Sandwich Mode*l of interchanged apprenticeship training and school-based teaching found in many vocational programmes (see publication #1) is typically the main form of industry contact for vocational students.

In many ways, the apprenticeship aspect of the Sandwich Model puts vocational colleges in a unique position by allowing for much closer and more persuasive education-industry collaboration, than purely scholastic education such as most university programmes. On the other hand, it also introduces a series of constrains that must be taken into consideration and can potentially limit more direct collaboration. One of the main issues is that all students are also employees in a business, and as such are subject to contractual obligations and restrictions that the educational institutions are required to respect. While this does not necessarily pose any problems, it does mean that students collaborating with businesses require extra scrutiny and possibly approval from every student's employer. In cases where the employers deems the student's participation to be potentially harmful to their business they can effectively hinder the student's participation. This could be due to interaction with potential competitors, clients or anyone otherwise related to their business, products, services or markets (see publication #2: *Developing apprentice skills for innovation through interdisciplinary training and education* & publication #3: *nKNOWation: an interdisciplinary collaboration on assistive technology between two North Jutland vocational colleges*).

Moreover, the businesses that have most employees with a vocational education, and which also happen to represent much of the Danish corporate landscape, are often not well represented in education-industry collaboration projects outside of student apprenticeship. When approached, many simply state that they cannot spare any of their limited resources on activities which do not generate revenue (see publication #4, section 2 for more detail). Presumably, this sentiment is one of the reasons these types of enterprises tend not to seek out or accept invitations to participate in projects that do not present clear and direct benefits to their operation.

CHAPTER 3. RESEARCH DESIGN

In an attempt to bring order to what often seems like a chaotic process, I have chosen to describe my research process based on Lars Mathiassen's model for designing engaged scholarship (Mathiassen, n.d., p. 3). Mathiassen's model (see Figure 2) draws on the idea of engaged scholarship as a means of addressing the complexity of producing knowledge in collaboration with multiple stakeholders, which is also useful in the contexts of these stakeholders. For example, this could be in relation to policy, practical and research applications, effectively seeking to lessen the gap between theory and practice in pursuit of a richer understanding of the field in question rather than viewing research as something separate from practice (Ven, 2007, pp. 1–14).

Mathiassen expands on this premise by suggesting a design approach to engaged scholarship on the basis that the process of scientific inquiry requires constant iteration between two areas which are not fully known beforehand. On the one hand, determining which questions are relevant and interesting to explore and how to go about doing so (Research Design). On the other hand, determining which results are relevant and worthy of publication and through which channels (Publication Design).

Mathiassen suggests that these designs will develop and affect each other during the research process and should, therefore, be documented throughout to ensure transparency. While I do not describe my process in the level of detail Mathiassen suggests, in this and the following two chapters I briefly summarise my process in terms of what has taken place within each of the elements described in the model.

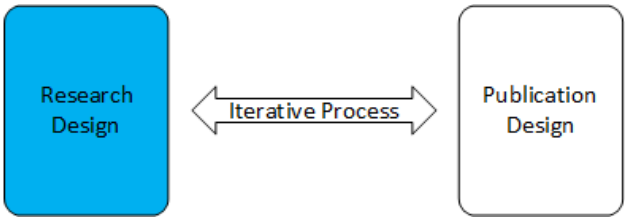


Figure 2: Designing Engaged Scholarship – Research Design

This chapter outlines the specific research questions addressed in this thesis. Moreover, a discussion of the research process is given to illustrate the disparity between the research ideal and its reality. The purpose is to demonstrate how certain realisations have affected the process, and lend some transparency to how this has influenced the methodological and publication aspects in Mathieson's model. This is not meant to excuse or even explain any particular results or findings. It is simply to recognise that the process has developed over time and there is a certain disparity between how it was originally envisaged, and its practical reality.

3.1. RESEARCH QUESTIONS

The main research question put forward in the original (Danish) research proposal for this project is translated into English[4] as follows:

How do interdisciplinary educational initiatives affect the cultivation and application of students' innovation capacity, and what are the organisational implications of these types of initiatives for educational institutions?

This is further broken down into four sub-questions, which were also part of the original research proposal.

3.1.1. SUB-QUESTIONS

The following four sub-questions represent different aspects of the main problem: Theoretical, methodological, technical and organisational. The purpose of this de-construction is to gain a more detailed perspective on the main problem by studying these aspects individually. As such, each sub-question targets a different aspect of the overall question. The English translations are as follows:

Sub-question 1 (Theoretical problem)[5]:

> How is it advantageous to understand the terms interdisciplinary and innovation capacity, so they may be operationalised and applied in a meaningful way in both an educational and professional context?

[4] Translated from the Danish: Hvilken rolle spiller tværfaglighed i opbyggelsen og anvendelsen af innovationskapacitet blandt studerende; herunder organiseringen af de tilhørende uddannelsesinstitutionelle rammer?

[5] Translated from the Danish: Hvordan er det hensigtsmæssigt at forstå begreberne tværfaglighed og innovationskapacitet og hvorledes kan de operationaliseres, så de kan anvendes i såvel en uddannelses- som en erhvervssammenhæng?

Sub-question 2 (Methodological problem)[6]:

> How can we utilise innovation capacity, and is it possible to measure the effects of said application in a meaningful way compared to the goals stated in the government's innovation strategy?

Sub-question 3 (Technical problem)[7]:

> What is required of educational institutions to facilitate the generation and application of student innovation capacity in an interdisciplinary context?

Sub-question 4 (Organisational problem)[8]:

> Which implications relate to educational institutions adapting their organisation to better enable them to effectively facilitate the use of student innovation capacity?

While they are all equally relevant, my focus in this thesis is on the first three. The organisational level targeted in the fourth sub-question is mentioned here because it represents a practical context, which influences all the other aspects.

During my work on this project, it became apparent that to fully answer the organisational sub-question would not only require the results of the first three sub-questions to be known beforehand, but also an entirely different form of study. Therefore, when this became apparent, I chose to focus my empirical efforts on the first three.

Since organisation still has practical and contextual significance, it remains listed as a sub-question. However, as I have not given it equal empirical attention I will only discuss the organisational question based on the practical implications drawn from the treatment of the theoretical, methodological and technical questions.

While none of the publications included as part of this thesis have directly addressed the organisational question, it has been touched upon indirectly in all of them. This led to the realisation, that the question of organisation is an integral part of all the research questions. It is, in effect, what binds them together since the theoretical, methodological and technical findings must in some way be combined in an

[6] Translated from the Danish: Hvordan anvendes innovationskapacitet, og kan man måle effekten heraf på en meningsfyldt måde set i lyset af regeringens innovationsstrategi?

[7] Translated from the Danish: Hvilke uddannelsesinstitutionelle rammer faciliterer opbyggelsen og anvendelsen af innovationskapacitet i en tværfaglig kontekst?

[8] Translated from the Danish: Hvordan organiseres de institutionelle rammer med henblik på effektiv udnyttelse af de studerendes innovationskapacitet?

organisational context to be practically applicable. In a sense they can be said to represent the *why?*, *how?* and *what?* of the organisational question. This is discussed further in Chapter 9.

In the spirit of engaged scholarship, it is relevant that the organisational question remains to maintain a practical dimension. However, since it is not addressed empirically the nature of the question has changed to one of drawing forward the practical implications of the previous questions and discussing them in an organisational context.

While my area of interest and the research questions themselves have not changed during my research, my understanding of their significance and meaning certainly has. In that sense, the research design process has not been characterised by eureka-moments that suddenly change everything, but more a gradual uncovering of new layers and details within each question, which had previously been hidden from me: Constantly increasing their complexity and re-defining the relationship between them. While I cannot list all of the ways my understanding has developed and changed, some are discussed in Chapter 6 (theory), Chapter 7 (method), Chapter 8 (technique) and Chapter 9 (organisation).

3.1.2. BOUNDARIES AND LIMITATIONS

The research questions themselves are broad and have, therefore, been gradually focused during the research project. Although, from the very beginning there were several implicit boundaries and limitations, which have framed the project.

Probably the most important of these is the focus on student-driven innovation specifically targeting vocational education students. There are several reasons for this. First and foremost, my professional teaching background is in vocational education, and I am currently employed by a vocational education institution that is also partly financing this research project. The second, and possibly more interesting, is the fact that, as mentioned in the introduction, a large portion of the Danish workforce is made up of people with this level and type of formal education (see publication #4: *Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective*, section 2). It also happens, that this demographic seems to be, if not overlooked, receiving less attention regarding driving innovation than their academic counterparts. Similarly, there is little academic literature dealing specifically with innovation in vocational education (see Chapter 2).

A related boundary is the focus on very small, micro, enterprises rather than industry in general. The reason for this is twofold. Firstly, over 80% of the Danish corporate landscape is made up of businesses of this size (Statsministeriet, 2005, p. 2); some because they are young start-ups, but most seem to remain within this size scale. Secondly, most of the vocational education students mentioned above find themselves

employment in this size of enterprise. Mostly because they represent the majority, but also because many of the skilled trades and crafts taught in vocational colleges tend to become self-employed at some point during their career.

While there certainly is a great deal of innovation research that focuses on this size of enterprise, most does not and, instead, focuses on larger enterprises with more resources available, and which can afford longer timeframes on returns of investment (Tidd & Bessant, 2014). Also, much of the literature concerning sub-micro sized enterprises tends to link this size profile with start-ups in the context of innovation and entrepreneurship. However, as already mentioned, many of the Danish companies of this size tend to remain in this size group; whether by design or circumstantial is beyond the scope of this project, and does not necessarily have any implications for their ability to innovate.

The final boundary is purely geographical, and limits the scope of this project's empirical processes to the Region of Northern Denmark. The reason for this is largely practical. The project's imperative is to be useful for the organisations helping to finance it; in this case two major educational institutions in this region of Denmark. Beyond that, both the background and foreground empirical processes (se sections 5.2 & 5.4.2) are centred around the educational institutions in this region.

Despite having such a regional focus, the project's findings are not considered to be limited to this region or these specific institutions. The reason for this is, that the institutions, along with the specific educational initiatives studied, are representative of similar institutions across the country, and indeed Scandinavia (see Publication #4: *Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective*, section 2). Likewise, the amount and distribution of sub-micro enterprises in relation to the total corporate landscape is comparable to most European countries (Eurostat. European commission., 2011, p. 11)

Whether the methods and techniques described here are easily translatable to different educational situations is beyond the scope of this project. However, I would argue, that if nothing else, it does provide a body of experience from which to start such inquiry.

CHAPTER 4. PUBLICATION DESIGN

This chapter addresses the second half of Mathiassen's model of designing engaged scholarship: the publication design. As with the previous chapter, the purpose is to describe the publication process, which has been intertwined with, and developed alongside the research design. Thus, this chapter lists, in chronological order, the publications submitted as part of this thesis along with the formalities surrounding them.

Moreover, the publication process has, for a variety of reasons, not always allowed, for papers to be published that directly address questions posed in the research design. Therefore, a table is provided in section 4.1 which cross-references each publication according to its relevance towards each sub-question presented in the research design. References to relevant publications are also made during the treatment of each sub-question later in this text.

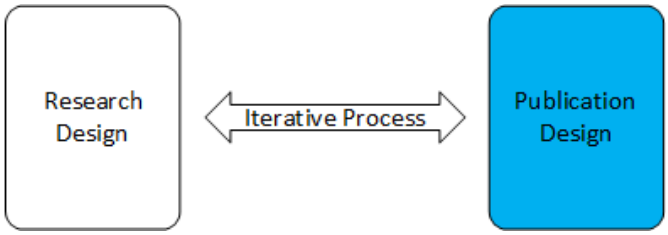


Figure 3: Designing Engaged Scholarship - Publication Design

During my research into the subject with which this thesis is concerned, I have contributed, either fully or in part[9], to the following peer reviewed publications on subjects related to this work. For that reason, I have retained the rights to each of these publications, and they are submitted here as a part of this thesis.

Two of the publications are originally written and published in Danish since this was, at the time[10], a requirement by the journal's editorial staff. The original papers have since been translated into English and both the original Danish versions are included in this thesis along with their respective translations.

In order of publication date, the following are included as part of this thesis:

[9] I am the sole author of one publication, the primary contributor on two others, and (equal) co-author of the last.

[10] This requirement has since been changed, and beginning in 2017 the journal now accepts submissions in the Nordic languages and English.

Publication #1 **2015** **10 Pages** **Status:** **Published**	**Evaluering af innovationskapacitet i erhvervsrettede uddannelser** (Translation: *Evaluating innovation capacity in vocational education)* *Christian Ravn Haslam (Aalborg University & Tech College) & Claus Andreas Foss Rosenstand (Aalborg University)* Published in: CEPRA Striben nr. 18, November 2015 by University College Northern Denmark (C. Haslam & Rosenstand, 2015). Double blind peer reviewed Authorship (See Author Declarations on companion USB): Christian R. Haslam – 80% Claus A. F. Rosenstand - 20%
Publication #2 **2016** **8 Pages** **Status:** **Published**	**Developing apprentice skills for innovation through interdisciplinary training and education** *Christian R. Haslam (Aalborg University & Tech College)* Presented at The XXVII ISPIM Innovation Conference – Blending Tomorrow's Innovation Vintage, Porto, Portugal on 19-22 June 2016. Published in conference proceeding (Christian R Haslam, 2016). Double blind peer reviewed Authorship: Christian R. Haslam – 100%
Publication #3 **2016**	**nKNOWation: et sundhedsteknologisk innovationssamarbejde mellem to nordjyske erhvervsskoler**

8 Pages **Status:** **Published**	(Translation: *nKNOWation: A collaboration between two Danish vocational colleges to promote student-driven health technology innovation.*) *Christian Ravn Haslam (Aalborg University & Tech College), Lona Bach (SOSU Nord) & Thomas Vrangbæk Thomsen (Tech College)* Published in: CEPRA Striben nr. 19, Special edition on Vocational Education, November 2016 by University College Northern Denmark (Christian Ravn Haslam et al., 2016). Double blind peer reviewed Authorship (See Author Declarations on companion USB): Christian R. Haslam - 90% Lona Bach - 5% Thomas V. Thomsen - 5 %
Publication #4 **2016/2017** **100 Pages** **Status: In review**	**Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, Strategy and Competitiveness – a dynamic perspective.** *Christian Haslam (Aalborg University & Tech College Aalborg) & Søren Smed (Aalborg University)* Currently submitted to the editorial board for external peer review before publication as part of the InDiMedia E-Book collection, Aalborg University Press Authorship (See Author Declarations on companion USB): Christian R. Haslam 50% Søren G. Smed - 50%

Figure 4: List of publications

4.1. PUBLICATIONS IN RELATION TO RESEARCH PROCESS

The publications included as part of this thesis, do not relate to its research questions in a one-to-one manner. Publishing opportunities have not allowed for papers which solely, and directly, address the research questions posed in this thesis. Therefore, most address issues relevant across multiple sub-questions. In the following table, I cross-tabulate each publication according to its relevance towards each sub-question so it is clear to which areas of discussion and analysis their findings and perspectives are relevant.

Each publication relates to the sub-questions from section 3.1.1 as shown in Figure 5.The publication titles and research questions are shown below for ease of reference.

Publications

Publication #1:	*Evaluating innovation in vocational education*
Publication #2:	*Developing apprentice skills for innovation through interdisciplinary training and education.*
Publication #3:	*nKNOWation – an interdisciplinary collaboration between two North Jutland commercial colleges on welfare technology.*
Publication #4:	*Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective.*

Sub-questions

Theoretical RQ:	*How is it advantageous to understand the terms interdisciplinary and innovation capacity, so they may be operationalised and applied in a meaningful way in both an educational and professional context?*
Methodological RQ:	*How can we utilise innovation capacity, and is it possible to measure the effects of said application in a meaningful way compared to the goals stated in the government's innovation strategy?*
Technical RQ:	*What is required of educational institutions to facilitate the generation and application of student innovation capacity in an interdisciplinary context?*
Organisational RQ:	*Which implications are related to educational institutions adapting their organisation to better enable them to effectively facilitate the use of student innovation capacity?*

	Theoretical	**Methodological**	**Technical**	**Organisational**
Publication #1	***X***	***X***		***(X)***
Publication #2			***X***	***(X)***
Publication #3			***X***	***X***
Publication #4	***X***	***X***		***(X)***

Figure 5: Cross-tabulation of publications and research questions

Regarding the organisational sub-question, all the publications are listed as relevant although three of the four are placed in parenthesis. This is to signify, that while publication #3 does address some aspects of organisation directly, most only do so to the extent that the problem of organisation is to some degree inherent to all the sub-questions. This is described further in section 3.1.1 and Chapter 9.

CHAPTER 5. METHOD & PROCESS

This section describes the design employed throughout the project, as well as the methodological considerations that have influenced these decisions. Section 5.2 describes the actual research process and reflects on how this design has been made manifest in practice.

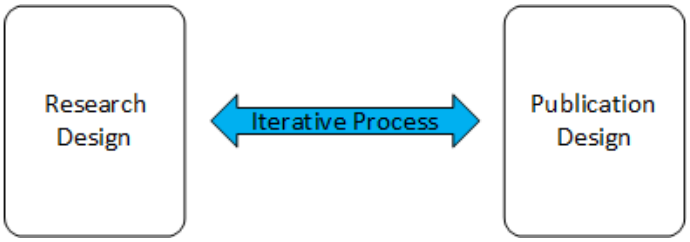


Figure 6: Designing Engaged Scholarship – Iterative Process

Within Mathiassen's model of designing engaged scholarship, this chapter describes the actual research process iterating between, and binding together, the research and publication design.

5.1. FRAMING AND META-THEORETICAL PROCESS

During my research, the theoretical perspective I have taken towards my area of interest has changed and developed in various ways. This is largely due to my understanding of the field developing during my work. However, it is also linked to my fundamental approach to research as a student of the humanities, attached to the HCCI Doctoral Research Programme, and thus a very broad and primarily qualitative tradition.

It is also important to point out, that the project itself is not an independent entity compared to my work and professional interests before it began. By this I mean that in many ways it is interspersed with previous professional experiences and a desire to improve on some of the things I was, and still am, professionally interested in.

From a methodological point of view this presents an interesting situation since I was already immersed in the field I intended to study. Attempting to distance myself from past experiences to avoid bias would, even if it were possible - something of which I am not convinced -, simultaneously exclude a large amount of potentially useful experiential data. Conversely, methodological approaches that attempt to capture and, at the same, time validate these experiences, such as phenomenological writing, (Manen, 1984) have never seemed completely viable to me. They certainly provide

some form of vehicle for structured reflection, and they also have the advantage of making experience tangible in the form of text. However, I am not convinced that there is a qualitative advantage to this degree of formalisation. There is no doubt, that my experiences teaching innovation have shaped my approach to this research. However, these experiences are only a small part of a larger personal perspective that has been shaped throughout my entire life. To formalise a small, albeit obvious, part of this seems to implicitly ascribe it undue significance.

Unfortunately, this perspective leaves me without an immediate solution for how to tackle this problem. Luckily, I am far from the only researcher to ponder this question, which is relatively common in the humanities, and qualitative studies in general. Enough so, that Professor Svend Brinkmann from Aalborg University has published an entire book on *Qualitative inquiry into everyday life* (Brinkmann, 2013) which directly addresses the question of how to use daily experiences as a basis for conducting sound qualitative research.

Brinkmann suggests an epistemology based on a combination of American pragmatism (Brinkmann, 2006; Dewey & Bentley, 1960) and Hermeneutics in a modern humanistic understanding in which we, as sentient beings, are part of a world filled with meaning, interpreted through the experience of action (Brinkmann, 2013, p. 70). This is extended with Charles Sanders Pierce's concept of abduction since Brinkmann suggests that structured or formalised research is only necessary when a breakdown occurs between our expectations (understanding / interpretation) and our experiences (actions) and forming the basis for inquiry.

5.2. RESEARCH PROCESS

During my time as a Ph.D. student, I have participated in several courses and conferences where I have had the opportunity to mingle with many other Ph.D. students and supervisors from around the world. One of the things this has taught me is, that there are two main approaches to Ph.D. research.

One is typically part of a larger research project that has been well described by one or more seasoned researchers, secured funding and so on. The other is a formalisation of an idea by the students themselves or, in some cases, their non-research based workplaces. The main difference being that one stems from academia and has the benefit of being thought out and formulated by someone with experience of doing this type of work, and the other does not!

In both cases, a breakdown has occurred to spark the research interest, however, the difference lies in the method and degree to which it is formalised up front.

This project belongs to the latter group. This is partly because neither I nor the company I work for could be considered seasoned researchers, or even researchers at

all when this project was originally formulated. Although my supervisor and Aalborg University graciously guided and assisted me through the initial process of formulating the research proposal, and of course supervised my progress thereafter.

As it is, when I started this project, I simply did not know enough about the area of interest to be able to formulate a clean and concise design. While my research questions themselves have changed little (only one has changes slightly during my work), the way in which I understand and interpret them has changed quite dramatically.

Also, much of the empirical experience relevant to the research questions began several years before the actual research project; before there was any compulsion to begin a research project. This lead to an interesting situation where re-visiting past experiences suddenly became relevant to the project, posing some interesting methodological questions in the process.

My overall research method consists mainly of inductive inquiry, experimentation and abduction brought together in a series of iterative hermeneutic interpretation cycles. It can be broken down in the following manner:

Empirically it consists of two main parts, or processes. The first is what I will refer to as the background process, which represents my continued accumulation of experience working with interdisciplinary innovation programmes, interdisciplinary education in general and, in conjunction with this, working with micro and sub-micro enterprises; basically, my experience with subjects relevant to this project that are not directly part of the study itself.

This background process began several years before I was ever even slightly aware that I would someday be performing any form of research on the subject. I first became involved with interdisciplinary innovation programmes, roughly 4 years prior to beginning my Ph.D. Studies; sometime between late 2009 and early 2010. With education becoming my full-time profession in late 2005 and setting me on a path to come up with different ways to try and make my classes interesting and useful beyond the goals stated in the official curriculum. While I was not really aware of it at the time a lot of what I was trying to do was stimulate curiosity and creativity. In other words, the background process began, to some degree, almost ten years before I enrolled as a Ph.D. student.

Not only that, but the background process has continued steadily throughout my Ph.D. studies with established projects and courses, each recurring once or twice a year. It was always my intention to make use of this experience, hence my continued involvement, so the experience gathered through this process is just as intentional as with the foreground process which, I will describe below. What makes it different is the way data from the background process is gathered and applied analytically. It

forms an epistemological stepping-stone on which iterations of induction and experimentation take place.

What I refer to as the foreground process represents the intentional experimentation that forms the empirical core of my research. These are activities that have been staged in a manner, which is directly related to the problems or questions with which I was concerned at the time, and data was gathered specifically for use in this project.

As such, the foreground process is shaped by inductive reasoning based on interpretation of my accumulated experience at the time; from both the background and the foreground processes. Although, in the early stages of this research the background process was the only source of experience making it the primary influence during the early stages of my research. As work progressed the foreground process became more and more influential; hopefully leading to more qualified interpretations of the research questions along with foreground attempts to answer them.

Resisting the urge to include a model of the Gadamer'ian hermeneutic spiral (Collin & Køppe, 1995, Chapter 5; Sonne-Ragans, 2012, pp. 150–151)which lies at the core of many humanistic research projects, I would instead simply describe the process as several sets of intertwined spirals. Not only describing the interaction and relation between the foreground and background empirical processes, but also the relation between the research and publication design and the empirical processes in relation to the theoretical understanding.

This is an attempt to illustrate the intertwined nature of the background and foreground empirical processes as a culminative and interdependent epistemological foundation for continued inquiry. This is not particularly surprising as it is fundamental within the humanistic tradition (Collin & Køppe, 1995, Chapter 1). The purpose here is to make explicit the approach taken, and to distinguish between the two separate empirical processes.

5.3. RELATION BETWEEN EMPIRICAL PROCESSES

The background process encompasses my involvement with pre-existing university college and university level innovation and entrepreneurship courses. Some are highly interdisciplinary by nature, and some are not. The main commonality between them is the format and purpose of the courses. Their purpose is to train innovation and entrepreneurship skills, and they typically take the form of annual or bi-annual workshops which are centred on some form of problem-based learning among small groups of students. The specific workshops are listed below in section 5.4.

While I have been, and in some cases still am, involved in the planning and execution of some of these workshops (see section 5.4.1 below), they were all designed and run

by others before I was ever involved or aware of them. Some are the reason I became interested in this mode of education in the first place.

The foreground process, on the other hand, is a direct attempt to emulate the effects I experienced at university-level by attempting to translate elements from the background process to a vocational education setting. In practice, the foreground process consists of a single welfare technology collaboration between Aalborg University, University College North Jutland, Tech College Aalborg and SOSU North (North Jutland Health College (VET). This formal collaboration encompasses two specific educational initiatives as platforms for experimentation. The first is simply known as Welfare Cluster and is an annual one-day innovation workshop which mixes students from different disciplines as well as different levels of education: Post-graduate, graduate and vocational. The other is an annual experimental innovation workshop solely for vocational education students spanning two different institutions and approximately 10 different educational programmes. The workshop is known as nKNOWation and has run for the fourth time (fall 2013 to fall 2016). Although I have been directly involved in designing and running both initiatives, nKNOWation has been my main focus during my Ph.D. research.

I am far form the only person involved in running nKNOWation[11], but, because of this research and my experience with similar projects I have maintained a key role in its inception and design throughout its evolution. This has allowed me to use the workshop as a platform for experimentation in the context of my Ph.D. studies.

5.4. EMPIRICAL SCOPE

As mentioned above, this project's empirical scope is twofold; i.e. a background and a foreground process.

The foreground process consists of the nKNOWation workshop, which I use as a platform for experimentation. The background process consists of most of the other innovation and entrepreneurship education initiatives I have been involved with, as they have provided the inspiration and foundation for the design and evolution of nKNOWation, and to some extent Welfare Cluster.

In the following I will briefly describe the various initiatives that make up the background process, along with a more detailed description of the nKNOWation

[11] Many people have been involved over the years, but the following have worked hard to make nKNOWation a reality: Thomas Vrangbæk Thomsen, Lona Bach, Bent Fuglsbjerg, Rene Andersen, Jan Kempf Bertelsen, Anette Juhl, Lotte Randeris Schulz, Mette Gram Rugholm, Winni Jørgensen & Trine Strandridder

workshop. I will also give a rough timeline showing my involvement and their occurrence relative to each other.

Data gathered during these initiatives, both foreground and background, is available in digital format, and is supplied to members of the evaluation committee and the Faculty of Humanities at Aalborg University on a separate USB drive. The data varies in nature since much of the background data was not gathered specifically for research purposes. However, the foreground data also includes formal evaluations, interviews and questionnaires. Much of the foreground data, and some of the background data cannot be made publically available since it is supplied in raw format and therefore not anonymised. All participants have given their explicit consent regarding the use of materials in this specific research project.

5.4.1. BACKGROUND PROCESS

The background process is made up of the following initiatives:

- Wofie: Workshop for Innovation and Entrepreneurship
- Solution Hub
- Innovation and Business Development Camp[12]
- U-CrAc
- AAU Entrepreneurship Faculty & d.school initiative
- DADIU
- Wild North: Micro-enterprise consortium initiative

These are described briefly below, with references to studies and on-line descriptions given where they are available.

Wofie

The workshop for innovation and Entrepreneurship or WOFIE (Aalborg University, n.d.-a) as it is more commonly known, is one of the first major attempts at incorporating interdisciplinary group work into the PBL model regarding training innovation and entrepreneurship skills among students. The workshop was started in 2008 and is applicable to all post-graduate students at Aalborg University on a voluntary basis (for 3 ECTS extra credit). Originally Bachelor-level students from select programmes at University College North Jutland also

[12] Innovation & Forretningsudviklings Camp

participated. However, this has gradually become less and less with University College students eventually withdrawing completely in 2015. The exact reasons for this are not known, at least not to me, however, University College has stated informally that they were unable to continue prioritising resources on external activities.

Wofie was the first such initiative I met, and its design heavily influenced the initial design of nKNOWation. It is based on a combination of creativity training (Den Creative Platform (Hansen & Byrge, 2008)) and a Design Thinking (Rosenstand & Tribler, 2012) process as a framework for a high-intensity, problem-based, interdisciplinary workshop. The workshop runs for four days, with each day representing a distinct phase in the Design Thinking process and incorporating elements of creativity training.

During the four days, pre-determined groups of students, and clusters of groups with different backgrounds are presented with a problem theme and given the task of developing an idea that addresses some aspect of that problem**.** During the course, they can draw on various experts to advise them on specialised subjects related to the main theme, or related subjects such as business plans, legal issues, financial estimates etc. The final phase of the workshop is a presentation where each group must present their idea to a panel of industry representatives relevant to the theme. The panel of representatives gives each group feedback, and ultimately selects three groups that they feel did the best job. Being among the 'winning' groups usually facilitates entry into national entrepreneurship competitions and some largely symbolic prizes[13]

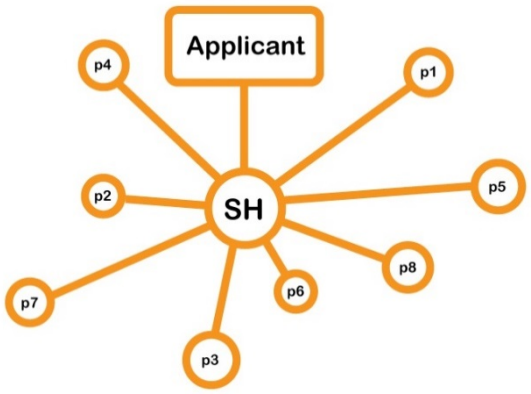
In its early iterations Wofie was a very high profile project involving three different university locations with constant video conference uplink and many staff; both educators and technical. However, although this was considered a great success, it was not financially sustainable in the long run. Happily, much of the experience gathered in the early years allowed for later evolutions to generate much the same effect at greatly reduced effort and cost. There exist several papers and evaluations of Wofie

[13] Prizes have become more modest in the later iterations of Wofie and focus has gradually shifted away from being highly competitive to a more collaborative tone.

documenting its development (Rosenstand & Tribler, 2012; Vintergaard Christian et al., 2009, pp. 20–27 & 51–57).

Solution Hub

Solution Hub (Aalborg University & University College Nordjylland, n.d.-a) was originally designed as an initiative to provide innovative solutions to industry through interdisciplinary student and industry collaboration. The overall premise was much the same as with U-CrAc, the main difference being, that Solution Hub selected a single business partner to present a real-world problem with which they were involved, and all the interdisciplinary project groups would work on solutions to that single problem. Essentially presenting the business partner with an entire portfolio of potential solutions and ideas.

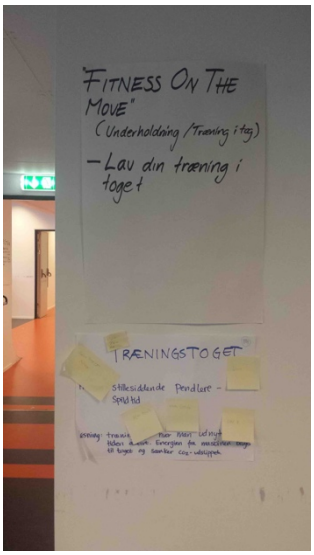


As with U-CrAc, Solution Hub included students from both Aalborg University and University College North Jutland, however Solution Hub spanned an entire semester of *normal*[14] project work with the addition of several pre-determined plenary and individual meetings between the business partner and the project groups. All plenary sessions were moderated by educators connected to Solution Hub, and not the groups regular advisors.

Solution Hub began in 2012 and ended in 2014 due to dwindling support from the attached programmes. It was briefly discussed whether the Solution Hub initiative should be transformed into a local version of the Hasso Plattner Institute of Design at Stanford University, colloquially known as *d.school*. However, this did not come to pass and ultimately Solution Hub was discontinued. This is discussed more below under AAU Entrepreneurship Faculty and d.school initiative.

[14] Aalborg University is particularly known for its Problem-Based Learning (PBL) approach where a large part of every semester in all offered programmes consists of a student project. University College has adopted the same approach to a certain degree.

Innovation and Business Development Camp



The Innovation and Business Development Camp or *Innovation og Forretnings-udvikling* as it is known in Danish is a 72-hour (three consecutive 24-hour days) university course in camp format, plus literature studies for students from various programmes at Aalborg University. It is held annually with few exceptions and is an elective course, which can be taken for extra credit (5 ECTS). By December 2016, approximately 1000 students have taken the elective in total.

The workshop places students in groups of their own design, although they must be interdisciplinary, with no single field dominating, where they are tasked with developing and presenting a business plan. In contrast to workshops like Wofie or U-CrAc, the focus here is not so much on generating ideas (although this is also an element), but more on formulating a business plan around an idea and presenting it. A unique aspect of the Innovation and Business Development Camp is that all participants are subjected to a personality type-test prior to the workshop. Specifically, the Myers-Briggs Type Indicator (www.myersbriggs.org) is used.

During the workshop, each participant is given a short one-on-one session with a certified Myers-Briggs consultant who gives them the personalised results of their test. The idea is to make the students more aware of the interdisciplinary group dynamic; the various professional personality development types represented and how this affects negotiation and general communication. During end-of-course evaluation this aspect is often mentioned as one of the most eye-opening and immediately useful by the students (Data: Innovation og Forretningsudvikling 2013, Fælles Interview 1400 27 Nov 2013 & DM650006).

U-CrAc

The User-driven Creative Academy or U-CrAc is an interdisciplinary, case-based and user-oriented workshop spanning three weeks, each representing a specific phase; Observation & Analysis, Synthesis, and Realisation (Poulsen & Rosenstand, 2009, 2012).

U-CrAc targets students from Aalborg University post-graduate programmes in Architecture & Design, Experience Design, Interactive Digital Media and Entrepreneurial Engineering. As with Wofie, it originally included bachelor students from University College North Jutland but for the same reasons now only has participants from AAU. In contrast to Wofie U-CrAc is a mandatory course and an integrated part of each programme's curriculum. Besides the workshop, it also encompasses several lectures on relevant subjects such as Applied Ethnography and Customer Journey Mapping[15].

The workshop element of U-CrAc is centred on interdisciplinary groups of students working on a case presented by, and in direct collaboration with an external business partner. Typically, business partners present cases that encompass problems for which they need actual solutions, and which represent real value for the business. While the groups are not expected to provide complete solutions to these problems during U-CrAc, they are expected to provide the business partner with some workable outlines or suggestions. In some cases groups will continue their relationship with the business partner beyond the scope of U-CrAc**.** However, this is not the norm and goes beyond Aalborg University's involvement.

U-CrAC has been an annual event, starting off the fall semester of participating programmes since 2008.

AAU Entrepreneurship Faculty & d.school initiative

During the past three years, there have been several meetings, initiatives and workgroups at Aalborg University focusing on developing PBL, increasing or better utilising interdisciplinarity in various programmes; increasing industry contact and collaboration and developing innovation and entrepreneurship initiatives. This work has originated in several different departments in response to different demands and goals of different programmes. However, over time, they have gradually found their way into what is now known as the AAU Entrepreneurship Faculty, which is the internal non-formal, name of a cross-departmental workgroup with a common overall goal managed by the SEA group (Supporting Entrepreneurship at Aalborg University) at the AAU Incubator (Aalborg University, n.d.-b).

In the face of dwindling support for Solution Hub, representatives from the entrepreneurship faculty meetings were gathered to discuss the possibility of re-framing Solution Hub as a summer school elective; disconnecting it from semester curricula. The idea being that this would remove administrative hindrances thereby

[15] See www.ucrac.dk for more information

rekindling support. During these discussions, the notion of re-branding Solution Hub as a local d.school branch (under the Stanford franchise) was also brought up. This resulted in a workshop specifically addressing the d.school idea along with a guest lecture by a representative of d.school in Paris. Ultimately, however, a consensus on what to do with the Solution Hub platform was never reached, nor was widespread support for licensing the d.school brand. The result was, as mentioned above, that Solution Hub was discontinued and d.school related discussions ceased.

Despite this, the informal entrepreneurship faculty workgroup persists and continues to hold meetings and workshops to exchange ideas or discuss common projects on an ad hoc basis.

DADIU

Dadiu or the (Danish) National Academy of Digital Interactive Entertainment is an educational initiative founded in 2005 by educators from research environments and art schools in collaboration with the computer game industry. The concept is based on bringing together various elements og game production in a single, multi-disciplinary, project. Essentially emulating the entire process of designing and developing a fully functional computer game albeit on a smaller scale.

The animation programme at the Danish National Film School hosts and lead the initiative with students from universities and art schools applying for various lead roles and students from technical colleges making up part of the production teams.

Dadiu takes up a full fall semester for students who are accepted into the programme. All university-level participants must hand in a report outlining and reflecting upon their experiences at Dadiu. They also present the result of their work in the shape of the main game their team produced.

Students do not select which roles they will play, nor which teams they will be part of. Although, students do specify which roles they would prefer along with their preference as to geographical location. The latter because groups are stationed either in Copenhagen or Aalborg during production of the main game.

Most courses and a small scale pilot project takes place in Copenhagen and is hosted by the National Film School.

Dadiu is particularly interesting because it combines very different disciplines and personality types in what is often a highly intense production process. Computer game design involves a wide array of disciplines such as project management, software development, game design, quality assurance, graphic design, audio design, aesthetics and interaction design.

The process is often very challenging and stressful for the students but has also yielded a great deal of valuable experience and some truly fun and well-designed games.

There are several cases of games designed at Dadiu latter winning indie game awards and/or going on to become commercial games with some of the students starting their own production companies.

My involvement with Dadiu has been as an external examiner for students from Aalborg University. As such no data is available on the companion USB drive regarding Dadiu since I do not have permission to distribute information pertaining to exams. However, more information on Dadiu, along with video demonstrations and a complete archive of playable games going back to 2011 can be found at the official website: http://www.dadiu.dk/. The latest games can also be downloaded free of charge on Google Play.

Wild North

Wild North (JK Innovation & Invio, n.d.) was a project conceived by JK Innovation, Invio and the Municipality of Aalborg to kick-start a consortium of small start-ups in Northern Denmark. It consisted of a one-day workshop designed to aid micro enterprises enter into project consortiums with larger organisations, known as project hosts. Students from Aalborg University and a group of unemployed academics also participated. This was partially to stimulate creativity and idea generation but also, more importantly, to give them the opportunity to engage with the businesses present in hopes of finding part- or full-time employment.

The Wild North workshop marked the culmination of a larger collaboration between JKinnovation and the Region of Northern Denmark (Væskthus Nordjylland) designed to aid local micro-enterprises to collaborate on larger-scale projects via interdisciplinary consortiums. Approximately 60 people, most representing sub-micro sized enterprises, participated in the 1-day workshop which presented several concrete cases with which enterprises could engage, and formalise collaboration.

Wild North presented a unique opportunity to engage with both micro enterprises and project hosts. Both of whom recognise the need for innovation and collaboration but were having trouble finding potential partners and/or projects with which to engage.

5.4.2. FOREGROUND PROCESS

The foreground process is, as mentioned, the nKNOWation initiative, which is also part of the above-mentioned Welfare for Future collaboration.

nKNOWation

nKNOWation is a Cross-institutional, interdisciplinary welfare technology innovation workshop aimed specifically at students from vocational colleges.

Part of the Welfare for Future (See 4.3.2.1) initiative, it is a three-day interdisciplinary workshop in the structural style of WOFIE (See 4.3.1.1) but adapted to the requirements of vocational education mandatory courses in innovation. The workshop is (Tech College Aalborg & SOSU Nord, n.d.), as with all Welfare Cluster initiatives, focused on solving current welfare problems through innovative, typically technology-based, solutions.

nKNOWation represents a direct attempt to emulate the format and results of Wofie with students from as many different vocations as possible. The only constants are students from health care participating from the North Jutland Health College (SOSU Nord), and students from IT & Electronics participating from Tech College Aalborg. Besides these two groups a diverse group of vocations are represented. These differ from year to year, but some examples are: Metal worker, Hair dresser, Auto mechanic, Automation technician, Carpenter, Web designer, Graphic designer, 3D animator and Pedagogical assistant.

Student groups are usually between 6 and 8 students with at least one technology and one health care student in each. Then, as many other different vocations as possible given the amount of students participating.

One of the main principles has been to try and engage as many different perspectives as possible by focusing on health care issues which all participants can, to some extent, relate to.

During the nKNOWation process group work is facilitated by educators from the participating educational programmes and students have access to external *experts* in relevant areas. These range from business experts and serial entrepreneurs to ordinary citizens who happen to suffer from a condition or handicap covered in the workshop theme.

On the final day, groups pitch their ideas to a panel of similar experts who give them feedback. While there are symbolic prizes for first, second and third place nKNOWation is more about collaboration and participation than competition. Prizes are usually nothing more than a diploma and cinema tickets for the winning group.

Welfare Cluster

Welfare Cluster is a mini-version of nKNOWation. Compacting the entire process of idea generation, business development and pitch into a single day. Apart from the compressed schedule, the main difference compared to nKNOWation is that Welfare Cluster includes students from multiple levels of education. Post-graduate level university students, typically from the field of Industrial design, facilitate the process in the groups they are part of. The students are given a brief introduction to useful facilitation techniques before participating.

No educators are directly involved in facilitation unless the university students explicitly request help. Otherwise educators take on a role similar to the external experts in nKNOWation. While some external parties are often present to present the workshops theme and main problem, the role of expert is primarily undertaken by educators form the participating educational programmes.

Other participants come from the same vocational health care and technology programmes as with nKNOWation, but usually none of the others. Also, students from the undergraduate programmes in business and international marketing at University College North Jutland participate with at least one student from this field in every group.

The purpose of Welfare Cluster was to attempt different types of interdisciplinary combinations. This time focusing on combining different levels of education as well as different types.

As with nKNOWation, groups pitch their ideas at the end of the day. This time, they do so to the same external parties who introduced the theme of the workshop in the morning. Although, a winner is declared the purpose is for the students to gain some experience working together and hopefully for the external party to gain some ideas for inspiration.

5.4.3. TIMELINE OF EMPIRICAL PROCESSES

The following table gives an overview of the empirical processes. Specifically, which initiatives I have personally participated in, when and how often they occurred and which data was gathered and how.

It also serves as an index for accessing the data available on the companion USB drive. The data is organised roughly according to *process* and *initiative* plus *year*. For example: *USB:\Background Empirical Process\Wofie 2014*

Initiative	Process	Timeline, Role and Data
Wofie	BG	Participated spring each of the following years 2011, 2012, 2013, 2014, 2015, 2016 Role of process facilitator every year and member of steering committee and organiser from 2014 to 2016 Data gathered by participatory observation, Interviews with students, formal evaluations & evaluation rapports. Evaluation rapports from 2008 and 2009 have also been collected.
Solution Hub	BG	One semester in 2013 and one in 2014 Member of steering Committee and respondent during presentation sessions and workshops Data gathered by participatory observation, video capture of presentations, group interview and formal evaluation rapport plus related correspondence
Innovation and Business Development Camp	BG	Participated in the Fall 2013 Camp Role of facilitator Data gathered by participatory observation, audio recording of plenary evaluation and group interview with participating students immediately after the camp ended.
U-CrAC	BG	Participated in Fall 2014 Lecturer. Taught a mandatory course on software design methodology.

		Data gathered by non-participatory observation + video and audio clips of external participants (business representatives) networking seminars.
Entrepreneurship Faculty & d.School	BG	Attended Entrepreneurship Faculty meetings in 2013 (1 – first d.school workshop) & 2016 (1). Attended d.school / Solution Hub summer school workshop in 2014. Participant Data gathered by participatory observation, proceedings and rapports. Summer school workshop: video of proceedings, Powerpoints and audio of all group workshop sessions
Dadiu	BG	Between 20 and 40 hours every December or January from 2011 to 2016 Primary or External Examiner Insight into the interdisciplinary process which makes up the Dadiu semester through examination of participating students work including formally reflecting on the process and presenting their teams results.
Wild North	BG	November 5th. 2014 Role of Official / Consultant Data gathered by participatory observation and discussions with participants (in the role of consultant). Access to formal evaluation rapport and some planning meetings.
nKNOWation	FG	Participated annually Fall 2013, 2014, 2015 & 2016

		Design & development, initial planning, steering committee, Facilitator Data gathered through participator observation, presentation video, process still pictures, Student questionnaires, formal evaluation, meeting minute's, nKNOWation manuscript (three versions)
Welfare Cluster	FG	Participated annually spring 2014 & 2015 Design & development, initial planning, steering committee, Organiser / Supervisor Data gathered through participatory observation, course materials, Participant interviews, Video of group process, Steering committee interviews, Student questionnaire, formal evaluation.

Figure 7: Overview of empirical data

Included on the companion USB drive is a range of other data gathered throughout the empirical process but not addressed directly in the table above. This data mainly consists of official statistics, government rapports, news articles and official curricula which are referenced either in this summary article or one of the included papers. In each case, the references are made according to the APA6 standard, however, the PDF files are also included on the USB drive for convenience.

5.5. RESEARCH DISSEMINATION

During my just-over[16] three year PhD-study, I have had the opportunity to disseminate my research through various channels.

Half of my teaching obligation during this period has been spent at Tech College, as part of the day-to-day teaching schedule, and the foreground empirical process

[16] My PhD was extended by a three-month period of leave due to sudden changes at Tech College that required extra teaching capacity for a brief period. As such my leave was spent teaching fulltime at Tech College for three months.

activities. In total, Tech College has claimed 410 hours out of the total 820 hours of dissemination specified in my contract.

Two weeks (80 hours) of my teaching obligation allocated to Tech College was spent visiting their counterpart in Singapore; ITE College, East. Most of my time there was spend teaching various IT courses, and collaborating with local educators on introducing and applying PBL techniques and principles to their courses. At the same time gaining insight into the methods and teaching style common at ITE.

Approximately 200 hours have been spent directly engaged in the workshops which make up the foreground empirical process; not counting planning, evaluation and administrative activities.

The remaining 200 hours have been spent teaching various computer science courses; mainly focusing on advanced high-level programming, large-scale software design and (organisational) systems integration management.

The remaining 410 hours in my contract have been spent teaching at Aalborg University. This mainly (approximately 300 hours) includes workshops which are part of the background empirical process but also regular post-graduate courses and exams.

Since most of these workshops are recurring (both foreground and background) they have contributed to an ever increasing body of personal experience which has allowed for a consistent reflection process throughout my research. Similarly, it has provided an avenue of dissemination at both an organisational level, and a didactic level.

Although this has produced a large, if not consistent, amount of data on planning, running and evaluating such workshops far from all of it is used directly, or even indexed and organised, in this thesis. However, the entire body of raw data is available on the companion USB drive, or through the faculty of humanities at Aalborg University.

Since the empirical process has been one of gathering new data and on processing it re-visiting and re-evaluating old data in a constant cycle of iterations it is not possible to present it in a way that accurately conveys how it was analysed (see section 5.2). For this reason, the data is presented the way it was originally ordered as it was gathered to avoid unintentionally ascribing any elements undue significance due to my current perspectives. The only changes made is the explicit ordering into foreground and background empirical processes, otherwise the data is represented in as close to original format and structure as possible which includes maintaining the original Danish fil and folder names.

CHAPTER 6. INNOVATION CAPACITY AND INTERDISCIPLINARY LEARNING

This chapter addresses the first of the research sub-questions:

> How is it advantageous to understand the terms interdisciplinary and innovation capacity, so they may be operationalised and applied in a meaningful way in both an educational and industrial context? (see section 3.1.1)

In many ways, this is also the most fundamental question since the perspective adopted here provides the foundation for the rest of this project.

The main purpose of the question is to define what is meant by 'interdisciplinary learning' as a process, and by 'innovation capacity' as a desired result. The latter framed in such a way it is considered both attainable within conventional educational practice, and a valuable attribute of (future) employees within the specific industries for which their educational programmes are directed.

For these reasons, it is also touched upon, if only indirectly, to some degree in all the included publications. Moreover, it is addressed directly in publication #1: *Evaluating innovation capacity in vocational education* and publication #4: *Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective*. Similarly, interdisciplinary learning is discussed in Chapter 2: State of the art.

In the following, the perspectives and insights presented in these publications will be summarised and discussed in relation to the project's empirical process.

6.1. WHAT DOES IT MEAN TO INNOVATE?

To answer this, it is advantageous to begin with the desired result and work backwards from there. This is because innovation is commonly used retrospectively, in recognition of a particularly successful attempt to create value by doing something in a new way. As such the process of innovation is inherently risky since there is no guarantee of its results ever being deemed innovative (see Publication #4, section 3.2 & 3.3). Analytically this leads us to gather examples of widely recognised innovations and look for commonalities among them to identify what makes an innovation. Luckily, many such studies have been performed over the past 50 or so years resulting in an enormous body of literature on the subject.

Reading through innovation literature and case studies, one quickly discovers that a wide range of skills, circumstances and creative business practices tend to play a role. In fact, there does not seem to be a single well-defined set of skills or drivers that are considered central and unique to innovation processes across industries and trades (see publication #4). One consequence of this realisation is that students may need to acquire different innovation skills to target different jobs or industries**.** Therefore, that different educational programmes may need a unique definition of innovation capacity designed specifically to target the industries in which their students are most likely to seek employment (see publication #1).

This is not surprising as different educational programmes are indeed different, because they already target varied and specific industry needs. We readily accept that other types of skills, even base skills like mathematics, need to be adapted to different industry requirements, so why should innovation, and thus, innovation capacity be any different? The answer is, that it probably should not. However, this does not bring us any closer to a 'meaningful' definition in an industrial context; micro-enterprises or otherwise.

Another aspect on the problem of different innovation skills for different industries is that the skills that seem to play a significant role in various innovation case studies also seem to differ within the same industry (see publications #1 & #4). This could indicate that there may be a host of parameters that affect the innovation process making it nearly impossible to reduce these types of processes to any set of core skills. It could also indicate that the innovation process is not reliant on specific skill-sets but simply makes use of those that are available in each situation. The latter would imply that innovation capacity has more to do with the *way we use* pre-existing skills (or indeed other resources) than with the skills themselves. In other words, that a definition of innovation capacity may be more meaningful as a form of meta-skill or mind set describing our ability to work, identify opportunities and problem-solve, in specific ways with the resources available to us.

This is not to say, it makes no difference which skills or resources are available to us if we possess the necessary capacity for innovation. There are several examples of skills being more frequently relevant both within specific industries and for innovation in general. However, these skills are neither new nor special in any way. They are often simply acknowledged analytical, design and business skills that are already taught at many schools all over the world. For example, the ability to plan, manage and evaluate a development process, the strategic evaluation of opportunities as a planning tool, or using simple financial tools to determine whether to continue investing resources in a specific plan (see publication #4).

A contributory factor is the simple observation that innovation processes can seldom be distinguished from any other process when viewed from within the process itself. Since the innovation label is usually applied after, or well into the process by someone

observing its effects from outside the process as a form of retrospective consensus. It does not necessarily seem different from within (see publication #4, section 6). The individual or company doing the innovation is simply trying to be competitive and go about their business. Of course, it is possible to be aware that you are attempting to innovate. However, whether or not you are successful does not necessarily become apparent until others acknowledge the result; if no one does, you may never know for sure.

This leads to another interesting aspect of the notion of innovation capacity. Even if no one ever recognises the work a company has done as being particularly innovative, this does not mean that the efforts have been unsuccessful. The object of innovation is to create value (see publication #4, section 4) to maintain a competitive advantage in one or more markets. Whether anyone thinks to retrospectively write a case study about it, crying innovation to the world may be great advertising but does not in itself have any bearing on the value the initiative created.

In this sense the capacity for innovation boils down to the ability to utilise resources and skills available to discover and exploit new ways to create value in one or more markets. If evaluation of one's efforts demonstrate some form of value (preferably, but not necessarily of the type desired) they can be considered a success, and if they create competitive advantage by doing something in a way that competitors are not, it can also be considered innovative. The extent to which others recognise and acknowledge this as innovation is advantageous, but not a requirement. The main point being, that innovation processes are, from an inside perspective, fundamentally processes like any others; albeit linked to more risk due to their abductive nature (see publication #4, section 3.3).

This is particularly important to point out since only the most extreme examples of innovation are likely to be praised as such by others. Examples of this are popular cases like Apple's development and launch of the iPhone, which had such a profound impact that it created several new product categories (the smartphone and the App Store content service) effectively disrupting the entire mobile phone industry and redefining handheld personal devices at the same time. This is a truly spectacular example of what successful innovation can look like; once again making Apple's slogan: "Think Different!" the mantra for all companies with dreams of emulating their success.

However, spectacular examples such as this are just that: spectacular examples. They do not represent what could be called 'everyday innovation' which takes place all the time in companies around the world. These everyday innovations are normally not changing huge established markets or industries; they are normally not creating incredible new products, the likes of which the world has never seen before. They are simply making small changes to business practices, product designs, marketing strategies etc. that create value in one way or another, and giving them a slight

competitive edge - at least for a time. This happens all the time, and has done since long before Apple disrupted the mobile phone market or Schumpeter wrote about technological innovation and the entrepreneurial spirit (Joseph A. Schumpeter, 2011, pp. 77–78). On the other hand, it is precisely these everyday innovations that possess the potential to, occasionally, become spectacular examples.

Empowering our vocational students with the capacity for innovation simply means that we want to teach them to become better at doing this; at being consistent everyday innovators. In Schumpeter's terminology, we want to cultivate and bring out the entrepreneurial spirit in as many of them as possible.

This is in line with the goals stated in the national innovation strategy:

> Students in vocational education programmes should also develop their ability to create specific solutions in relation to their relevant business fields. (The Danish Government, 2012, p. 26)

Although, it possibly represents a broader interpretation than originally intended.

This sentiment is also reflected among the micro-enterprises with which I have been in contact throughout the project. Particularly during the Wild North Interdisciplinary Consortium workshop (see section 5.4.1), which in many ways represents the businesses with which this project is concerned. In some cases, they were start-ups by former students from both university and vocational colleges, while others were seasoned small business owners who now employed a few people but had not grown significantly.

Most of these participants had read one or more innovation handbooks and knew the usual success stories by heart. They were also aware of the various offers and initiatives available to them through regional and municipal innovation programmes. However, while 94% (see Data: Wild North Workshop November 2014, TK Final, p. 29) felt that interdisciplinary consortia represented a significant innovation potential for enterprises such as their own. One of the workshop's major conclusions was that almost none of these micro-enterprises possessed the strategic foresight and/or initiative to seek out and engage in such consortiums without external aid of some description (Ibid. p.33-34). Thus, one of the solutions presented in the project report must do with making this form of external aid more apparent and available (Ibid. p. 38).

How, in an empirical sense, this capacity will manifest itself in the various companies and industries these students come to work in is, of course, unknown; having a clear idea of what they are going to achieve would negate the innovative nature of the result. This makes innovation capacity a very difficult entity to work with inside the established practices of the Danish educational system (and likely most others) since by nature of the very definition of innovation, it becomes impossible to apply a direct

causal link between any educational effort and a desired output when the output is defined by being unknowable and ever changing (see publication #1 & Publication #2: *Developing apprentice skills for innovation through interdisciplinary training and education*).

This means that, if this premise is accepted, no matter which type of educational initiative one attempts to teach students to be innovative, a leap of faith is required. In this sense, it is somewhat comparable to teaching "good" design practice (see publication #4). As such, it has more to do with instilling in the students a sense of good practice regarding innovation processes.

6.2. WHAT DOES INTERDISCIPLINARY LEARNING OFFER?

In this thesis, the leap of faith has in many ways been the idea of interdisciplinary learning to train and develop the meta-skills necessary to develop needed capacity for innovation. For my part, it stems from my experiences in the background empirical process. Particularly the university-level innovation workshops, all of which have an interdisciplinary element, in the broad definition (see section 2.1).

In the educational programmes that I have been a part of and studied (Poulsen & Rosenstand, 2012; Rosenstand & Tribler, 2012; Vetner et al., 2015), the idea of interdisciplinary learning is often based on the notion of co-creation (Bason, 2010; Prahalad & Ramaswamy, 2004; Scharmer & Senge, 2009) and coupled with some form of creativity training (Armitage, Pihl, & Ryberg, 2015; Hansen & Byrge, 2008; D. Kelley, 2013). The rationale being, that a creative outlook is the foundation of innovation and that a significant element of this is the ability to re-combine existing knowledge (Dyer, Gregersen, & Christensen, 2011, p. 23). Interdisciplinary learning stimulates this creativity by introducing 'new' perspectives (in the shape of people schooled in other disciplines) to each participant. At the same time, this approach seeks to condition students to be open to, and see the value of actively seeking out perspectives different from their own. Thus, every participant 'disturbs' every other participant's intra-disciplinary perspective on the problem in hand potentially generating minor breakdowns in understanding, leading to new inquiry (action) and interpretation (see Chapter 5).

As mentioned in chapter 2, there are several modes of disciplinary combination; each with its distinct definition**.** However, in this regard, the simple fact that several different perspectives are being combined in relation to a shared problem is the most important aspect. The mechanics of how this combination takes place are secondary to this, and mainly of interest in relation to the didactics of an educational initiative. This will be discussed in Chapter 8.

With that in mind, the fact that students, faculties and industry representatives alike appear to greatly enjoy the experience of interdisciplinary learning (see Data:

nKNOWation 2015 & nKNOWation 2016), once they overcome any initial trepidation, does not have any bearing on whether the initiatives in question are successful. It does however demonstrate that it is practically possible to successfully operationalise interdisciplinary workshops to the participating parties' overall satisfaction, and thereby, that it is a viable format; effective for building innovation capacity or not.

6.3. SUMMARY

In relation to the above question of understanding and operationalising the idea of interdisciplinary and professional context, is relative to what we wish to achieve through its application, and to what extent we can measure or evaluate it. In other words, interdisciplinary learning can be defined in the non-specific sense discussed in section 2.1 and be equally useful in both educational and professional contexts. The main issue is having a clear understanding of what we wish to attain; in this case innovation capacity. Interdisciplinary learning is simply a means to an end, and to determine its usefulness is wholly dependent on our ability to accurately achieve that end.

The main point regarding innovation capacity is that it is not an immutable or static entity, but rather highly mutable and dynamic; requiring adaptation to the ever-changing requirements of the specific industry or profession being targeted. The effect being that innovation capacity does not represent a single goal that can easily be evaluated and assessed across educational programmes, industries or nations. It also suggests that a single didactic practice such as interdisciplinary problem-based workshops (PBW, see section 2.1.1), or PBL for that matter, will probably not prove to be a one-stop solution fulfilling all these needs from a pedagogical point of view.

The problem of how to evaluate innovation capacity given such a dynamic definition is discussed further in the following chapter. Similarly, the didactics of cultivating innovation capacity, along with PBW's usefulness in this regard, are addressed in Chapter 8.

CHAPTER 7. EVALUATING INNOVATION CAPACITY

This chapter addresses the second research sub-question:

> How can we utilise innovation capacity, and is it possible to measure the effects of said application in a meaningful way compared to the goals stated in the governments innovation strategy?

This question is closely linked to the understanding of innovation capacity discussed in the previous chapter. From a research design perspective, the questions of understanding and evaluating innovation capacity cannot easily be separated and have, therefore, been addressed simultaneously. However, from the perspective of publication design the question of how to evaluate or measure innovation capacity in a contextually meaningful way, was addressed first, and re-visited at the end. Publication #1: *Evaluating innovation capacity in vocational education* attacks the problem head-on; developing the idea of a differentiated approach to innovation capacity, which is discussed in the previous chapter, in the process. This became a process of constantly moving back and forth between attempting to define innovation capacity as something that could be used to create value in a multitude of business scenarios, and which would allow meaningful measurement of this value. The result was not only a model for evaluating innovation in vocational education, but also the foundation for the understanding of innovation, which is presented more fully in *publication #4: Enabling consistent innovation in micro-, small and medium enterprises. Innovation strategy and competitiveness - a dynamic perspective* (see Publication #4, section 3.2, 3.3 & 6).

This dialectic process raises several interesting and fundamental questions that must be clarified before addressing the research questions. As previously mentioned, it is necessary to have a clear understanding of the desired or expected result of a process to perform a meaningful evaluation of said process. Similarly, it is necessary to understand the purpose of the evaluation. For example, is it to give the people engaged in the process a tool for reflection, or is to satisfy some external party's interests? Which types of measurements satisfy these requirements in a meaningful way? In the case of much education, evaluation is a means to allow institutions, departments, teams and individual faculty members to reflect upon their practices, but it is almost certainly also a political tool for comparing and measuring economical proficiency. Consequently, there is often a need for different measurements to satisfy all requirements, although it may be up to the institutions themselves to define those for internal use, while those required by law primarily support the needs of policy.

This was certainly the case, in relation to my work on the nKNOWation initiative during the foreground empirical work for this project, as described in *publication #2: Developing apprentice skills for innovation through interdisciplinary training and education,* & *publication #3: An inter-disciplinary collaboration between two North Jutland commercial colleges on Health-Technology*.

In this case, the steering committee was focused on two things from an evaluation perspective. The first was to get feedback from the participating students, faculty and industry representatives on their respective experiences of the workshop. Particularly regarding*:*

a) whether the students' attitudes were changing in regards to their own ability as innovators and entrepreneurs (students)?
b) whether the workshop was successfully fulfilling the formal criteria for the various educational programmes represented (faculty)?
c) whether the processes being emulated, along with the skills demonstrated throughout the workshop were sufficiently representative of those found in practice (industry representatives)?

The second, was to satisfy administrative, and by extension, policy requirements of financial viability. By this, I mean our ability to demonstrate that we were in fact performing in a cost-effective manner compared to the estimated mean cost of a *default*, theory-based, classroom course, as performed at the various educational programmes represented. If the cost of attaining the pre-defined educational elements pr. student deviated significantly from the estimated mean cost, it was necessary to document precisely which elements had not been achieved, or which extra elements had. In the case of the latter, it would also be necessary to document, or in some other way qualify the relevance of these extra elements in relation to their cost.

While the second of these evaluation imperatives was ridiculed by educators, myself included, it remains valid and representative of the socio-economic reality of our current educational policy, which forms the context for all educational initiatives. Failure to comply with these criteria would simply result in the initiative being denied funding and closed; regardless of any other view or views.

Fortunately, in the case of the nKNOWation initiative, it was possible to demonstrate a mean cost pr. student only slightly above the base-line on its third and fourth iterations. While the initial cost was significantly higher than the base-line, the fact that it was a pilot initiative combined with positive feedback from all involved parties secured continued support for a second attempt. On its second iteration, the cost was reduced to fall within acceptable deviation limits, and the evaluation also indicated that it was possible to optimise further. Participant feedback was also positive, allowing, the initiative to continue (see publication #3: An inter-disciplinary

collaboration between two North Jutland commercial colleges on Health-Technology).

However, this tells us only that it was possible to optimise the cost-effectiveness of planning and running the workshop. Most likely because the steering committee continued to include the same core group of people, thus easing the process of reflection and ensuring that built up experience from each part iteration was considered during planning of the next (See publication #3: An inter-disciplinary collaboration between two North Jutland commercial colleges on Health-Technology).

This is necessary for continued funding, and demonstrates that the pre-defined educational goals describing mandatory innovation courses for each participating educational programme were being met (see question b. above). However, it does not tell us anything about the students' attitudes towards innovation and entrepreneurship (see question a. above), or to what extent the workshop emulates innovation processes found or desired in practice (see question b. above).

From my perspective, these questions are interesting because they pertain to the desired purpose of cultivating and applying innovation capacity rather than simply complying with the current organisational reality.

7.1. EVALUATING MUTABLE DEFINITIONS OF INNOVATION CAPACITY

Devising a method for answering these questions is the focus of publication #1: *Evaluating innovation capacity in vocational education*, which looks at the problem of causality in relation to educational initiatives as well as presenting a mutable understanding of innovation capacity. In effect, painting a picture of innovation capacity as a moving target, where we can, to some extent determine if the target has been hit, but not where the hit originated. Thus, there is still no way of drawing a causal connection to this effect from any specific initiative.

While this is problematic, it is neither surprising nor limited to innovation initiatives. The same dynamic is found in any situation that concerns itself with a large, complex system. One perspective on how to think of and work with evaluation in these types of situation is described by Ray Pawson and Nicholas Tilley in their book Realistic Evaluation (Pawson & Tilley, 1997) which, along with perspectives by Peter Dahler-Larsen and Hanne Kathrine Krogstrup (Krogstrup & Dahler-Larsen, 2003, Chapters 1, 4, 7 & 10) formed the basis for the models presented in the above mentioned publication; an expanded version of which is shown below in Figure 8 in the next section. Pawson and Tilley's ideas are based in the ideas of Critical Realism (Bhaskar, 1975) and developed as a method for evaluating complex initiatives involving a

multitude of actors and variables over extended or open-ended periods of time; such as changes to policy and law by government.

The central idea regarding evaluation, being that actions performed must first be *actualised* to produce *outcomes*, which, in turn, can only be ascribed as meaning dependant on a variety of *contextual mechanisms* but not necessarily directly linked to the actions themselves or the *agency* with which they were performed (Bhaskar, 1998, Chapter 3). This is in direct contrast to the empiricist ideal of observing a direct causal relation between an independent and a dependent variable. In practice this form of evaluation seeks to describe the relation between the agency of the actions performed, the context (historical, societal, political or otherwise) within which they are performed, and the perceived changes within the areas these actions seek to affect.

To be effective this requires the prior formulation of a hypothesis or *programme-theory* describing the intention, context and expected effects along with the intended intervention; hence the term *theory-based evaluation* (Krogstrup & Dahler-Larsen, 2003, p. 51). This allows for multiple, iterative if so desired, evaluations over time, based on the actors within the intended areas of effect, and the experiences of the intervention's actualisation compared to what is stated in the programme-theory. This considers, that different actors can experience differently, as it can be actualised differently in different contexts or environments. Gathering these experiences from multiple actors and comparing them to the programme-theory thereby forms the basis for a more nuanced and *realistic* evaluation of the intervention in question.

Unfortunately, this presents some challenges in the context of vocational education since there is a potential discrepancy between the agency of the actors describing the goals of an educational intervention, and those designing and performing it. Similarly, the intended areas of effect could be subject to a similar discrepancy due to the issue of translation between practices discussed below. These challenges are discussed further in relation to the technical and organisational sub-questions in chapter 8 and chapter 9.

7.2. DIFFERENTIATING BETWEEN AREAS OF PRACTICE

Another key element to the question of evaluation is acknowledging that educational initiatives occupy, and can be evaluated within, different contexts. As mentioned at the beginning of this chapter, there are typically multiple reasons for educational evaluation. The model presented in publication #1: *Evaluating innovation capacity in vocational education* generalises these into two distinct practices: a *professional practice* and an *educational practice*. The reason for this is to highlight the differences between the rationales affecting each of these as a context, while at the same time illustrating the relation between them. For example, there are rules stemming from educational policy along with pedagogical principles guiding and affecting what takes place within educational practice. These help form a rationale which must be

considered when designing or evaluating actions within this practice. However, the rationale in a specific educational practice, while certainly similar in many ways, may not be identical to that in others; even between related institutions in the same country, although the differences will likely be more significant across nations and educational levels. This is the same with the rationale governing a specific professional practice.

There are many theories and ideas surrounding the concept of distinct practices as an observational and analytical tool (Nicolini, 2012, pp. 8–11), however, in this instance, I simply use the term to allow general distinction between the rationales that form the context for evaluation. The labels I use are chosen to illustrate that there is both a fundamental difference and a strong dependence.

The point is not to perform a practice study but to make it clear, that evaluation of educational initiatives cannot be performed without considering both the educational and the professional practices. Moreover, goals, intentions and rationales cannot simply be transferred between one and the other; they will need to be translated. To this end, the ideas and methods presented in the field of practice theory by scholars such as Silvia Gheradi (Gherardi, 2012) and Elizabeth Shove et.al. (Shove, Pantzar, & Watson, 2012) are certainly useful tools. However, the specifics of how this should be conducted and where focus should be placed will depend on the specific initiative along with the precise practices involved.

The need for translation is due to the relationship between education and professional practice. The purpose of an educational initiative is to prepare students for the demands of professional practice whatever that may be in any given situation. These demands are identified and exist within a professional practice, which is fundamentally different from the one where the actual preparation, i.e. initiative, takes place. Each must be evaluated in the context of its own rationale, but also in the context of the overall educational imperative of meeting professional, and by extension societal, demands. The latter requiring evaluation across practices and the rationales they represent leading to the need for translation between-, rather than transference from-, one to the other.

In the above mentioned publication, this idea is limited to only two orders of practice (professional and educational) in describing the relation between profession and education. However, this can be extended and adapted to enable more complex variations of the same principle as illustrated below in Figure 8. For example, it could be extended to include a research practice which also informs and is related to the educational practice. This could in turn be extended even further to include a governmental or societal practice guiding the creation and revision of policy affecting every other practice in a variety of ways and to varying degrees. In the model, the term government is used, albeit in a broad sense inclusive of organisations, supportive or otherwise, related to the governments work.

The idea of extending the model was primarily developed as a response to the sub-question (see sub-question #4 in section 3.1.1) pertaining to the organisational implications of interdisciplinary education. However, it also remains deeply rooted in the question of evaluation (see sub-question #2 in section 3.1.1). Therefore, it is first presented here in the context of evaluation, and later re-visited in the context of organisation (see Chapter 9).

The extended practice model is as follows:

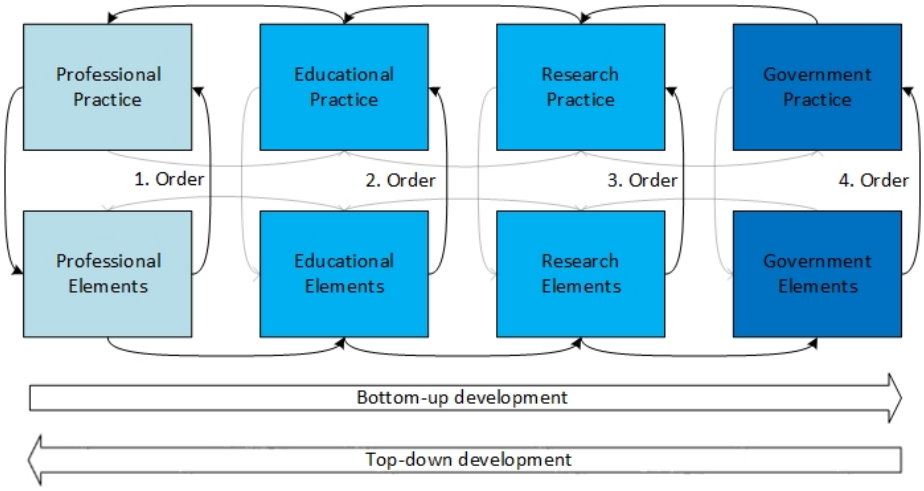


Figure 8: Example extended practice model

While this extension was originally inspired by Chris Argyris' ideas on the concept of double-loop learning and reflective practices in organisations (Argyris, 1990, pp. 92–94) it is more closely related to the concept of Triple Helix Innovation (Etzkowitz, 2008) in that it attempts to describe the same dialectic between government, industry and university.

In this case the university strand is separated into education and research since it was designed to accommodate other modes of education that do not share the same direct link to research as seen at the university level (the colouring in Figure 8 represents the relation to the three strands of the Triple Helix model: industry [1. order], university [2. & 3. order] and government [4. order]). The orders of reflection are, in this case, listed from the perspective of a bottom-up process beginning in professional practice. However, they could, in principle, be ordered according to the perspective of any practice in the model.

The triple helix model also acknowledges the separation between separate practices, and the need for closer integration across these practices in certain situations; innovation also being the primary focus. The double-loop learning model is more

closely related to the evaluation within every practice, or loop, as well as the need to extend this evaluation to a higher order loop, or governing context. In the case of the example above this idea is extended further by including third and fourth order loops also, however, in principle this can be done in different ways; for example, the same effect in only three orders as shown with the Triple Helix model.

As a side note, the separation of education and research into separate practices does not only serve to acknowledge non-university educations that do not have an intrinsic research component. It underlines that education and research are, in many ways, two separate practices; even within the same institution. It also illustrates the need for some form of connection between education and research, with research bridging the gap to government; for all forms of education. The reason for this is to illustrate the need for research as a form of qualifier for policy while simultaneously being affected by policy.

This model also demonstrates the fundamental difference between a bottom-up and a top-down development process. A top-down process moves from right to left pushing elements from each practice to the next without the receiving practice understanding the rationale behind the elements it receives nor how they were translated. Conversely, a bottom-up process moves from left to right, pulling elements into their own practice; attempting to understand the rationale behind the elements and translating them *within* the receiving practice.

From an evaluation point of view, a bottom-up approach, allows the formulation of a useful programme-theory since the practice maintains control over the process being evaluated. It is responsible for determining which elements are of interest, how they are translated and synthesised into the new practice. For example, an educational institution could, through analysis, determine which traits are relevant in a professional practice, translate them into educational goals, and synthesise them into educational practice by applying pedagogical and didactic theory. This lets the same institution a programme-theory which describes every step of this process in detail along with relevant actors within the professional practice. In turn, having such a detailed programme-theory allows for realistic evaluation of every step, creating a platform for reflection on how to modify or fine tune the process in future.

A top-down approach to the same situation obscures the professional practice elements along with the translation process from the educational institution itself, presenting it only with the elements it must synthesise into its own practice. This does not allow for the same detail in evaluation or much reflection on the process of synthesising these elements. It restricts the institution to evaluating whether or not it complies with the elements specified without the necessary context to determine whether they are *meaningful* in the professional practice they are meant to target. Effectively creating a situation where the practice pushing these elements (e.g. government practice) is the only one capable of evaluating their relevance to

professional practice. This potentially generates a high degree of reflective latency within the educational practice since it is now reliant on the government practice providing generalised evaluation results of their efforts.

While a top-down approach does not hinder evaluation, it does set some limitations on the detail, specificity and frequency with which an educational initiative can be evaluated. Conversely, it ensures that every professional practice is represented through precisely the same elements across every relevant educational practice. This standardisation is ideal for national and international comparison, simplifying the government practice.

Since all practices mentioned here are relevant an ideal solution would be to compromise between top-down and bottom-up. Allowing for both processes and focusing on the different needs of different practices. This means adjusting the levels of abstraction in the translation of elements between practices in different directions. Top-down elements would need to be more abstract, thus, allowing for detailed interpretation within the educational and research practices while catering to the need for standardisation within government practice. Similarly, the bottom-up elements would provide the detailed interpretation, within the boundaries of these abstract elements, allowing for detailed evaluation towards professional practice.

Although, the situation cannot yet be considered ideal in this regard, the latest versions of curricula in certain areas of vocational education are moving towards a more abstract set of educational elements. This creates the opportunity for these educational practices to engage more directly with relevant professional practices and create the foundation for more detailed evaluation and reflection in this regard. Possibilities in this area are discussed further in section 8.4.

7.3. APPLYING INNOVATION CAPACITY: TRANSCENDING PRACTICE

On reason to pursue more detailed evaluation of professional practice is to gauge the effect of various educational efforts. Having a detailed programme-theory helps us specify what we mean by effects at any given time, allowing informed reflection on our actions to attain them.

This is important because the effects we are interested in are meaningful from the rationale of one practice, whereas the actions performed to attain them are meaningful from the rationale of a different practice.

In principle, this is the case for most educational initiatives, however, in this context it is especially reminiscent of the base, abductive nature of innovation processes (see publication #4: *Enabling consistent innovation in micro-, small and medium enterprises. Innovation strategy and competitiveness - a dynamic perspective*, section

3.3). In this, the process of innovation is compared to that of design; both strive towards a goal that is not fully defined from the onset, requiring frequent iterations of evaluation, reflection and adjustment.

The national innovation strategy specifically states, that innovation capacity should not only be cultivated in educational practice, it should also be applicable within professional practice *from* the educational practice (The Danish Government, 2012). It is not enough to wait for the students (the students representing innovation capacity) to move from educational to professional practice. The capacity the students represent should be meaningful within the professional practice, while the students remain part of an educational practice. This means, that the interaction between professional and educational practices must occur at a much higher frequency than the duration of the educational programme in question.

Moreover, this abductive nature of innovation coupled with its mutability across professional practices (see sections 6.1 & 7.1 above) indicates that meaningful evaluation of an initiative's ability to cultivate innovation capacity is closely linked to its ability to apply the capacity to the relevant professional practice.

In other words, innovation capacity can only be evaluated in a meaningful way from within the practice it is targeting. Since the idea of innovation itself is somewhat unclear by nature, close relations to practice along with formulation of programme theories and frequent iterations of evaluation are necessary.

7.4. LESSONS LEARNED FROM NKNOWATION

During the foreground empirical process, this dynamic has become increasingly apparent. Over the past two iterations, there have been two attempts at evaluation. However, the ideas presented here (and in publication #1 & #4) on evaluation were not fully developed at the time. This lead to the nKNOWation manuscript (see Data: nKNOWation, Drejebog til nKNOWation 2016 for the latest version) being used as a makeshift programme-theory in the evaluations.

While this provided some interesting results, they were very general in nature and did not allow for precise changes to be made to the initiative in a more qualified manner. This appears to be due to the fact, that the nKNOWation manuscript was not designed as a programme-theory and, therefore, lacks the level of detail necessary. In other words, it seems to be a question of: *ask a vague question, get a vague answer*.

These results are similar to those found in previous evaluations of other, related, initiatives such as Wofie (for example, Data: Wofie Evaluering 2012, WOFIE 2012 evaluering, version 12.10.2012). This is not to say they are too vague to be useful, but simply that they are primarily of use in relation to evaluating the more abstract top-down elements.

From an evaluation point of view, this is unfortunate. However, it is largely due to this experimentation that the understanding and model described here were developed while also providing us (the steering committee) with a better understanding of the level of detail required.

The result is, that a much more detailed programme-theory is being developed for nKNOWation 2017 based on this research and in close collaboration with the professional practices it targets. In this case the application of technology to Danish healthcare practices surrounding lifestyle related illnesses that currently require the use of trained care-givers.

Hopefully, it will be possible to do the same with some of the other, background, initiatives with which I hope to remain involved. Although this is not in any way certain, it would provide an opportunity for experimentation across a broader empirical platform; covering a wider array of professional and educational practices.

7.5. SUMMARY

Returning to the question of whether it is possible to utilise, and evaluate the effects of innovation capacity in a meaningful way, the answer is slightly more complicated than a simple yes or no.

That said, I will venture a careful *yes*, albeit with the following caveats. The main one being that it depends on what you want to evaluate! As discussed above, a necessary pre-requisite for a precise evaluation is a precise programme-theory outlining not only what is being done, but also the expected outcome. This in turn requires close and direct contact between the educational and professional practices involved; allowing for analysis of the professional practice along with careful translation of the resulting elements.

While this is certainly possible, there is often greater incentive to simply focus on the top-down requirements pushed by the governing entity and rely on their ability to provide the relevant educational elements. This form of evaluation is much more simple and often directly linked to the educational institution's perceived performance, which in turn relates to its financial platform. In other words, it is meaningful within the government practice.

However, if the abductive and mutable nature of innovation capacity is accepted, this method alone simply does not provide the level of iteration or the detail of reflection required to cultivate and utilise it in a meaningful way within professional practice.

Accepting this perspective on innovation and innovation capacity, implies a need for a bottom-up approach as a supplement to the existing top-down one. The principles of theory-based evaluation discussed above seem well suited to this purpose.

CHAPTER 8. THE DIDACTICS OF INTERDISCIPLINARY LEARNING

This chapter addresses the following, technical, sub-question (3) from section 3.1.1:

> What is required of educational institutions to facilitate the generation and application of student innovation capacity in an interdisciplinary context?

The sub-question is addressed directly in *publication #2: Developing apprentice skills for innovation through interdisciplinary training and education*, and *publication #3: nKNOWation – an interdisciplinary collaboration between two North Jutland commercial schools on welfare technology.*

The points discussed in this chapter, as well as in the publications referenced, are based in the empirical work I have taken part in throughout the project. These are described in more detail in section 5.4 and the data collected during participation is supplied for reference in the companion data package. The data not subject to a privacy statement, privacy laws or any ethical considerations can be made available to fellow researchers on request.

8.1. DIFFERENCES BETWEEN UNIVERSITY AND VOCATIONAL PROGRAMMES

The main focal point of the foreground empirical process has been an attempt to adapt and translate the experience gained through participation in the background process initiatives to vocational education. Since most students attending these programmes seem to gain employment in micro-enterprises, this process has placed emphasis on what innovation capacity could mean in the context of these types of enterprises. Not least because they appear to represent a disproportionately large part of the Danish corporate landscape compared to how little attention they are given in the innovation literature (see publication #4: Enabling consistent innovation in micro-, small and medium enterprises. Innovation strategy and competitiveness - a dynamic perspective, section 2).

This has caused my attention to shift from focusing solely on teaching concepts such as creative thinking (Hansen & Byrge, 2008; Tanggaard, 2008), design thinking (Brown & Katz, 2009; Martin, 2009) and co-creation (Scharmer & Senge, 2009) to include such things as strategic thinking (Faulkner & Campbell, 2006; Mintzberg & Hunsicker, 1988; Porter, 1996), competitiveness (Manral, 2013; Porter, 1985;

Prahalad & Hamel, 1990) and value creation (Clarysse, Wright, Bruneel, & Mahajan, 2014; Porter, 2008; Prahalad & Krishnan, 2008)[17].

This shift towards vocational education and micro-enterprises highlighted a significant difference between the university-level workshops I have been a part of, such as Wofie, U-CrAc and Solution Hub, along with the one for which I was involved in the design. Where the university workshops were full of students eager to participate in what was, for the most part, an elective for extra credit, their vocational counterparts displayed an astounding lack of interest. Although, this is not the only reason behind the decision, the vocational workshop was quickly made mandatory. Despite the threat of extra written exams for students failing to participate, roughly 20%[18] decided to stay away during the pilot workshop in 2012. Classroom discussions with students before every iteration of the workshop has yielded similar attitudes (see nKNOWation questionnaires 2015 & 2016); the students are not opposed to the idea, but feel it is a waste of time for them because a) they are not innovative, and b) they do not have any desire to become entrepreneurs[19], regardless of whether we think they are innovative. There are slight differences of attitude among technology students (software development, network infrastructure & industrial operations technicians), and some construction trades (carpenter, metal worker and electrician). The former did not tend to see themselves as entrepreneurs, but were more likely to consider themselves innovative. The latter had the opposite perspective. They did not consider themselves innovative but many were already considering starting their own company at some point.

Common for them all, was a distinct lack of enthusiasm for the interdisciplinary workshop format. They were told about the workshop well in advance of it being held. This was an attempt to create a sense of excitement and alleviate any anxiety students may have about participating. Reactions ranged from indifference (*the majority*) to anxiety attacks at the prospect of being forced to work together with total strangers, and aggressive indignation at being made to "waste their time on such nonsense" (see

[17] The references given here are simply examples of works that have influenced my perspective in these areas. A more thorough review of the literature in these fields along with how they have shaped my perspective on innovation can be found in *publication #4: Enabling consistent innovation in micro-, small and medium enterprises. Innovation strategy and competitiveness - a dynamic perspective*.

[18] There is no formal data from this event. The number listed is estimated based on personal notes and talks with members of the steering committee present during the pilot workshop.

[19] The term entrepreneurs is not used in the Schumpeterian sense in the evaluations, but simply to mean willing or interested in starting a business, and thus *running an enterprise* of some description.

publication #3: *nKNOWation: an interdisciplinary collaboration on assistive technology between two North Jutland vocational colleges*).

Surprisingly, several of the educators from the various educational programmes shared many of these sentiments, although they were more diplomatic when expressing them.

Originally, the intent was to mimic the model developed at Wofie of sharing the cost of the workshop across participating programmes by having educators from each accompany their students. In a vocational setting this would mean that the educator scheduled to teach the participating class of between twenty and thirty students when the workshop was held would simply accompany his or her students and act as a facilitator instead. They were of course offered (later made mandatory) thorough instruction beforehand, and no novice facilitators were left on their own; they were always placed in a cluster with one or more experienced facilitators.

This is a simple, tested model that eliminates the need for complex time management and potential invoicing between departments. However, when first attempted in the vocational setting it quickly became necessary to hand-pick educators from the different programmes; to the extent that many of the classes selected to participate were selected according to which educators were scheduled to teach them.

Fortunately, this initial scepticism has lessened over time following positive word of mouth comment from students and educators alike who have had a positive experience participating. This relates to one of the most notable results of the formal evaluations in 2015 and 2016. Where almost all students are indifferent to participation beforehand, but over 80% report that they would like the opportunity to participate in similar workshops on a regular basis throughout their education (see publication #3: *nKNOWation: an interdisciplinary collaboration on assistive technology between two North Jutland vocational colleges* & Data: nKNOWation 2015, & nKNOWation 2016).

This dynamic demonstrates the apparent positive change of attitude during the later iterations of the nKNOWation workshop. Most start out negative or indifferent and they do not consider themselves innovative or potential entrepreneurs. Conversely, at the end of the workshop somewhere between half and two thirds of participants report having a positive experience, and feel the workshop was relevant to their education. This seems to have a contagious effect on future participants, since we gradually experience less negativity toward the workshop in concert with more and more students having heard of it from friends. The same is true, although to a lesser extent, of the educators. For the 2016 iteration, some even volunteered, saying they had heard about the workshop from colleges and were interested to try it themselves (see Data: nKNOWation 2016, nKNOWation 2016 Spørgeskema [parts 1&2]).

This also seems to indicate, that there is a fundamental need to change the attitude found among vocational students, and their educators, who in many ways are indicative of the professional practice in their field. Unless there is a change of some sort, it is possible that these students would never pursue any form of innovation initiatives; even indirectly, such as hiring someone with relevant competencies to aid with developing their business. For example, projects such as Akademikerkampagnen[20] that helps businesses find and hire unemployed academics for a trial period of three months at extremely favourable rates (since they are supplemented by the government and unions). Initiatives such as this have shown favourable results among businesses that have used them (DAMVAD Analytics, 2015, pp. 9–14), but they are still dependant on a fundamental belief that their businesses can and should attempt to innovate, or at least seek new areas and methods of development and growth.

In that vein, an area that remains a challenge, and which has not changed over time, is getting companies and other external parties to participate. It is not difficult to engage external parties with an interest in the theme of the workshop; many are eager to participate, and return in different capacities year after year. However, very few represent the micro-enterprises, which many of our students will go on to seek employment with. Most simply state that they are not interested or do not have the time when approached. Whether this is because they share the student's sentiment, that they are not particularly innovative and, therefore, that it would be a waste of time to participate or simply because they do not have the time or resources to do so is not known. However, it is reasonable to assume that both have a share of the reason. Tackling this issue is a main theme in publication #4: Enabling consistent innovation in micro-, small and medium enterprises. Innovation strategy and competitiveness - a dynamic perspective.

8.2. EXPERIENCES GAINED FROM NKNOWATION

Aside from the initial differences in attitude towards innovation between university and vocational students, many of the same experiences are expressed across the different workshops. These take the form of main areas where the workshops differ (both positively and negatively, although they are almost all mentioned in a positive sense) from the student's everyday educational activities, i.e. normal classes, project work, lectures etc.

Only background and foreground initiatives that are similar in format and purpose are compared here. In this case, all are variations on interdisciplinary, problem-based innovation workshops. The differences are summarised in the table below along with the data types on which they are based and my role in the initiative:

[20] See http://www.akademikerkampagnen.dk/ (Website in Danish)

Educational initiative	Role	Data types	Summary of experienced differences
Wofie	Steering Committee Facilitator	Participation Observation Evaluation Interviews	Interdisciplinary Real-world problems External Experts
Solution Hub	Steering Committee Facilitator	Participation Observation	Real-world problems Close business collaboration
Innovation and business development camp	Facilitator	Participation Observation Evaluation Interview	Interdisciplinary Myers Briggs Test Real-world problems Intensity
U-CrAc	Observer	Observation	Interdisciplinary Real-world problems Close business collaboration
Welfare Cluster	Design Team Steering Committee Facilitator	Participation Observation Interviews	Collaboration across vocational and academic disciplines Real-world problems

nKNOWation	Design Team Steering Committee Facilitator	Participation Observation Evaluation Interviews	Interdisciplinary Real-world problems External Experts Intensity

Figure 9: Differences between innovation workshops and everyday educational experiences

The fact that all, one way or another, specify *interdisciplinary* as a difference is unsurprising in this case since all the workshops were specifically designed to be so. However, it is of note, that it is almost always referred to as a positive difference. Even regarding Welfare Cluster and nKNOWation where none of the students have freely chosen to participate. Despite some initial trepidation and occasional frustration, it seems that interdisciplinary group work is generally seen in a positive light. In the one case (Data: Innovation og Forretningsudvikling 2013) where each student was presented with a Myers Briggs personality type assessment to serve as a reflection tool and aid them in their group collaboration all students viewed this as very helpful. However, only one group had expressed any difficulties in their group before they were given their assessments. While all groups may have benefitted from the tool, it seems most were quite capable of collaborating without it.

The next difference, and probably one of the most significant in nKNOWation evaluations, is the fact that students collaborate on real-world problems in which the external participants have a genuine interest. This is only mentioned in a positive fashion across all the data. It is considered a strong motivating factor for two main reasons: firstly, it helps the students realise that they do indeed have something to offer and secondly, it gives meaning to what they are doing because their work could potentially make a difference in the real world.

The specific problems with which the students work could, in principle, be anything. Interdisciplinary learning does not set any limits in this regard. Moreover, by its very nature it presents the opportunity to allow students to reflect on their intra-disciplinary skills (and limitations) by allowing them to work on problems that have no relation to their industry affiliation.

In practice, themes are selected based on relevant industry or societal (grand) challenges in accordance with goals specified in the national innovation strategy. Apart from creating a motivational effect which in itself can be linked to innovation (Christensen, Horn, & Johnson, 2008, pp. 6–10) it also serves to integrate industry (professional practices) directly into the educational process.

Doing so allows for student reflection on the usefulness of their skills, potentially more so than if they were working on a fictional problem, but also promotes direct student-industry interaction in the hope that the interdisciplinary synergy will produce ideas or solutions that are directly applicable to the problems with which the external participants are concerned. This in turn serves as a possible explanation for the reason why external experts are listed as an overall positive difference. They serve as a manifestation of the 'real-world' and thereby, a tangible reminder that the work being performed is not fictitious or irrelevant.

From the perspective of industry, it is a cheap and non-comital method of ideation which will bring new ideas, perspectives and areas of interest to the attention of the participating organisations.

The actual value created through this focus on real-world problems is debatable since it is hard to evaluate unless participation is the result of a well formed strategic initiative by the organisation (See publication #4: *Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective*, publication #1: *Evaluating innovation capacity in vocational education* & Chapter 7). So far this has not, to my knowledge, been the case, meaning the results may not be entirely as intended in the national strategy. However, although this does not influence the perceived value of the interdisciplinary learning experience either way, it can still potentially enhance it in a variety of ways.

Similarly, returning to an industry perspective, even though participation is more ad-hoc and not part of a strategic innovation process it will still serve as a form of cross-pollination (T. Kelley & Littman, 2004, pp. 49–51), which can be justified as such or branded as a form of altruism / societal responsibility, since, no matter what the outcome, it will always be a mode of supporting educational initiatives and thereby investing in our collective future.

The final difference expressed, concerns the perceived intensity of the workshops. Since all the workshops are designed to run over a set amount of days, back to back, the students often indicate that the participatory experience seems more intense than simply attending a class or participating in regular group work. This is despite the fact, that most of the workshops mentioned above only run for the duration of a standard school day; typically, from 08:30 until 16:00 at the latest.

The exception to this is the innovation and business development camp, which runs non-stop for approximately 32 hours. It is no surprise, that students experience this as more intensive than their regular classes. Even though the course targets university students who can be considered fairly used to intensive sprints before handing in semester projects etc.

What is interesting about the experienced intensity is the fact that the only other students who made more than off-hand comments about it were the vocational students participating in nKNOWation. This is by far the most relaxed of the workshops mentioned with the Innovation and Business Development Camp being at the other extreme. It runs over three days from 08:30 to 15:00 with an hour for lunch every day. Also, since the participants are generally not used to this type of work and are often less motivated to begin with, an effort is made not to put too much pressure on them too quickly.

Even so, it is widely regarded as being more intense than what they otherwise experience during their education. This is not given as a negative comment about the workshop. On the contrary, it is positive, with the typical comment being that it is *more fun*, and they *want to keep working* (see nKNOWation evaluations*).* This could simply be due to the fact, that the workshop represents a break from the usual, or a result of it not being a format with which they are familiar. Whatever the case, it would suggest, that doing essentially the same thing for several days on end is not necessarily a bad, or boring, thing. It can, in fact, be more engaging given the right circumstances.

A working hypothesis explaining this could be, that problem-based learning helps create a more immersive experience, which students at Aalborg University are more accustomed to, due to the integrated PBL element in the Aalborg Model (Armitage et al., 2015). Thus, they only experience this dynamic as more intense than usual when it is taken to an extreme as with the I&BD course. For students not similarly accustomed to PBL to the same degree, nKNOWation would conceivably seem more immersive, allowing uninterrupted focus on a single problem. In this thesis, however, I have not delved deeper into this dynamic, but simply note that there seems to be a link between intensity / immersion and motivation, which is stimulated in this type of educational format. This intensity can also be taken to an extreme without it having a detrimental effect. While it would certainly be interesting to explore this dynamic in more detail, to do so falls outside the scope of this project.

It is also worth noting, that the differences expressed by students participating in the initiatives mentioned in Figure 9 on page 88 appear to be in line with the perspectives on innovation competencies or requirements expressed in the literature on the subject.

While this is by no means an extensive or particularly structured literature review, it does suggest, that the PBW format does not stand in stark contrast to what can be considered innovation competencies. On the contrary, it would appear to support them to various extents.

In the table below, the main points from the literature used in this and previous chapters are shown together with the findings from the evaluation of nKNOWation in the foreground empirical process described in chapter 5.

Reference	Areas of focus
nKNOWation (Christian R Haslam, 2016; Christian Ravn Haslam et al., 2016)	Interdiciplinary, Immersive, Real-world problems, collaborative, Involves external parties
Tangaard (Tanggaard, 2008, p. 39)	Longer, uninterrupted, work periods, Equal focus on process and product, Risk and experimentation encouraged / rewarded, Collaborative, learning process supports production, observation and reflection equally, Self-assessment and peer-assessment encouraged
Van de Ven (Ven, 1999)	Process supports switching between Learning by discovery and Learning by testing.
Clayton et. al. (Christensen et al., 2008, pp. 7–9; Dyer et al., 2011, pp. 23–25)	Motivation, Observation, Networking, Experimentation, Courage (to experiment)
Yams (Yams, 2016)	Combining competencies within the areas of Exploration (content), Interpersonal, and Intrapersonal skills in an innovation practice.

Figure 10: nKNOWation findings compared to selected literature

Although the terminology varies, there does not appear to be a huge disparity between the points focused on in the various works listed above, and those observed during nKNOWation. While it is entirely possible that there are many other perspectives about innovation competencies, the ones observed in Figure 9 are not outliers, and the PBW model seems to support them.

8.3. ALTERNATIVES TO THE WORKSHOP-BASED MODEL

The format discussed in this thesis is almost entirely what I have referred to as Problem-based Workshops or PBW. This model is highly useful in a didactic sense since it allows for uninterrupted project work while being practically and administratively accommodating in terms of involving students from different educational programmes and institutions, and engaging external parties to participate. Spreading the workshop over a few hours twice a week would not give the same degree of immersion and focus, nor would it be as simple administratively speaking.

This is not to say that it is the *only* model that works. It is one model that works, and has done consistently, when the goal is to combine a high degree of interdisciplinarity with external parties and (real-world) problem-based group work. One potential issue with the format's success is that it has not created a need for experimentation with other models; at least not yet. That said, interdisciplinary workshops have also largely been considered as extra-curricula, or otherwise out of the ordinary. While it would certainly be possible to integrate several workshops of varying shapes and sizes into most curricula there is still a need for variance and less cumbersome models.

A large part of the practicality of problem-based workshops is, that it is a format which combines several of the traits that are either motivational, serve a direct purpose in relation to the innovation strategy or are linked to innovation in the literature.

For example, the (real-world) problem-based nature of the workshops is mentioned in the evaluations as a significant motivational factor (Data: nKNOWation 2015 & 2016), but also serves as a method of utilising innovation capacity to solve real problems as specified in the innovation strategy (The Danish Government, 2012, p. 11).Similarly, some examples of desired traits in innovators are *motivation* (Christensen et al., 2008, p. 7), *Questioning*, *Observing*, *Networking*, *Experimenting* and *Courage* (Dyer et al., 2011, pp. 23–30). Motivation has already been mentioned, and I would argue that it is reasonable to assume that the others are also stimulated or developed to various degrees throughout the PBW format. The students are certainly encouraged to question each other, themselves, and all third-parties present. They observe existing solutions, customer needs, viable technologies and other groups' ideas and solutions. Networking with peers from different fields, and external parties alike, is hard to avoid entirely and easy to over-do if desired, given the sustained proximity of all involved. Experimentation is encouraged and a point is often made to celebrate failure rather than lament it. Celebrate that you have learned something and move on, is a common mantra that has the explicit purpose of building the courage that goes with experimentation.

It is certainly convenient to be able to combine several traits into one practical bundle in this way, however, none of these traits are in any way restricted to a certain didactic method. Nina Bozic Yams from Mälardalen University in Stockholm is currently

conducting research into a model for competencies in relation to innovation, which could be used to develop and evaluate didactic methods in relation to integrating innovation training into a wide variety of educational activities and formats (Yams, 2016). While her research is ongoing, there is certainly nothing that suggests that PBW is unique in any way. It simply allows for a grander scale of projects and easier external involvement.

Designing small-scale projects that address real problems, stimulate collaboration, allow for experimentation or train communication skills is no more challenging from a didactic perspective than what already goes on in most educational institutions. Although doing so with the specific purpose of stimulating innovation competencies in students may be. Most Danish educational curricula still describe innovation only as a separate course, which is possibly one of the reasons for the workshop format being relatively simple to implement from an administrative point of view. Integrating the same ideas consciously into a wider selection of courses and initiatives requires more effort across a broad spectrum of faculties and staff.

This makes it initially less attractive from an organisational point of view while, from a pedagogical point of view, the consistent and increased focus on these competencies raises the possibility of continuously re-enforcing the effects of above mentioned workshops.

To truly become a nation of innovators and cultivate innovation capacity across a wide range of educational types and levels it is necessary to integrate, among other things, the ideas and principles identified here into as wide a range of courses and educational programmes as possible. This will certainly require many courses and didactic methods to be re-designed in some way to accommodate these ideas more directly.

These changes are not necessarily particularly challenging from a pedagogical/didactical point of view, but will require educators to shift attention (supported through policy) to these competencies and be given time to experiment and implement whatever changes they feel necessary.

8.4. SUMMARY

In summary, work within both background and foreground empirical processes suggests that there are several differences between more common forms of education found today, such as classroom teaching, lectures and group work, and what has be categorised here as Problem-Based Workshops. It also indicates that these differences are well suited for developing innovation competencies described in a selection of publications on the subject.

Comparing these perspectives also shows that there is at least some consensus about which types of general skills or competencies, across professional practices, are

relevant to try and develop in students if they are to constitute some form of innovation capacity.

The PBW format also allows administratively for easy integration of external parties along with more intense focus on real-world problems. This makes the format an ideal platform for bridging the gap between professional and educational practices; providing a means to aid translation between them. This goes both ways, not only serving as a means to utilise student innovation capacity in the context of professional practice, but also helping pull relevant elements from professional practice into educational practice.

However, it also becomes clear, that Problem-Based Workshops are not enough on their own. Firstly, the mastering of all skills requires training and practice. This goes for things such as collaboration, curiosity, creative problem-solving and reflectivity just as much as it does for any other skill. Having students participate in one or two extra-curricula workshops throughout their formal education is no doubt better than nothing, but probably far from enough to effect lasting change.

Secondly, one major issue with vocational students in particular is that they do not see themselves as potential innovators. This reflects an attitude that must be changed if any other initiatives are to have a lasting effect. If they do not consider themselves innovators it will be extremely difficult to get them to engage in any future initiatives trying to help with, or promote any form of innovation. Even if they personally lack interest in the innovation process itself, if they see innovation as part of their professional identity, they are more likely to seek these skills elsewhere; through networks, partnerships or hires. If innovation is not seen as even a small part of their professional identity, why would they even consider it in anything but desperation?

The strategic perspective on innovation presented in publication #4 is only viable if there is an attitude of interest and opportunity in the first place. Assuming the attitude displayed at the beginning of nKNOWation is in any way representative, there is a need for greater integration of the above mentioned differences into more common forms of education to reinforce the skills and principles throughout all types and levels of formal education.

Achieving this does not seem to represent any particular pedagogical or didactical challenges, but mainly practical and organisational ones.

CHAPTER 9. RE-ORGANISING EDUCATION FOR STUDENT-DRIVEN INNOVATION

This chapter addresses the final, organisational, sub-question (4) from section 3.1.1 which reads:

> Which implications are related to educational institutions adapting their organisation to better enable them to effectively facilitate the use of student innovation capacity?

As described in chapter 3 this question is not addressed empirically, but rather as a summarisation of elements discussed during the treatment of the previous sub-questions. These elements are each discussed in the light of their potential organisational implications within the areas represented by each sub-question.

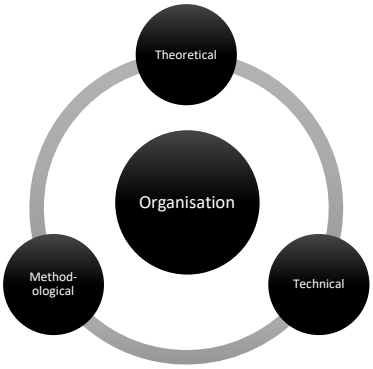


Figure 11: Organisation in relation to the previous research elements

In other words, the question of organisation is viewed as the organisation of elements from the theoretical, methodological and technical dimensions. Highlighting the practical implications of synthesising these into educational practice; specifically, in the context of vocational education in Denmark. Given this perspective, all the included publications along with all the discussion of previous sub-questions are in principle relevant to the organisational question, since it is concerned with bringing these parts together in a practical sense.

This question also re-visits the extended practice model presented in chapter 7 on page 78. For ease of reference the model is also included here; albeit in simplified form, excluding the feedback loops pertaining to its use in an evaluation context.

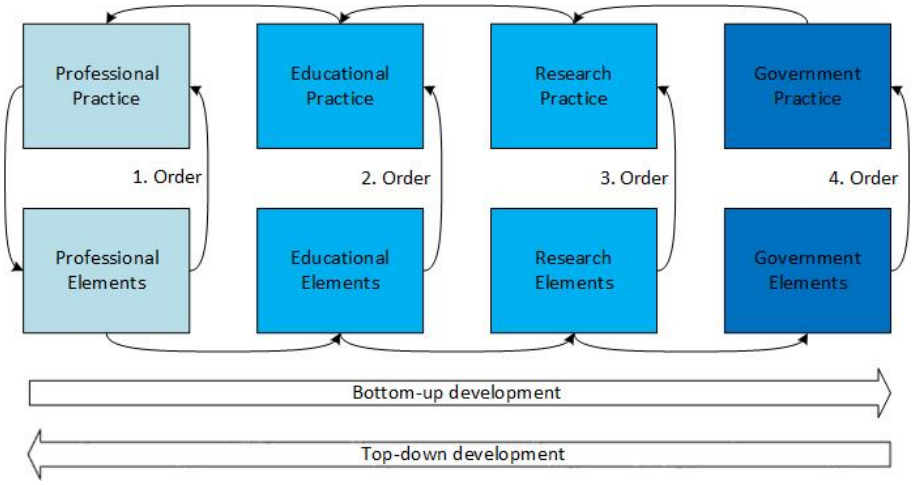


Figure 12: Extended practice model (organisational context)

In this context, the perspective is from within the educational practice, which is subject to top-down goals and limitations pushed from within the government rationale. It is also, as previously discussed, ideally subject to varying and dynamic bottom-up goals pulled from the professional practices with which it is concerned. These forces are inclusive but not necessarily complimentary by nature. This creates an organisational environment where different goals must be identified according to their purpose or underlying rationale and treated accordingly. However, all goals are not equal and, as mentioned, not necessarily in harmony with each other.

Directives and goals stemming from the government rationale are typically much harder to work with. They require representatives from the educational practice to enter into the government practice or its discourses which, typically include representatives from many other interest groups affected by the policy in question. This process can take many forms: advisory boards, lobbyism and formal channels for feedback, complaint etc.

Influencing the government practice is slow and time-consuming work that can have unpredictable results. It involves many actors representing many interests as well as being subject to an underlying, periodically changing, political rationale with its own set of goals to achieve. While it is certainly possible to affect these top-down goals and limitations, for the most part it is necessary to contend with them, at least temporarily. Top-down goals and limitations are not normally debatable; they are generally legally binding, meaning that they will take precedence over anything *pulled* from professional practice. In general terms, the broad national interests take precedence over any specific local ones.

Luckily, the national interests are supposedly representative of the various professional ones found locally. Similarly, the national goals are typically more general since they must take greater diversity into account. However, this does not change the fact, that where disparity does exist, government practice will usually[21] always need to be adhered to regardless of anything else.

This organisational balancing act between two independent forces, each pushing and pulling towards potentially different goals is represented within the theoretical understanding of innovation presented in this thesis. It allows for different legitimate understandings to co-exist and be meaningful within their respective rationales (see Chapter 6 & Publication #4: *Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective*).

Furthermore, the abductive nature of this theoretical understanding of innovation simultaneously increases the need for some form of reflective loop, integral to the process focusing on translating elements from professional practice. Only general innovation competencies are known beforehand (to a certain extent at least, see Chapter 8) whereas the specific innovation elements of a specific practice at any given time and location will more likely be *discovered* interdependently with the practice itself. This, in turn, requires a method of evaluation that allows for an abductive process.

As described in chapter 7 and publication #1: *Evaluating innovation capacity in vocational education*, the notion of theory-based evaluation can be used in this regard. However, this mode of evaluation requires some degree of strategy on the part of the educational institution. If it is not possible to describe the process in detail: its intentionality, actions performed, actors involved and expected results, it will not be possible to perform a meaningful evaluation, thereby limiting reflection and the process itself (see publication #1).

Similarly, without a clear idea of the desired results along with an understanding of the professional practice in question, it will be difficult to design educational initiatives through which to attain them. Thereby, limiting ourselves to only working with innovation in general terms. While this is certainly better than not at all, it only satisfies half of the theoretical perspective on innovation (top-down).

In principle, these implications are precisely the same as those put forward in publication #4 which is concerned with strategic design of innovation processes. From an organisational perspective, this understanding of innovation not only implies that

[21] I am speaking in general terms here. There are of course situations where dispensations can be made, however, under normal circumstances national interests will take precedence over local ones.

we should teach students to apply the principles of strategic innovation, but also that doing so is itself a strategic innovation process subject to the same principles and uncertainties.

From an organisational point of view, this presents some practical challenges. Vocational colleges already have an established platform for collaboration with professional practice which can be adapted and utilised in response to many of the implications mentioned above. However, this platform also represents some complications. Due to the nature of apprenticeship, vocational students are, first and foremost, employees which means that educational institutions are required to seek approval with the employer for any activity pertaining to their apprentices which is not part of the formal (top-down, governmental) curricula. While flexible curricula descriptions allow for a certain degree of interpretation by the educational institution, activities involving other external participants, or not easily relatable to the specific vocation in question, risk being vetoed by the employer.

This dynamic potentially increases the administrative burden and risk of failure when developing new workshops and similar initiatives. Since many of the employers share their apprentices' initial sentiment, that innovation is not part of their professional profile, getting them to approve more time being allocated to it can present a challenge. Although the platform is already in place, utilising it for close collaboration on innovation will require it to be adapted to this purpose.

The main problem being, that neither the vocational colleges nor the enterprises employing apprentices have much incentive to prioritise already scarce resources on something as uncertain as innovation. The required goals pertaining to innovation as defined in the curricula (see data: EUD Målepinde og Uddannelsesordning 2015) can mostly be achieved with little fuss through a simple one-week mono-disciplinary class. Doing anything more than this requires some form of strategic leap of faith on the part of the educational institution; leading to the allocation of resources and an attempt to develop the nature of the existing collaboration platform.

While the PBW model allows for much of this required interaction with professional practice within the current framework dictated by government practice, it cannot conceivably meet all requirements on its own. As mentioned in chapter 8 there is a need for more initiatives, more closely integrating elements of innovation into different aspects of educational practice. This would also imply a need for increased collaboration with external parties that requires other ideas and models besides PBW's to support it. Without a strategic decision to pursue these ideas moving beyond occasional extra-curricula workshops present a significant challenge.

In summary, the main organisational challenge within Danish vocational education would seem to be recognising that student-driven innovation is a worthy strategic pursuit and prioritising initiatives to develop their collaboration with professional

practice. Interaction with both professional and government practices are already established but can only reflect issues related to student-driven innovation once this is part of the institutions strategy. From there new ideas and initiatives can be explored and experimented with.

CHAPTER 10. CORE FINDINGS

In this chapter, I present a brief recap of my work along with a summary of my findings throughout this Ph.D. research project, and discuss what I consider to be my contributions to the field of student-driven innovation as it is described in chapter 2.

My area of interest is student-driven innovation in vocational education, along with its application in, among others, micro-enterprises; both in a Danish context. While there have been several initiatives experimenting with the cultivation of, what I consider, a form of innovation capacity, none that I am aware of targeted or even included vocational education prior to this project. Innovation capacity and what I refer to as interdisciplinary problem-based workshops were primarily the domain of post-graduate university students, and to some extent graduate students from university colleges.

This also, presumably unintentionally, had the effect of excluding many of the micro-enterprises which primarily exist within the vocational segment, and happen to make up the majority of the Danish, and to a certain extent European, corporate landscape.

These enterprises are not purely start-ups, and are not founded on the basis of doing something new or particularly different. Similarly, they do not necessarily have organisational growth as a strategic goal. They are often founded out of a desire to attain the freedom associated with being your own boss while being able to maintain a comfortable living doing something you enjoy.

That being said, my experience interacting with enterprises such as these, revealed that many were acutely aware that simply doing the same thing, providing the same products or services in the same geographical area, was not a particularly secure business plan. However, only a few had any practical sense of what to do to alleviate the situation; typically, they did not consider themselves innovative and even if they did they were still unsure as to what they should actually do in a practical sense.

I have met many such enterprises attending a variety of workshops, networking sessions and innovation camps (see data: Wild North Workshop November 2014 as an example). Most did not have a clear idea as to what they expected to gain from participation and a common complaint was along the lines of, that if something did not happen soon they would simply stop attending these types of initiatives since they were costing them too much money with no returns. In other words, many were participating in networking sessions and similar, in the hope that they would stumble into a revenue generating opportunity of some description.

These experiences are what prompted my interest in a theoretical perspective on innovation which could help de-mystify the process. Providing a platform of sorts

which could aid enterprises, including micro-enterprises, work strategically with innovation and thereby select and prioritise actions including participation in such events. This is the subject of publication #4: *Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective.*

Simultaneously with developing this interest in micro-enterprises which has shaped my overall perspective on innovation, I have focused on adapting PBW initiatives from university to vocational education.

Experimenting with the nKNOWation and Welfare Cluster initiatives has given insight into the value this mode of educational initiative can provide. It has also provided practical, organisational experience and demonstrated some of the differences between university and vocational students in regard to their general attitude towards innovation. Publication #2: *Developing Apprentice skills for innovation through interdisciplinary training and education* and Publication #3: *nknowation: an interdisciplinary collaboration between two north Jutland commercial colleges on welfare technology* focus specifically on these aspects of my work. However, the main findings in this regard can be summarised as follows:

- The precise mix of vocations and disciplines does not seem to have a significant impact on either the results or process during a PBW session.
- Mixing students from different levels (upper-secondary to post-graduate) and stages (years in) of education does not seem to impact results or process significantly. Although there may appear to be an initial hierarchy between educational levels the groups process appears to minimise this over a short period of time.
- Vocational students are much less enthusiastic than their university counterparts in regards to participation in PBW initiatives. While university students often see it as a relevant extra-curricular activity, vocational students initially view it as time that would be better spent on developing practical skills (which they consider useful). However, after participating in a workshop for a short time most vocational students appear to change their mind, indicating they feel there should be more PBW initiatives during their education.
- Working on real problems either with or on behalf of representatives from real businesses or organisations which are invested in these issues is a central and significant motivating factor.
- Although far from all ideas generated during a PBW initiative are directly applicable as solutions within the selected problem area some are. Even those that are not seem to be useful as an indirect source of inspiration to participating industry representatives, of whom most state that they feel they are gaining some form of value by participating.

- The immersion provided by an uninterrupted, multi-day workshop is generally seen as a motivational factor.
- The majority of vocational students appear to change their attitudes towards innovation and entrepreneurship during the 3-day nKNOWation workshop; from not seeing themselves as potential innovators to saying they would like to pursue more innovation projects and would consider starting their own businesses.

While working on adapting and running the above workshops for vocational education, a recurring and persistent problem was that of evaluation. It quickly became apparent, that the term evaluation can be quite charged in the sense that it can be used to serve many purposes. Thus, the idea of what constitutes a meaningful evaluation caused a distinction between not only different types of evaluation, but also the various rationales underlying the purpose the evaluation is meant to serve. In combination with the ideas being developed on strategic innovation mentioned above, this led to a highly dynamic understanding of innovation; meaningful and valuable primarily within its own rationale.

This also made it apparent, that the positivist/empiricist definition of causality was far too simplistic to form the basis of meaningful evaluation concerning innovation. Innovation processes often involve many actors engaged in complex sequences of incidental events and intentional actions over arbitrary periods of time. Moreover, the dynamic understanding above infers that the meaning and significance of these processes depends on the perspective of the rationale within which they are viewed.

This lead to a model and understanding of evaluation, in the context of innovation, to be based in critical realism and the concepts of realist evaluation (see Chapter 7). These thoughts along with a theoretical framework for conducting this type of evaluation within the context of a dynamic understanding of innovation is the subject of publication #1: *Evaluating innovation capacity in vocational education*.

10.1. CONTRIBUTIONS

Of the findings discussed above, I consider my contributions to the field of student-driven innovation to be the following:

- Focus on innovation in vocational education and micro-enterprises. (see publications #1, #2, #3 & #4)
- The fundamental understanding of innovation along with the base framework and perspective for evaluating innovation (see Chapter 6, Chapter 7 & Publications #1 & #4). Specifically, its focus on both strategic and analytical applications (see publication #4). The former drawing parallels to strategic design processes.

- The extended evaluation model describing the educational practices relation not only to professional practice, but also research and government. This forms the basis for planning, organising and evaluating educational initiatives for student-driven innovation (see Chapter 7, Chapter 9 & Publication #1).
- Documenting a series of initiatives specifically targeting vocational students and generating data suggesting that these initiatives are applicable at this level and appear to positively affect vocational student's attitude towards innovation and entrepreneurship (see Chapter 8, Publications #2 & #3).

Together, these contributions expand upon the concepts presented in chapter 2, either by adding theoretical framing to the idea of student-driven innovation, outlining a methodological framework for implementing and evaluating initiatives, or presenting the results of experimentation within the area of vocational education as a platform on which to build and design new initiatives.

10.2. REFLECTIONS AND PERSPECTIVES

As is the case with all research projects, there are certain things that, had I been aware of their possible significance at the time, I would have liked to do differently. Similarly, many of the findings presented above give rise to new questions and avenues of inquiry. In the following, I will briefly discuss a few of these which would be interesting to pursue. I have split these into two distinct areas, the first concerning further research into interdisciplinary problem-based workshops, and the second, into research with other, non-PBW, educational initiatives.

<u>On nKNOWation and further PBW research:</u>

While working on the nKNOWation programme it would have been particularly useful had I had the foresight to implement a full programme-theory early on to allow more uniform evaluation and practical tests of the evaluation and theoretical model. Of course, I was not aware that I needed a programme-theory at the time, so this is not too surprising. However, the lack of one has limited the possibilities for testing the ideas presented in this thesis fully. Happily, this will be remedied beginning in autumn 2017 nKNOWation workshop, and a full programme-theory is currently being developed specifically for that purpose.

Similarly, it would be interesting to re-visit the idea of utilising psychological profiles as a collaboration tool like the Innovation and Business Development Camp in 2013 (see data: Innovation og Forretningsudvikling 2013, DM650008). During evaluation, this concept was singled out by many of the (university) students as one of the most useful aspects of the workshop. Whether it is a good idea to attempt something similar in a vocational context, and if so *how* and *what* are questions it would be interesting to explore further. So far, this idea has raised some ethical concerns as well as practical

problems. Time being the most significant problem, since approaching such an undertaking in an ethical and professional manner would require private one-on-one sessions with all the approximately 200 students participating. For this reason, along with the observation that groups' processes seem to be functioning rather well on their own, it has not been pursued further.

On research into non-PBW educational initiatives:

As mentioned in the previous chapters, the theoretical perspectives I put forward in this thesis indicated, there is a need for closer collaboration between professional and educational practices; beyond what Problem-based Workshops on their own can accomplish.

While I have not had the opportunity to do so during this project, it would be interesting to begin exploring ways to develop the pre-existing relationship between professional and educational practices found in vocational colleges. Similarly, experimenting with ways to integrate elements identified in professional practice directly into educational practice in various forms; such as, regular courses, group projects and similar. Potentially, in some cases, beginning to design courses or workshops in direct collaboration with representatives from professional practice.

While these areas are beyond the scope of this thesis, they would be interesting avenues of inquiry to explore in future.

CHAPTER 11. CONCLUSIONS

Throughout this thesis, I have sought to answer the following main research question:

> How do interdisciplinary educational initiatives affect the generation and application of students' innovation capacity, and what are the organisational implications of these types of initiatives for educational institutions?

To do this, the research question was broken down into individual sub-questions each examining a different aspect of the main question. These were the theoretical, methodological, technical and organisational aspects, which were discussed based on the publications submitted with this thesis in chapter 6, chapter 7, chapter 8 and chapter 9 respectively.

Before addressing the main research question directly, I will first summarise the main implications presented during the treatment of each sub-question.

Theoretical RQ: How is it advantageous to understand the terms interdisciplinary and innovation capacity, so they may be operationalised and applied in a meaningful way in both an educational and professional context?

A dynamic and abductive understanding of innovation implies that the national strategy only represents the general (top-down) innovation goals, which are so abstract as to be theoretically applicable within every practice. This must be supplemented with a deeper understanding of each professional practice (bottom-up) to contextualise and focus the general goals.

To enable educational institutions to gain insight into relevant professional practices requires close collaboration between professional and educational practice. Each is governed by its own rationale, and without collaboration between representatives of both, or an individual with practical insight into both, accurate translation of needs and goals from one to the other may be difficult.

It is up to the educational institution to qualify what the relevant innovation competencies are for each professional practice their educational programmes target. These must then be balanced and combined with the goals pushed from within government practice.

Utilising or applying innovation capacity is also dependant on close relations between educational and professional practices. However, in this case there is more focus on translation from educational to professional practice.

The theoretical model implies interaction which on the one hand translates or pulls problems, needs and areas of interest from professional practice. On the other hand, the same interaction pushes ideas, solutions and new areas of interest back to professional practice while simultaneously creating an educational platform for cultivating more innovation capacity. This interaction is framed by national goals and requirements pushed from government practice.

Ideally, this dynamic is complemented by an interaction with research practice. Similar in nature to the interaction between professional and educational practice. In this case, however, collaboration with research practice becomes a means to help generate, validate and otherwise qualify any ideas pushed back to professional practice. In the case of universities and university colleges this interaction is potentially contained within the educational practice. Although, in educational institutions which are not research-based, as with vocational colleges, this dimension requires maintaining external collaborations like the professional practices.

Methodological RQ: How can we utilise innovation capacity, and is it possible to measure the effects of said application in a meaningful way compared to the goals stated in the government's innovation strategy?

Working with innovation from an educational standpoint implies evaluation of educational initiatives and goals. Given the theoretical understanding above, this means evaluation must distinguish between goals originating from different rationales.

National goals are set based on the current rationale within government practice. Similarly, specific professional goals, and indeed the nature of collaboration between a professional and educational practice, are primarily defined within the professional practice. Also, any education to research collaboration, whether it be internal or external by nature, would need to contribute in some way to the research practice to remain viable.

Moreover, given the abductive nature of innovation processes all but the national goals are unknown beforehand and must be *discovered* through the respective collaborations. This implies, that collaboration between various practices, particularly professional and educational, would benefit from being based on short and frequent iterations on a practical level rather than in-frequent, formalised exchanges.

Since theory-based evaluation is rooted in a non-empiricist understand of causality it allows for this complexity. Although, it depends on the formulation of a concise programme-theory prior to initiating these collaborative initiatives to allow meaningful evaluation within the rationale of each practice. These programme-theories, in turn, require a degree of strategic planning within the educational practice. Collaborations should be undertaken with intentionality, described in detail according

to the principles of theory-based evaluation, and subject to continuous reflection and revision.

Similarly, there is a need for strategy within the professional practice as to what the expected result of a collaboration is. For innovation capacity to be meaningful it must be able to fulfil well-defined goals within all relevant practices, especially in the professional and educational practices. To be able to determine whether this is the case, these goals must be defined in the programme-theory which in turn requires an element of intentionality, not only in in educational practice, but also as part of the professional practice's innovation strategy.

Technical RQ: What is required of educational institutions to facilitate the generation and application of student innovation capacity in an interdisciplinary context?

From a didactic standpoint, the educational formats required to cultivate innovation capacity will potentially be as varied as the specific requirements of each practice. This does not necessarily pose a significant didactic challenge so long as the curricula dictated through government practice is flexible enough to accommodate the desired local adaptations. It does, however, mean that educational practices must be adapted to prioritise resources on engaging and collaborating with professional practice to discover which adaptations to make and how to evaluate them.

Interdisciplinary problem-based workshops (PBW) provides a platform for interacting with professional and research practices while focusing on real and relevant problems in an immersive learning environment. They also have the advantage of being relatively simple to use from an organisational standpoint since they can be held as extra-curricular activities without impacting day-to-day operations and planning in any significant way. Their status as something extra also allows for a degree of external funding while their compact nature simplifies collaboration with external parties. They also appear to be effective across educational levels and a diverse disciplinary mix of participants. Demonstrating a motivational effect on most students participating; even those who are highly sceptical to being with.

However, if the intention behind the national innovation strategy is to be taken seriously, occasional workshops are not enough. Particularly among vocational students, there seems to be an attitude that innovation is something which takes place in higher education and not something they should be concerned with. Demonstrating that this is not the case by being confronted with concrete examples and participating in innovations processes themselves seems to negate this attitude to some extent but should probably be continuously reinforced to have a lasting effect.

Closer collaboration to professional practice could be cultivated and utilised to adapt more aspects of the educational programmes to include specialised innovation goals. Simultaneously, problem-based workshops or comparable initiatives could be more

closely integrated into the educational programmes so they can be used to even greater effect.

From an organisational standpoint, vocational colleges already have a platform for collaboration which could be adapted or developed for these purposes. Doing so would, however, require a strategic decision to prioritise resources on pursuing student-driven innovation.

Organisational RQ: Which implications relate to educational institutions adapting their organisation to better enable them to effectively facilitate the use of student innovation capacity?

The main implications for educational institutions is to promote closer collaboration with professional practices in a variety of ways. Problem-based workshops present one way of doing this with minimal organisational challenges, however, if collaboration is to be better integrated into more aspects of educational practice other methods must also be explored.

Developing the specific educational elements for innovation based on the requirements of each professional practice; in collaboration with said practice. Integrating them into curricula and regularly evaluating these efforts as part of the collaborative effort would require a greater investment of resources.

Firstly, to establish or, in the case of vocational colleges, adapt the platform for collaboration. Secondly, to regularly maintain and utilise said platform. Moreover, the broader the aspects of educational practice involved in collaborations along with the diversity of professional practices engaged will directly impact the amount of resources needed.

A balance between the investment of effort and its effects will need to be established for the specific institution through experimentation. However, no matter the institution, collaboration of this sort will certainly represent a substantial investment of time and effort; not only at management level, but also with educators.

Despite vocational colleges having a distinct advantage in that they have already established a platform for collaboration with professional practice. This platform does not, in its present form, fully address the organisational practicalities of integrating innovation more closely into vocational education practice. It does, however, suggest that the unique relationship between Danish vocational colleges and the professional practices with which they are connected could potentially be adapted to support many variations of student-driven innovation; not only through interdisciplinary problem-based workshops, but also potentially through closer day-to-day collaboration.

The primary obstacle to developing this form of collaboration has to do with incentive (see Chapter 9). Since it would require prioritising and allocating resources (both professional and educational) to such a collaboration there need to be a clear incentive to do so, either politically, financially or by example (that it works). Structured evaluation and research into various collaborative initiatives can certainly help provide the knowledge required to gain support for such incentive, however, none exists today.

To gain political and financial support it is necessary to demonstrate that such collaborative efforts can indeed create value for the enterprises and students and educational institutions involved. To do this a gradual process of adaption and experimentation is required. The perspectives presented in section 10.2 suggests several avenues of inquiry where this work could begin.

11.1. ADDRESSING THE MAIN RESEARCH QUESTION

Returning to the main research question it has been shown, that interdisciplinary educational initiatives such as the interdisciplinary problem-based workshop nKNOWation can indeed be useful in the generation and application of innovation capacity in students; vocational or otherwise.

To emphasise how these types of initiatives are useful in utilising students as a capacity to drive innovation it is necessary to understand what is meant by innovation. In this thesis, it is defined as an abductive process of creating value in a way which is meaningful within a specific practice. In other words, generating and applying innovation capacity is concerned with gradually discovering and, together with research practice, meeting the needs of a specific professional practice in collaboration with said practices. This makes the close collaboration and focus on real-world problems within interdisciplinary problem-based workshops well suited to this purpose. In this way, generating and applying innovation capacity are not two separate processes, but rather a constant, iterative, process generating and applying simultaneously.

The main implication of this is, a greater need for both professional, educational and to some extent research practices to prioritise resources on initiating, maintaining and strategically applying collaborative efforts. Thus, student-driven innovation implies two main things:

To cultivate innovation capacity, educational practices must strategically focus resources on collaboration with specific professional and research practices; utilising this to develop educational elements relevant to innovation practices within these professions. Educational institutions with no integrated research practices, must also

engage with relevant external research practices to be able to qualify and translate professional practice needs to educational elements. Without this dimension, the collective potential for exploration of professional needs is limited along with the ability for student-driven innovation to generate feasible solutions.

The ability of students as well as actors from professional, educational and research practices to work effectively in an interdisciplinary environment is fundamental to the process of translation between practices as well as synthesis within them. Training this ability not only supports student-driven innovation within educational practice, but also gradually strengthens educational collaboration from within professional and research practices.

Similarly, to apply innovation capacity, professional practices must strategically prioritise specific innovation goals which can reasonably be achieved through a student-driven approach; along with the resources to engage relevant educational institutions to do so. This is equally important within many different types of professional practice; whether it is a micro-enterprise, a department or team within a large, international enterprise, or a consortium of enterprises. Without a strategic focus on the part of professional practice, the application of innovation capacity will not be focused. While the responsibility for this lies solely with the professional practice in question, there is no doubt, that some will have a much easier time of gaining this focus.

Others, as with several of the micro-enterprises that I came into contact with during this project, may have more trouble adapting a strategic focus. In these cases, it is possible, that the collaborative platform between them and educational practice, which in some cases already exists, could also be used to aid them in this endeavour; allowing for educational institutions to utilise their central position, amidst much collaboration, in a consulting capacity in these situations.

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EVALUATION OF INNOVATION CAPACITY IN VOCATIONAL EDUCATION

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DENMARK'S ECONOMIC GROWTH MUST, AMONG OTHER THINGS, BE SECURED BY THE DEVELOPMENT AND USE OF INNOVATION CAPACITY. THE COUNTRY'S EDUCATIONAL SYSTEM MUST, THEREFORE, ENSURE THAT STUDENTS OBTAIN THE CORRECT INNOVATION COMPETENCES, FOR WHICH REASON MANY INITIATIVES HAVE ALREADY BEEN IMPLEMENTED. HOWEVER, HOW WE CAN SYSTEMATICALLY DEVELOP, USE AND EVALUATE SUCH INITIATIVES IN A MEANINGFUL WAY IN RELATION TO THE OVERALL STRATEGY FOR INCREASING, DIRECTING AND APPLYING INNOVATION CAPACITY IS STILL UNCLEAR. THIS ARTICLE REFLECTS ON THE HINDRANCES TO BE OVERCOME AND PRESENTS ARGUMENTS FOR A MODEL THAT CAN FACILITATE THE PROCESS OF WORKING WITH THE STRUCTURED DEVELOPMENT AND EVALUATION OF INNOVATION CAPACITY IN EDUCATION.

In this article, we explore the methodological problem: *How can we apply innovation capacity and how can we measure its effect in a meaningful way in the context of the government's innovation strategy?* First, we present the concept of innovation capacity as a vehicle for growth in the light of the government's innovation strategy, followed by a model for clarifying the relationships between education and business. Then we describe the educational problems associated with operationalising that strategy; especially regarding evaluation processes. Finally, we present the idea of a dynamic and differentiated perspective on innovation competences together with a theoretical model (based on the previous model) for structured work with the development and evaluation of innovation initiatives.

The article's work-hypothesis is that innovation initiatives (for example educational) lead to innovation competences, and that the collective quantity of innovation-competent workers and students form the nation's innovation capacity. With this as our point of departure, we argue that a generalised perspective on innovation competences is a primary hindrance regarding the evaluation of innovation initiatives, as it does not permit a suitably detailed analysis of important contextual relationships. Instead, to obtain an inclusive theoretical understanding of innovation competences we propose a dynamic perspective that is empirically founded in the individual

professional practices targeted by relevant educational programmes. In this way, we can apply innovation capacity *by increasing specialised innovation competencies defined within a professional practice* rather than *by increasing general innovation competencies and afterwards focusing them on a specific practice*. The theoretical model proposed in the article is a methodological contribution that can form an important framework for this work within individual fields of practice.

Innovation capacity as a vehicle for growth

In 2010 the Danish Government published its innovation strategy in response to the OECD's report from two years earlier (OECD 2010). The government's strategy states that the road to continued competitiveness and economic growth appears to depend on the ability of Danes to be innovative.

Moreover, it has been mentioned several times throughout the public discourse that innovation equates to the ability to convert new knowledge and new technologies into value in a business context[i] and, that development should be driven by and founded in real societal challenges (Denmark's Government 2012, 11).

From an educational perspective, the notion of innovation competences is of particular interest. Based in current social challenges, knowledge must be generated that can be applied within the professional fields where it can generate added value, which is why innovation competences are essential to future workforces (ibid 2012, 8). The premise is in line with this article's working hypothesis; that the people represent the nation's innovation capacity and, thereby that education which develops the students' innovation competencies contributes to strengthening the national capacity (ibid 2012, 25).

The task of education is to ensure that the students possess the competencies required to become the future generation of innovative employees and thus a part of the nation's innovative capacity.

Innovation competencies

As innovation competences, must be identified on the basis of current and future social challenges and able to be used to overcome them, the relationship between education and business is central to precisely defining what innovation competencies are.

To clarify the relationship between education and business along with the strategic and operational objectives for each of them we propose a basic representation as shown in figure 1.

The figure cross-tabulates two distinctions that are directly derived from the government's distinctions between education and business. Specifically, the distinction between *practice* and *elements* along one dimension and the distinction between *profession* and *learning* on the other dimension. All businesses and all educations constitute a practice; shown in Figure 1 as *Professional Practice (I)* and *Educational Practice (II)* where the rationales for each are *Value* and *Knowledge*

respectively. This can be seen in the innovation strategy which differentiates between these practices by, for example, by speaking of converting knowledge to value; from education to business (Denmark's Government 2012, 8, 20, 23).

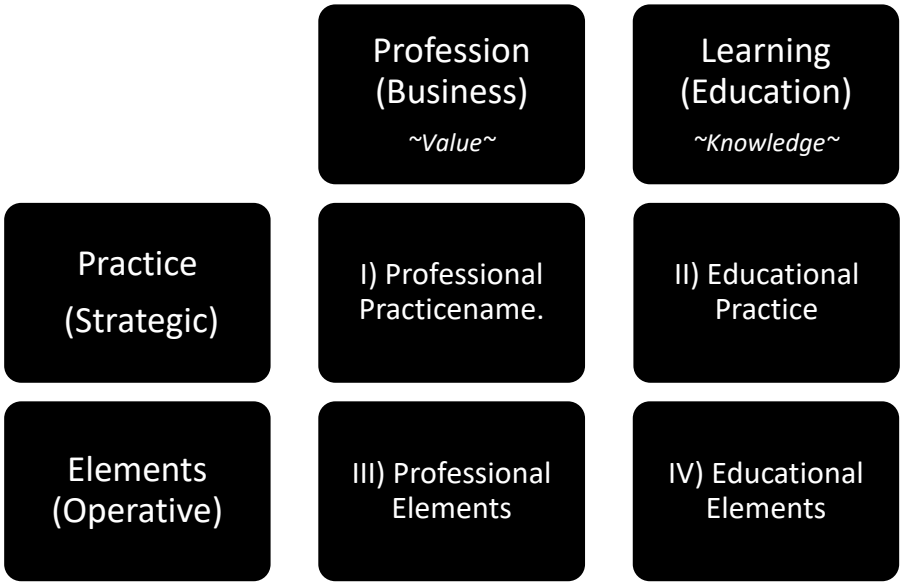

Figure 1: Business and Education as different practices

In addition to differentiating between two fundamentally different fields of practice, each practice consists of a series of elements and thus, can either be seen as a single entity (I and II) or as separate elements (III and IV). The term *practice* is used here in accordance with Andreas Reckwitz's (2002. 249-250) broad definition of *a practice*. This results in four areas, all of which are essential to the concept of innovation capacity in an educational perspective.

Professional Practice (I) represents the field of practice towards which the student's education is directed. In some cases, that is a single, well-defined professional field in a specific geographical area, and in other cases can be a mixture of different types of jobs and places of work spread throughout the whole country, or even the world. Similarly, it is possible that the practice in one workplace differs from the practice in another within the same profession or job. For example, the professional practices can vary significantly for nurses, depending on the department or hospital in which they are employed.

Professional practices can, therefore, describe varying levels of focus and thus go from describing an entire profession on a national (or in principle international) level,

to describing specific job functions in a specific company; depending on what is meaningful for the relevant analysis. Regardless of the level of focus, these professional practices are typically motivated to create value in one form or another.

Educational Practice (II) represents the field of practice that the student and his/her educator (and possibly also researchers) are part of during their education. Educational practices differ from each other across the department, institution and type of education, potentially in relation to a broad range of parameters; for example - physical limitations, economy, culture, choice of didactic methods, curricula, educator competences etc. Thus, the same educational programme at two different universities could represent quite different educational practices, just as a university college and a vocational college can represent different practices.

Educational practice can also be described at different levels stretching from a national perspective where focus is on the range of educational options, to a much narrower local perspective; for example, a specific course offered by a specific department of a specific institution as part of a specific educational programme. This community of practice is typically politically motivated in order to provide, and in some cases, develop knowledge on the basis of current wishes and needs expressed by relevant professional practices.

Both fields of practice can be viewed at both a strategic and an operational level. *The strategic level* relates to the general or collective range of practices that arise from its individual elements (Reckwitz 2002, 244, 250, 258; Schatzki 2010, 73). It is at the strategic level that the national innovation strategy has its primary focus when addressing how both fields of practice should be interacting to advance the nation's innovation capacity. At this level, it is about *how* work is performed and how to work towards a strategic objective within a practice.

Similarly, it is often at the strategic level that it is useful to describe direct collaboration between practices. That could be between educational institutions that collaborate on a project. An example of this can be found in the assistive technology projects where professional healthcare educations at SOSU North and *purely* technological education programmes at Tech College Aalborg work together[ii]. It could also include cases where representatives from professional practice consult on developing educational curricula, educators or researchers temporarily becoming part of a professional practice to work on an education or research project. Similarly, it could be in the form of representatives from professional practice temporarily joining educational practice to participate in educational or research projects.

Common to these types of collaboration at the strategic level is that it is often unclear precisely what each representative takes home to their respective practices. There is no doubt that they affect or disturb each other's practices, which possibly helps to develop them in some sense (Stadil & Tanggaard 2015, chapter 1). However, it does not necessarily occur in a particularly structured, focused or predictable way, which makes it difficult to identify what has been changed regarding the respective practices.

The Operational Level consists of strategic objectives broken down into operational elements by analysing a practice in the context of its overall strategic movement towards an anticipated future need. Similarly, it is through a synthesis of the operational elements that results can be seen at the strategic level. This does not imply that the sum of the elements is exactly equal to the practice from which they are derived; simply that the elements are derived from practice (analysis) and that operationalising them contributes to defining practice (synthesis).

The term *element* is used at the operational level because it can represent different things; e.g. competences, technologies, markets, inter-branch links, products etc.) according to which practice is being discussed and which focus is selected.

At the operational level, *professional elements (III)* can be found consisting of, among other things, technologies, specific knowledge of a subject, special skills or competencies. There can be elements that already have an established role in practice, for example the basic calculation skills of a carpenter in a specific professional practice. And there can also be elements that attach themselves to the strategic movement towards an anticipated future need. Knowledge about how to go about starting one's own company is an example of this; if increasing the number of start-ups is a strategic objective.

Opposite to professional elements at the operational level are *educational elements (IV)*. These are the concrete educational objectives given in official programme descriptions and curricula. Based on the examples above, we would look at *which* specific calculation skills can be considered basic for a carpenter in that professional practice, and what specific knowledge would equip the carpenter - and maybe even motivate him – to start his own company.

Based on Figure 1 innovation competencies can be perceived as a series of professional elements that are thought to have the potential to *create value* in a professional practice by adding *new knowledge* that can contribute to solving strategic challenges. Central to both the education and evaluation of innovation competencies is the ability to precisely define the specific professional elements.

Operationalisation - the task of education

For vocational education programmes, it is the Ministry of Education in consultation with selected industry experts that expresses the professional practices and elements through its official programme descriptions and curricula. Then, it is the educational institutions' responsibility to operationalise these documents within a local education plan (Undervisningsministeriet 2014 §45 & §46) that describes the precise educational elements that form the basis for the teaching and learning practices at that institution.

Thus, there are two separate processes: One business-related (professional practices and professional elements) and one education-related (educational practice & educational elements) in which the latter evolves from the former. Subsequently,

when we speak about evaluation of the effect of an educational initiative, we are comparing *the result of the educational process with the point of departure within a related professional process*. As this involves two different processes, theoretical perspectives, empirical investigations and other considerations related to the one, are typically not visible to those working with the other.

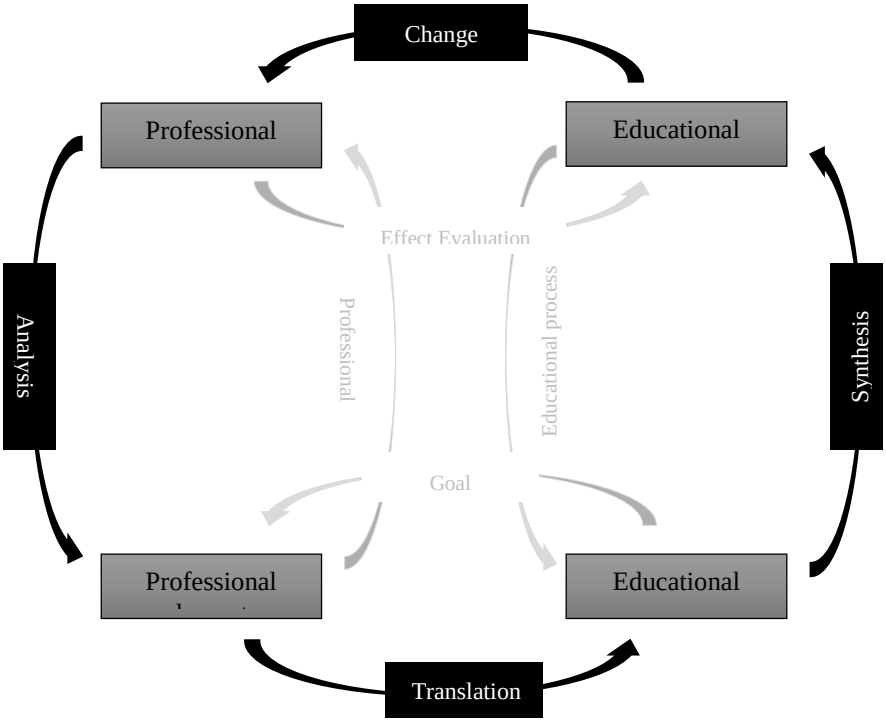

Figure 2: Development and evaluation processes

This disparity can be illustrated through a simple search among the Ministry of Education's programme descriptions and curricula for vocational education. The search criteria are courses up-dated after 2012 and in which the word "innovation" is used[iii] either in the main text or in the related headline. For example, "The student can generate and select new ideas that either build on existing ideas or are developed independently" (Industriens uddannelser, Teknisk innovation, Fagnr. 09592), "Through knowledge of the innovation process's different phases and methods the participant can use the individual phases independently for analytical problem solving" (Industriens uddannelser, Innovation og kreativ idégenerering, Fagnr. 47845) or, "The Student can use innovative methods for task completion" (Industriens uddannelser, Innovation Erhvervsfag 3, Fagnr. 10797)[iv]. The examples have been selected because they illustrate typical formulations and choice of wording used in relation to educational objectives concerning innovation.

Common to these examples is that they are expressed in such general terms that it is difficult to form a clear picture of which competencies are essential to achieving them in relation to the specific professional practice in which they are intended to be applied. Apparently, they represent a need for skills in *structured creativity* or *inventiveness*, which are so general that they could apply in almost any professional practice. The problem with that is that evaluations based on such general perspectives will likely result in equally general conclusions that typically lack the precision necessary for useful evaluation (Dahler-Larsen 2006).

That creates problems for the educationalists' work to ensure that professional elements are made tangible and well defined within the context of a local education plan. They are not tangible enough to be directly transferable to educational practice and the rationale behind their formulation is not visible to the personnel who must work with them, which makes it difficult to describe in precise terms with any acceptable degree of certainty. The same problem arises when attempting to evaluate educational initiatives. The risk attached to this is that, because of the uncertainty, the evaluation ends up focusing on something other than what was intended from the strategic perspective.

A consequence of this problem could be that it becomes difficult to ratify experiments with more costly initiatives[v], when it is not possible to differentiate its results from any others. This does not harmonise well with the desired shift towards: "[…] a cultural change within the educational system where more focus is placed on innovation […]" (Danmarks Regering 2012, p.8), which is expressed in the national innovation strategy.

Innovation is several things for several professions

To be able to evaluate work with innovation competencies more effectively it is necessary to find a way of being more precise about what these competencies consist of, and at the same time ensuring the entire process from strategy to specific innovation initiative remains clear.

It must be clearer for all parties exactly what any given competence is expected to achieve (strategic context), and what each competence consists of (professional elements) in relation to the educational programme (learning elements). In other words, a shift from a general view of innovation competencies that is the same across the range of professions to a more differentiated, profession-specific perspective. That means that innovative workers in different professions do not necessarily have to have the same innovation competencies and that the same competencies can be developed in quite different ways. Achievement of the overall objectives described in the innovation strategy that relate to societal challenges through the development new knowledge as well as transferring and applying that knowledge to create practical solutions, therefore means having different requirements for different roles in different professions and in different phases of each process.

Innovation deserves evaluation

The perspective presented implies the use of systematic evaluation as a key tool for continuous development. Innovation capacity and thereby innovation competencies are dynamic, which means that the processes that develops them must be adjusted in accordance with how they develop and change.

What works and doesn't work? Why are things the way they are and what could we do differently? Did we define the correct objective? These are all questions that every department in every educational institution must regularly address if they want to ensure continuous quality assurance and development in their work. In that context, a minimum requirement should be, that every work action performed can live up to the basic reason for doing it (Dahler-Larsen 2009, 18, 31).

To that must be added the simple fact that today's educational sector is characterised by a very strong evaluation culture dictated by the government. Thus, different performance indicators have the potential to directly affect, and lead to serious consequences for an institution's economy, and thereby its employees' ability to perform to the best of their abilities (Dahler-Larsen 2006).

The reasons for engaging with the evaluation of innovation initiatives include the continued development of educational practices in this area along with a quality assurance mechanism ensuring the institution continues to meet the objectives specified in curricula, as well as ensuring that these objectives and targets continue to be relevant.

Development- and evaluation processes

To be able to work with the development innovation initiatives based on this premise; including the structured evaluation of such processes it is interesting to look at movements between the different areas described in figure 1. By adding development- and evaluation processes respectively to the model, it transforms into Figure 2.

Figure 2 adds the movement from professional practice to educational practice as well as the evaluation of this movement; both as evaluation of the sub-processes between the individual parts of the model and as a part of the wider evaluation of the entire movement. In this way, the distinction between the bigger process at strategic level, and the related sub-processes is made clearer.

The outer movement in the model represents the development process, which has its point of departure in professional practice. From the analysis of this a set of professional elements can be described that represent specific competencies (elements) considered essential to the assurance of innovation capacity within the professional practice from which the point of departure was taken. In other words, those that an innovative employee within that professional practice would require.

Professional- and educational practices are fundamentally different, as they are driven by the different rationales of value and knowledge respectively (see Figure 1). Therefore, a form of translation from professional practice to education practice is necessary. The purpose is to describe exactly what must be learned in order for the student to acquire the innovation competencies described as professional elements. Learning elements do not necessarily differ from professional elements but the process of translation from one to the other remains important because it represents a clear shift in rationale from *value* to *knowledge*.

The last part of the development process is the synthesis of learning elements in the relevant educational programme's educational practice. That movement represents the didactic methodology where specific principles and methods are selected towards presenting the educational elements to the students in the best possible way. On the one hand, the culture (educational practice) influences how the elements are realised within it. On the other hand, the transition from educational elements to educational practice also influences and helps develop the educational practice since it contributes experience using different methods and models.

The direct contact between both practices constitutes the change process and final step in the model. That step represents the students leaving the educational system to become part of professional practice. It also represents potential continued collaboration between business, education and, for universities and university colleges, also research (see *Innovation competencies* above).

In the evaluation process illustrated by the inner movement in Figure 2, each individual step in the development process can, in principle, be evaluated separately, as each step raises different questions. For example, the evaluation of the movement from professional practice to professional elements will typically question if the correct professional elements have been identified. Similarly, the translation between professional elements and learning elements will typically focus on investigating if the educational elements being used actually fulfil the objectives represented by the professional elements. Evaluation of the synthesis from educational elements to educational practice, however, focuses on the extent to which the pedagogical / didactic methods work as intended; i.e. if the students learn what the elements describe.

Finally, we have to consider the evaluation of the longer-term effect (Krogstrup & Dahler-Larsen 2003), which seeks to ascertain if the entire process works as it should by systematically examining each step within the total process. In this case, it means to what degree the education system can deliver employees with the correct competencies resulting in increased innovation capacity within professional practice and, by extension, at a national level. That is still not an easy task and it continues to be a long-term process. However, it has been made easier to handle because of the focus being narrowed and the fact that the success criteria can be more precisely defined.

What is interesting about this perspective is, not only that the overall movement can be a process for which it is possible to evaluate the effect, but also that it can be broken down into individual, well defined sub processes; each with its own evaluation cycle, which functions as a cog in the larger process by constantly optimising its own objectives and methods, and thereby gradually adjusting the premises for the next cog.

Conclusion

The article has explored the methodological problem: *How can we apply innovation capacity and how can we measure its effect in a meaningful way in the context of the government's innovation strategy?* As a contribution to this problem we proposed a differentiated perspective on what the term innovation capacity implies; namely, different innovation competencies adapted to different professional practices.

A fundamental differentiation between practices implies that innovation competencies can differ greatly according to the type of work, type of company or sector and geographical location with which one is concerned. In other words, a definition that more precisely defines the theoretical and conceptual understanding of innovation through empirical/analytical focus on individual and specific professional practices. *The use of innovation capacity can thereby be made more tangible in relation to a specific professional practice.*

The above model offers a fundamental framework as a methodological tool to aid working with a differentiated view of innovation competencies and innovation capacity. By describing the individual elements that make up the movement from professional practice to educational practice along with their integral relationship it becomes possible to identify and work with each of the transition processes individually and to differentiate between component parts and the whole in order to maintain the strategic aim. That creates a point of departure for, and eases the work with, evaluation of effect, since the individual processes can be evaluated individually while still being related to their position in the overall strategic process of which they are part.

The consequence of this is that educational institutions initially must determine which professional practices their respective educational programmes are aimed at before they can determine which educational objectives along with related pedagogical / didactic considerations should be part of the individual programme's educational practices. With that, a large part of the responsibility for the content of educational programmes along with their continued relevance is taken back from the ministry. Similarly, the related development- and evaluation processes will be highly dependent on the degree of detail with which the professional processes are described. Of course, such changes still represent a challenge. Especially when working with educational programmes that are not necessarily aimed at a single well-defined and clearly formulated professional practice. On the other hand, the benefits of attempting to implement these changes provide a possibility of structuring and working systematically with evaluation in a meaningful way.

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Notes

[i] See, for example: The Ministry for Research, Innovation and Continuous Education 2013, p.5 and Nielsen 2015

[ii] Welfare clusters, nKNOWation along with the continuing work with welfare technology education as an inter-institutional collaboration are all examples of this.

[iii] The Ministry of Education programme descriptions can be studied on retsinformation.dk, and the curricula for vocational education on uddannelsesadministration.dk. The specific courses can be found under curricula by using the unique reference number (Fagnr.).

[iv] (*) The quotes are not available in an official English Translation. They have been translated to match the original wording as closely as possible.

[v] Examples of this are projects like "Open Minds" (TCAA), solution Hub, Wolfie -U-CrAc (AAU and UCN) plus nKNOWation -Welfare Clusters (SOSU North, TCAA UCN and AAU).

(P1a) Evaluering af innovationskapacitet i erhvervsrettede uddannelser

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Evaluering af innovations-kapacitet

i erhvervsrettede uddannelser

Danmarks økonomiske vækst skal bl.a. sikres gennem udvikling og anvendelse af innovationskapacitet. Landets uddannelser skal derfor sørge for, at studerende besidder de rette innovationskompetencer, hvorfor mange allerede har indført forskellige tiltag herfor.

Det er dog stadig uklart, hvordan vi systematisk kan udvikle og evaluere disse tiltag på en meningsfuld måde set i forhold til den overordnede strategi om at øge, målrette og anvende innovationskapacitet. Artiklen reflekterer over hvilke forhindringer, der er for at gøre dette samt argumenterer for en model, der kan danne udgangspunkt for struktureret arbejde med udvikling og evaluering af innovationskompetencer i undervisning.

Artiklen udfolder det metodiske problem: *Hvordan anvendes innovationskapacitet, og hvordan måles effekten heraf på en meningsfuld måde i forhold til regeringens innovationsstrategi?* Først præsentereres ideen om innovationskapacitet som vækstfremmer i lyset af regeringens innovationsstrategi samt en model til anskueliggørelse af relationen mellem uddannelse og erhverv. Herefter beskrives og problematiseres uddannelsernes opgave med at operationalisere denne strategi; særligt med fokus på evalueringsprocesser. Til slut fremsættes ideen om et dynamisk og differentieret perspektiv på innovationskompetencer samt en teoretisk model (baseret på den forgående) til struktureret arbejde med udvikling og evaluering af innovationstiltag.

Det er artiklens arbejdshypotese, at innovationstiltag (som eks. undervisning) fører til innovationskompetencer, og at den samlede mængde af innovationskompetente medarbejdere og studerende udgør nationens innovationskapacitet. Med dette udgangspunkt argumenteres der for, at et generelt perspektiv på innovationskompetencer er en primær forhindring med hensyn til evaluering af innovationstiltag, da det ikke tillader en tilpas detaljeret analyse af væsentlige kontekstuelle sammenhænge. I stedet for en overordnet teoretisk forståelse af innovationskompetencer foreslås et dynamisk perspektiv, der er empirisk funderet i de enkelte faglige praksisser, som der uddannes til. Således er der tale om at anvende innovationskapacitet *ved at øge målrettet innovationskompetencer inden for praksis* fremfor at *øge generelle innovationskompetencer for derefter at målrette dem praksis*. Den teoretiske model, som artiklen fremsætter, er et metodisk bidrag, der kan danne en væsentlig ramme for dette arbejde inden for de enkelte praksisfelter.

Innovationskapacitet som vækstfremmer

I 2012 udgav Danmarks Regering (2012) sin innovationsstrategi som respons på OECD's innovationsrapport fra to år tidligere (OECD 2010). Af regeringens innovationsstrategi fremgår det, at vejen til fortsat konkurrencedygtighed og økonomisk vækst i Danmark synes at hvile på danskernes evne til at være innovative.

Fælles for denne type samarbejde på det strategiske niveau er, at det ofte er utydeligt, præcist hvad interessenterne bringer med sig hjem til deres respektive praksis. Der er ingen tvivl om, at man påvirker eller *forstyrrer* hinandens praksis, hvilket sandsynligvis er med til at udvikle dem i en eller anden forstand (Stadil & Tanggaard 2015, kapitel 1). Det forekommer bare ikke nødvendigvis på en særlig struktureret, målrettet eller forudsigelig måde, hvorfor det kan være svært at identificere, hvad det har forandret ved de respektive praksisser.

Det operative niveau består af strategiske mål nedbrudt til operationaliserebare elementer ved at analysere praksis i konteksten af dens overordnede strategiske bevægelse mod et formodet fremtidigt behov. Ligeledes er det gennem en syntese af disse elementers operationalisering, at resultater kan ses på det strategiske niveau. Ikke dermed sagt at summen af elementer svarer præcist til den praksis, de er udledt af, blot at elementerne er udledt af praksis (analytisk), og at operationalisering af dem er med til at definere praksis (syntetisk).

Begrebet *elementer* bruges på det operative niveau, fordi det kan repræsentere noget meget forskelligt (fx.: kompetencer, teknologier, markeder, snitflader mellem brancher, produkter etc.) alt efter hvilken praksis, der tales om, og hvilket fokus der tages.

På det operative niveau findes *fagelementer (III)*, som kan bestå af blandt andet teknologier, specifik viden om et emne, særlige færdigheder eller kompetencer. Der kan være tale om elementer, som allerede har en etableret rolle i praksis som eksempelvis grundlæggende regnefærdigheder hos en tømrer i en bestemt fagpraksis. Der kan også være tale om elementer, som knytter sig til den strategiske bevægelse mod et formodet fremtidigt behov. Viden omkring opstart af egen virksomhed er et eksempel herpå; hvis der er et strategisk ønske om, at flere skal starte egen virksomhed.

Modstykket til fagelementer på det operative niveau er *læringselementer (IV)*. Her tænkes der på de konkrete læringsmål, der opstilles i uddannelsesbekendtgørelser og studieordninger. Bygger vi videre på eksemplet ovenfor, ville man her tale om *hvilke* specifikke regnefærdigheder, der kan siges at være grundlæggende for netop en tømrer i pågældende fagpraksis, samt hvilken viden der vil ruste og måske endda motivere samme tømrer til at blive selvstændig.

Ud fra Figur 1 kan innovationskompetencer således anskues som en række fagelementer, som antages at ville *skabe værdi* i fagpraksis ved at tilføre *ny viden*, der kan biddrage til løsning af strategiske udfordringer heri. Det centrale for arbejdet med såvel undervisning i som evaluering af innovationskompetencer bliver dermed den præcise definition af de konkrete fagelementer.

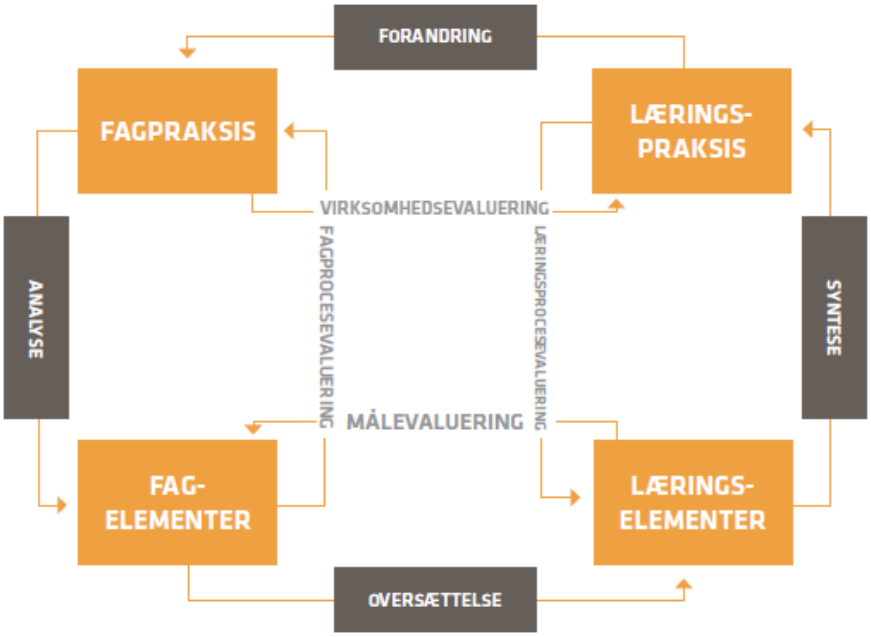
Operationalisering - uddannelsernes opgave

På erhvervsrettede uddannelser i dag er det undervisningsministeriet der i samråd med et fagligt udvalg udtrykker fagpraksis og fagelementer i form af henholdsvis en uddannelsesbekendtgørelse og en uddannelsesordning. Herefter er det uddannelsernes opgave at operationalisere disse dokumenter i en lokal undervisningsplan (Undervisningsministeriet 2014, §45 & §46). Denne beskriver de konkrete læringselementer, der skal danne grundlag for undervisningen og dermed læringspraksis på stedet.

Således er der tale om to adskilte processer: En erhvervsorienteret (fagpraksis & fagelementer) og en uddannelsesorienteret (læringspraksis & læringselementer) hvor sidstnævnte udspringer af den første. Når vi efterfølgende taler om evaluering af læringsforløbseffekt, sammenligner vi reelt *resultatet af den uddannelsesorienterede* proces med *udgangspunktet for den erhvervsorienterede*. Da der er tale om to forskellige processer, er eventuelle teoretiske perspektiver, empiriske undersøgelser samt øvrige overvejelser ved den ene typisk ikke synlige for dem, der arbejder med den anden.

Denne disparitet illustreres ved en simpel søgning blandt Undervisningsministeriets bekendtgørelser og uddannelsesordninger på EUD området. Kriterierne er fag, som er opdateret efter 2012, hvor ordet "innova-

Figur 2:
Udviklings- og evalueringsprocesser



tion" indgår [3] i enten brødtekst eller fagtitel, hvilket giver flere konkrete bud på fagelementer udtrykt som læringsmål. Eksempelvis: "Eleven kan foretage idégenerering og idéudvælgelse, der bygger på kendte eller helt nye ideer." (Industriens uddannelser, Teknisk Innovation, fagnr.: 09592), "Gennem viden om innovationsprocessens forskellige faser og metoder kan deltageren selvstændigt anvende de enkelte faser til analytisk problemløsning" (Industriens uddannelser, Innovation og Kreativ idégenerering, fagnr.: 47845) eller "Eleven kan anvende innovative metoder i opgaveløsning." (Industriens uddannelser, Innovation Erhvervsfag 3, Fagnr.: 10797). Eksemplerne er udvalgt, fordi de illustrerer typiske formuleringer og ordvalg for læringsmål vedrørende innovation.

3. *Undervisningsministeriets bekendtgørelser kan gennemses på retsinformation.dk og uddannelsesordninger på EUD området kan ses på uddannelsesadministrationen.dk. De refererede fagmål kan findes ved søgning blandt uddannelsesordninger ud fra det unikke fagnummer.*

Fælles for disse eksempler er, at de udtrykkes i så generelle vendinger, at det er svært at danne et billede af hvilke kompetencer, der er nødvendige for at kunne opfylde dem i forhold til de konkrete erhverv, hvor indsatserne skal udmøntes. De repræsenterer tilsyneladende et ønske om færdigheder inden for struktureret kreativitet eller "hittepåsomhed", der er så generelle, at de kunne finde anvendelse i stort set alle fagpraksisser. Problemet med det er, at evalueringer ud fra et så generelt perspektiv formentligt vil afføde ligeså generelle konklusioner, som typisk ikke besidder særlig udsigelseskraft om genstandsfeltet for evalueringen (Dahler-Larsen 2006).

Dette problematiserer uddannelsernes arbejde med at konkretisere og målrette fagelementerne i forbindelse med udviklingen af en lokal undervisningsplan. De er ikke konkrete nok til at kunne overføres direkte til læringspraksis, og samtidigt er rationalet bag deres

formulering ikke synlig for personalet, der skal arbejde videre med dem, hvilket gør dem svære at præcisere med nogen særlig grad af sikkerhed. Samme problem gør sig gældende ved evaluering af de konkrete undervisningstiltag, der udspringer heraf. Her er risikoen, at man som konsekvens af denne usikkerhed evaluerer på noget andet end det, der var intentionen med målene fra strategisk side.

En konsekvens af disse problemer kunne eksempelvis være, at det bliver svært at ratificere forsøg med mere omkostningsfulde læringsformer [4], når det ikke er muligt at differentiere resultatet fra enhver anden. Ikke umiddelbart en bevægelse mod den "[...] kulturændring i uddannelsessystemet med mere fokus på innovation", som innovationsstrategien (Danmarks Regering 2012, 8) lægger op til.

Innovation er flere ting for flere fag

For effektivt at evaluere arbejdet med innovationskompetencer er det nødvendigt at finde en måde, hvormed vi kan være mere præcise omkring, hvad disse kompetencer egentligt dækker over, samtidigt med at hele bevægelsen fra strategi til det specifikke innovationstiltag forbliver tydelig.

Det skal fremgå tydeligt for alle parter, hvad man forventer at opnå med en given kompetence (strategisk kontekst), samt hvad denne kompetence reelt dækker over (faglige elementer) i relation til den pågældende uddannelse (læringselementer). Med andre ord et skift fra en generel betragtning af innovationskompetencer som noget nogenlunde ens på tværs af fag til et mere differentieret perspektiv. Det betyder, at innovative medarbejdere i forskellige fag ikke nødvendigvis skal besidde de samme innovationskompetencer, og at samme kompetence potentielt kan udfoldes på vidt forskellig vis.

Opfyldelse af innovationsstrategiens egentlige mål om at tage udgangspunkt i samfundsudfordringer, opbygge ny viden samt overføre og anvende denne viden til at skabe løsninger i praksis stiller dermed forskellige krav til forskellige roller i forskellige fag i forskellige faser af denne proces.

Innovation fortjener evaluering

Det præsenterede perspektiv på innovation lægger op til en systematisk evaluering som et centralt redskab for kontinuerlig udvikling. Innovationskapacitet og dermed innovationskompetencer er dynamiske størrelser, hvorfor de tiltag, der skal udvikle dem, må justeres i takt med, at de ændrer sig.

Hvad er det, der virker og ikke virker? Hvorfor er det sådan, og hvad kunne vi eventuelt gøre anderledes? Er det overhovedet de rigtige mål, vi har opstillet? Dette er alle spørgsmål, som enhver afdeling i enhver uddannelsesinstitution må spørge sig selv om med en vis regelmæssighed, hvis de vil sikre en løbende kvalitetssikring og -udvikling i det arbejde, der udføres. I denne kontekst må mindstemålet være at det arbejde, der udføres, som minimum lever op til det grundlæggende formål med dets udførelse (Dahler-Larsen 2009, 18, 31).

Dertil kommer det pragmatiske, at undervisningssektoren i dag er præget af en stærk evalueringskultur fra statens side, så forskellige performanceindikatorer potentielt har direkte og anseelige konsekvenser for en institutions økonomi og dermed dens medarbejderes muligheder for at udfolde deres hverv (Dahler-Larsen 2006).

Formålet med at beskæftige sig med evaluering af innovationstiltag er både det kontinuerlige arbejde med udvikling af læringspraksis på dette område og en kvalitetssikringsmekanisme i forhold til institutions opfyldelse af studieordningens mål, samt at sikre at disse mål fortsat er relevante.

Udviklings- og evalueringsprocesser

For at kunne arbejde med udvikling af innovationstiltag ud fra denne præmis, herunder struktureret evaluering i forbindelse med en sådan proces, er det interessant at se på bevægelserne mellem de forskellige områder beskrevet i Figur 1. Tilføjer man henholdsvis udviklings- og evalueringsprocesserne til opdelingen, ser det således ud:

4 *Eksempler på dette er projekter som Open Minds (TCAA), Solution Hub, Wafie & U-CoA:c (AAU og UCN) samt nKNOWation & Velfærdscluster (SOSU Nord, TCAA UCN og AAU).*

I Figur 2 tilføjes henholdsvis bevægelsen fra fagpraksis til læringspraksis samt evalueringen af denne; både som evalueringer af sub-processer mellem modellens enkelte dele, men også som led i en større evaluering af hele bevægelsen. Dermed tydeliggøres sondringen mellem den større proces med strategisk sigte samt de sub-processer, der indgår heri.

Den ydre bevægelse i modellen repræsenterer udviklingsprocessen, som tager sit udgangspunkt i fagpraksis. Gennem analyse heraf beskrives et sæt fagelementer, som repræsenterer helt konkrete kompetencer (elementer), som det menes er nødvendige for at sikre *innovationskapacitet* i den specifikke fagpraksis, der tages udgangspunkt i. Altså det som en innovativ medarbejder inden for denne fagpraksis har behov for.

Da fag- og undervisningspraksis er grundlæggende forskellige, idet de primært drives af henholdsvis et værdi- og vidensrationale (se Figur 1: Erhverv og uddannelse som forskellige praksis), er der tale om en form for oversættelse fra fagpraksis til uddannelsespraksis. Formålet her er at præcisere, hvad der skal læres, for at den studerende eksempelvis kommer til at besidde de innovationskompetencer, der er beskrevet som fagelementer. Læringselementerne er ikke nødvendigvis anderledes end fagelementerne, men oversættelsesprocessen fra det ene område til det andet er vigtig, fordi den repræsenterer et markant og tydeligt skift af rationale fra *værdi* til *viden*.

Sidste del af udviklingsprocessen er syntesen af læringselementerne i den pågældende uddannelses særegne læringspraksis. Denne bevægelse repræsenterer den metodiske del af didaktikken, hvor der overvejes hvilke konkrete metoder, man vil benytte til at formidle de enkelte elementer. Det kan siges, at kulturen (læringspraksis) er med til at forme, hvordan de realiseres i denne. Omvendt er overgangen fra læringselementer til læringspraksis også med til at definere praksis i takt med, at der opbygges erfaring med forskellige metoder og modeller herfor.

Den direkte kontakt mellem begge praksisser udgør forandringsprocessen og sidste led i modellen. Dette led repræsenterer de studerende eller eleverne, der forlader uddannelserne og bliver en del af praksis, samt eventuelt løbende samarbejde mellem erhverv, uddannelse og for universiteternes og professionshøjskolernes vedkommende forskning (se afsnit: Innovationskompetencer).

I evalueringsprocessen, der er illustreret af den indre bevægelse i Figur 2, er tanken, at hvert enkelt led i udviklingsprocessen i princippet kan evalueres hver for sig, da de hver især rejser forskellige spørgsmål. For eksempel vil evaluering af bevægelsen fra fagpraksis til fagelementer typisk have fokus på selve analyseprocessen og stille spørgsmål ved, om det er de rigtige fagelementer, man har fundet frem til. Ligeledes er der i oversættelsen mellem fagelementer og læringselementer interesse i at undersøge om de læringselementer, man opstiller rent faktisk opfylder de mål, som fagelementerne repræsenterer. Evaluering af syntesen fra læringselementer til læringspraksis spørger derimod til, hvorvidt den pædagogisk / didaktiske metode fungerer som forventet, altså om de studerende lærer det, elementerne beskriver.

Sidst men ikke mindst er der den mere langsigtede virkningsevaluering (Krogstrup & Dahler-Larsen 2003), der søger at undersøge om hele processen, samlet set, virker, som den skal ved systematisk at undersøge hvert led i processen. I dette tilfælde altså i hvilken grad uddannelsessystemet formår at levere medarbejdere med de rette innovationskompetencer, så de dermed kan siges at øge erhvervenes og derigennem landets innovationskapacitet. Dette er stadig ikke nogen nem opgave, og der er fortsat tale om en langsigtet proces, men den er dog blevet mere håndterbar i kraft af, at fokus er blevet indsnævret, samt det forhold at succeskriterierne er blevet mere præcist defineret.

Det interessante ved dette perspektiv er ikke kun, at den overordnede bevægelse kan anskues som en proces, det er muligt at foretage virkningsevalueringer af, men også at den lader sig nedbryde i enkelte, veldefinerede sub-processer; hver især med deres egne evalueringscyklus, der fungerer som tandhjul i den større proces ved konstant at optimere sine delmål og metoder og dermed gradvist ændre præmisserne for det næste tandhjul.

Konklusion

Artiklen har udfoldet det metodiske problem: *Hvordan anvendes innovationskapacitet, og hvordan måles effekten heraf på en meningsfuld måde i forhold til regeringens innovationsstrategi?* Som et bidrag til dette problem, er der foreslået et differentieret perspektiv på, hvad begrebet innovationskapacitet dækker over nemlig forskellige innovationskompetencer tilpasset forskellige fagpraksisser.

En fundamental sondring mellem praksisser lægger op til, at innovationskompetencer kan dække over meget forskelligt alt efter hvilken type arbejde, hvilken type virksomhed eller branche og hvilket geografisk område, man taler om. Altså en definition der præciserer den teoretiske og kontekstuelle forståelse af innovation ved empirisk/analytisk at tage udgangspunkt i den enkelte, særlige fagpraksis. *Anvendelsen af innovationskapacitet bliver dermed konkretiseret i forhold til den specifikke fagpraksis.*

Ovenstående model tilbyder en grundlæggende struktur som metodisk redskab i forhold til arbejdet med et differentieret syn på innovationskompetencer og innovationskapacitet. Ved at beskrive de enkelte elementer, der indgår i bevægelsen fra fagpraksis til læringspraksis samt deres indbyrdes forhold, er det muligt at synliggøre og arbejde med de enkelte transitionsprocesser hver for sig samt sondre mellem dele og helhed for at bevare det strategiske sigte. Dette danner udgangspunkt for og letter arbejdet med eksempelvis virkningsevaluering, da de enkelte processer udover at kunne evalueres hver for sig, ligeledes kan forholdes til den overordnede strategiske proces, de indgår i.

Konsekvensen af dette er, at uddannelsesinstitutioner i første omgang er nødt til at forholde sig til hvilken fagpraksis, deres respektive uddannelser retter sig mod, før de kan forholde sig til hvilke læringsmål samt pædagogiske/didaktiske overvejelser, der skal være en del af de enkelte uddannelsers læringspraksisser. Dermed tages en større del af ansvaret for uddannelsens indhold og relevans tilbage fra ministeriet. Ligeledes vil udviklings- og evalueringsprocesserne i denne forbindelse være stærkt afhængige af detaljeringsgraden, hvormed fagpraksis er beskrevet. Dette er selvfølgelig fortsat lettere sagt end gjort. Særligt hvis man beskæftiger sig med uddannelser, der ikke nødvendigvis retter sig mod en enkelt vel-defineret og afgrænset fagpraksis. Genvinsten ved at forsøge er til gengæld muligheden for at strukturere og systematisere evalueringsarbejdet på en meningsfuld måde.

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(P2) Developing apprentice skills for innovation through interdisciplinary training and education

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Developing apprentice skills for innovation through interdisciplinary training and education

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Abstract: This paper is concerned with training students of vocational education programs; specifically, tradesmen and skilled workers to better utilise value networks and knowledge hubs, set up through government initiatives, as an innovation platform. The study indicates that massively interdisciplinary innovation workshops originally designed for university students can be adapted to vocational programs demonstrating similar effects on this demographic. Collaboration around solving real-world problems across various trades and even academic disciplines seems to influence participants' attitude towards not only interdisciplinary collaboration but also entrepreneurship in general. The study is based on two years of experimentation running six independent workshops across ten different disciplines and trades and four educational institutions.

Keywords: Innovation skills; education; interdisciplinary training; vocational education; apprentice

1 Area of interest, background and research question

In response to the OECD innovation report (2010), the Danish government published an innovation strategy proposing several focus points to increase innovation (The Danish Government 2012, p.8). Among others, the Danish strategy focuses on increased collaboration between enterprises, while tasking educational institutions to produce students with, what is referred to as, increased *innovation capacity*.

This studies area of interest is developing and testing various methods of teaching innovation skills, viewed as building innovation capacity, inside the Danish educational system, that also simulates the desired collaboration dynamic. Specifically, with regards to students currently engaged in vocational education programs coupled with apprenticeship to become tradesmen or skilled workers.

The reason for this specific focus is, that currently almost 80 per cent of enterprises in Denmark fall into the EU's micro or sub-micro category; a substantial group of which are comprised of skilled workers or tradesmen (Statistics Denmark 2014).

Moreover, many of these companies already choose to, or see a clear need to, engage in, and collaborate through, various value networks in an attempt to remain competitive, participate in larger projects and access broader markets.

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However, although the Danish government has created several initiatives to ensure a well-developed and accessible business ecosystem as part of its innovation strategy (Ministeriet for Forskning Innovation og Videregående Uddannelser 2013, p.5) preliminary interviews with randomly selected sub-micro enterprises seem to indicate that many do not feel the value they gain from these networks in any way corresponds to the amount of time and effort they invest in them. This could lead to a gradual decline in the use of said networks devaluating their appeal even more.

The sentiment was particularly evident among skilled workers and tradesmen, who are educated through vocational programs which interchange school-based education and apprenticeship in the so-called sandwich model[1].

The working hypothesis for this study is, that business owners who have undergone vocational education, simply lack training and experience in networked business practices, and therefore that teaching *innovation skills* in this case could be a matter of teaching them to use these resources effectively.

Most vocational programs focusing on skilled trades do not teach any form of business skills despite the fact that many students from these professions are well represented as small business entrepreneurs. They almost exclusively focus on their own trade and seldom on collaboration or interdisciplinary projects; despite many tradesmen later gaining employment on larger projects involving close collaboration between trades.

In contrast, students with an academic background seem more used to strategic planning, identifying skills or knowledge they require but do not possess themselves, seeking out ways to attain them or collaborating with those who already have them.

Moreover, academic students seem more naturally inclined to use the knowledge hubs around them since these are mostly comprised of academic educational and research institutions with which they already have experience through their own education.

The point of departure for this study is the question of how to change this dynamic among vocational students; particularly, in a region of Denmark that already has a well-developed, government financed, business ecosystem specifically designed to support value networks along with potential knowledge hubs (The Danish Government 2012, pp.20–24) in the form of two institutions of higher education and several others offering vocational programs.

This leads to the following research question investigated in this study:

> *How can we design vocational training modules, which develop the mind- and skillsets necessary to effectively use networks as an innovation and collaboration platform?*

This question is broken into two parts. Firstly, delivering practical training of interdisciplinary, problem-based work processes and thereby developing relevant interpersonal, communicative skills along with a basic understanding of development processes involved. Secondly, by attempting to bridge the gap between vocational education and academic education in the hopes that this will facilitate better use of knowledge hubs among trades with little or no prior connection to academic institutions that form these hubs.

The primary approach is to emulate university modules with similar goals, since preliminary enquiries indicated that university students were better equipped for networked collaboration than their vocational counterparts. For this purpose, two workshops were developed to create an innovative environment in which to simulate

collaborative product development processes; mimicking the (idealised) use of value networks portrayed in the Danish innovation strategy. One workshop would focus solely on collaboration (value networks) and the second would also attempt to bridge the gap between academic and vocational disciplines (knowledge hubs).

2 Framing

The concepts of value networks (Clarysse et al. 2014; Prahalad & Krishnan 2008) & open innovation through cross-pollination (Chesbrough 2010; Kelley & Littman 2008) is well understood and this study does not challenge or expand on it, but rather accepts it as a premise along with the Danish innovation strategy itself. The focus of this study is to examine the output (Pawson & Tilley 1997, pp.63–64), through action research, of specific training methods targeting the attitude towards and use of these types of networks in students currently engaged in some form of vocational education.

Conceptually, the experimental workshops are grounded in practice theory (Reckwitz 2002; Nicolini 2012, pp.78–92) and the idea that *educational praxis* should be based on an analysis of a specific *professional practice*. Thus, that vocational education in particular may need to interpret professional practice differently from trade to trade thereby forming different educational praxis' to fit each one (Haslam & Rosenstand 2015, p.70).

This reasoning lends itself to a much broader discussion of how innovation skills, and by extension innovation capacity, may be defined, which is the subject of a different ongoing study[ii] related to this one. This paper does not enter this discussion but simply accepts the use of value networks, as specified in the Danish innovation strategy, as a premise.

However, the distinction between professional practice and educational praxis is maintained during evaluation of the workshops since the teaching of skills, and the application of said skills are seen in two fundamentally different contexts driven by different rationales (Haslam & Rosenstand 2015, pp.66–67).

To evaluate output participant questionnaires' and interviews are used to gauge reactions from:

1. External participants representing relevant professional practice
2. Educators participating as facilitators representing education praxis
3. The students themselves representing both education (as students), and profession (as apprentices).

Having run the workshops multiple times allows for output comparison from iteration to iteration, however, no matter the consistency of results it does not allow for conclusions toward outcome; only for comparison with similar initiatives. Attempting to demonstrate causation between arbitrary educational initiatives, and long term behaviour by participants in said initiatives is considered impractical if at all possible. Thus, only process and outcome are evaluated (Krogstrup & Dahler-Larsen 2003, p.75).

This paper was presented at The XXVII ISPIM Innovation Conference – Blending Tomorrow's Innovation Vintage, Porto, Portugal on 19-22 June 2016. The publication is available to ISPIM members at www.ispim.org.

3 Experimental interdisciplinary workshops

Two workshops were designed as a platform for action research experimentation. They have each been run and revised three times over the last two years. Both are designed as innovation workshops, both are problem-based and revolve around the general theme *welfare technology* and both are based on highly interdisciplinary group work.

Welfare technology was selected as the general theme for two reasons. Firstly, the realisation of this experiment was made possible through an existing collaboration between two local institutions (SOSU Nord[iii] and Tech College Aalborg) representing health care and technology programs respectively, and secondly because the theme was considered both relatable to all participants and applicable from most educational programs perspectives to some extent.

Both workshops are modelled on existing initiatives designed and run at Aalborg University[iv] allowing their design to draw on a large body of experience. Since these initiatives were designed specifically for use at university level they could not be used outright, so were adapted in theme, scope and process rigidity to fit the vocational education programs involved. One major difference is, that students participating in the original university workshops generally do so on a voluntary basis whereas students from the vocational programs have no say whatsoever. Participation is mandatory and replaces or supplements existing *innovation theory*[v] courses.

The first workshop has a duration of three days and consists solely of participants from vocational education programs; most, but not all, of which are based on the sandwich model of school-based training and apprenticeship. Participants come from as wide a range of fields as possible across two institutions but always include enough from *health service* as well as *technology* to allow for one participant from each field to be in every group. Groups usually have between five and seven participants in total, with approximately fifteen to twenty groups per workshop.

The workshop is run, and the group work facilitated, by educators from the various educational programs represented. However, representatives from local businesses and organisations relevant to the specific workshops theme are invited to give inspirational talks, act as experts and ultimately judge the participants' contributions.

During the workshop students collaborate in groups to identify a specific problem within the theme parameters, develop a solution to this problem that could also be a viable business opportunity and finally pitch their idea to judges in under five minutes. Educators acting as facilitators help students drive the process, often introducing useful tools and methods on an ad hoc basis throughout. Thus, avoiding large blocks of theory or abstract information during the workshop; focus is almost solely on the process.

All groups receive feedback from the judges (who represent the current or relevant business practice) and a selection of the facilitators (who represent the educational praxis); a winner is declared, however, there are no prizes. The workshop is concluded with representatives from relevant local networks introducing themselves and in some cases approaching groups to discuss opportunities for continued work on their ideas.

The second workshop follows the same formula, with two exceptions: the duration is reduced to one (rather long) day, and it also includes participants from the two largest academic institutions in the area (University College North Jutland and Aalborg University). A minimum of one from each institution to participate in every group.

The reason for reducing the duration is mainly logistical since the challenge of coordinating approximately ten different educational programs across four different

institutions made it impractical to maintain a three-day duration. The reason for introducing academic students alongside vocational students is to test if and how this would affect the process dynamic, and at the same time introduce, and hopefully demystify, the concept of collaboration between vocational professions and academic disciplines.

Student feedback

Students were quizzed as to their expectations towards the workshop before participating, and asked to evaluate the workshop by completing a semi-qualitative questionnaire afterwards.

In general terms approximately 60% of vocational students did not see the workshops as at all relevant to their field or consider it at all useful to begin with. Most of this group called it an outright waste of time that should be used to train actual trade skills. The remaining 40% were largely indifferent with only 15% directly expressing a positive interest in the workshop. By contrast, in the final evaluation, almost 90% of the students stated that the workshop was *relevant* to their field and that they though the skills learned would be *very useful* in their work life.

Similarly, the final evaluations show an increased general interest in interdisciplinary projects. Interestingly, almost 80% of the vocational students said they were surprised that they themselves had anything to contribute to the process, and the other participants (students and judges) seemed to value their input.

In spite of the fact, that the actual ideas generated during the workshops are often simplistic and seldom (there are exceptions) particularly original or interesting business propositions, the students are immensely proud of what they have accomplished in such a short time. That they are working on solutions to real problems which real businesses have an interest in, seems to be an important factor towards this.

A rather surprising result is an apparently increased interest in becoming an entrepreneur within professions that typically are not noted for a high degree of entrepreneurship (f.eks. Health Care Assistants who are typically employed in government run facilities). During final evaluation, almost 40% of this group express an interest in becoming an entrepreneur at some point in their life. By contrast none expressed similar interest beforehand; many actually laughed at the idea when the question was put forward.

4 Findings

Data collected during the study consists of Excel spreadsheets containing student evaluations, recorded interviews with facilitators (educators) and various external participants (experts, judges, business and network representatives etc.) together with observational notes made by steering committee members (including this author).

The data shows many of the same tendencies as in the university counterparts they are based on (Østergaard & Rosenstand 2012; Poulsen & Rosenstand 2012) which is also theoretically underpinned within innovation and entrepreneurship education research (Poulsen & Rosenstand 2012; Poulsen & Rosenstand 2009; Smed et al. 2010).

Students from vocational programs are forced to move out of their comfort zones and collaborate with other students from different vocational backgrounds and in some case an array of academic disciplines. While this is the source of much frustration during the

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workshop, for the most part it turns out to be a largely positive experience which in turn prompts reflection; both towards the pros and cons of collaborative projects, but also on the students own professional identity and what they have to offer outside their own trade.

The rapid development of confidence among vocational students to contribute to the collective, is one of the most visible results during the workshops and seems to mirror the change in general attitude towards the idea of actively seeking out different perspectives.

5 Discussion

The idea of teaching certain skills by emulating the environments in which they are used as closely as possible is well understood. However, this study attempts to emulate a desired ideal that does not fully exist; while much of the infrastructure necessary is in place the specific demographic targeted is not currently making full use of it.

The workshops in this study emulate a reality based on what appears to work for a different demographic, but does not take into consideration that the infrastructure it seeks to enable may simply be better suited to the demographic that already seems capable of using it.

Even though these workshops have produced results similar to the original academic versions, this does not mean that the participants will be any better suited to utilise the infrastructure in question. It does, however, facilitate a visible and positive change in attitude towards the base concept of interdisciplinary collaboration among the vocational students. It also seems to *soften* the participant attitude towards entrepreneurship; possibly allowing for a broader understanding of what it means to be entrepreneurial. Whether or not this is a lasting effect is beyond the scope of this study. Although, it is worth noting that all six of the workshops held so far have displayed very similar results in this area.

6 Conclusion

This paper unfolds the question: How can we design vocational training modules, which develop the mind- and skillsets necessary to effectively use networks as an innovation and collaboration platform?

The research so far demonstrates that the type of massively interdisciplinary innovation workshops developed for university use can indeed be translated to vocational education to similar effect. Indicating that enabling effective use of value networks and knowledge hubs is a skillset that can be trained, and that these formats are a viable method of doing so.

7 Areas for feedback & development

All suggestions and ideas for further experimentation and development is much appreciated. Comments on methodology are also welcome: Alternatives to action research in the continued research? Methods and approaches regarding long term evaluation on professional practices. Specifically, in regards to demonstrating

effectiveness which is particularly relevant considering the current political discourse on education.

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Østergaard, C. & Rosenstand, C.A.F., 2012. Five waves of innovation.

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[i] In Danish the term *vekseluddannelse* is used which roughly translates into *alternating education*. However, it is usually referred to as the *sandwich model* in English.

[ii] The study is a collaboration between this author and Søren Smed from the Invio group at Aalborg University, and is concerned with developing a design-based model for working with innovation processes. It is expected to be published by late 2016.

[iii] Social og sundhedsuddannelserne Nordjylland (SOSU Nord)

[iv] Workshop for Innovation and Entrepreneurship – WOFIE (wofie.aau.dk/) and User-Driven Creative Academy - U-CrAC (ucrac.dk/) formed the inspiration and model for the basic format of the experimental workshops.

[v] Depending on the vocational or academic program the students are enrolled in, the specific course supplemented or replaced by workshop participation varies. However, all of the participating programs curriculum so far have included at least one course covering innovation that made it easily compatible.

(P3) nKNOWation: an interdisciplinary collaboration on assistive technology between two North Jutland vocational colleges

Translation of:

nKNOWation: Et sundhedsteknologisk innovationssamarbejde mellem to nordjyske erhvervsskoler

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NKNOWATION: AN INTER-DISCIPLINARY COLLABORATION ON ASSISTIVE TECHNOLOGIES BETWEEN TWO NORTH JUTLAND VOCATIONAL COLLEGES

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THIS ARTICLE PRESENTS AND REFLECTS ON THE RESULTS OF THE MOST RECENT EVALUATION OF NKNOWATION - AN INTER-INSTITUTIONAL TEACHING PROGRAMME WITH THE PURPOSE OF PROMOTING INNOVATION-THINKING REGARDING ASSISTIVE TECHNOLOGY AMONG STUDENTS ATTENDING VOCATIONAL COLLEGES. THE ARTICLE PRESENTS AND DISCUSSES WHAT THE STEERING COMMITTEE CONSIDERS TO BE THE MOST SIGNIFICANT RESULTS OF THE EVALUATION, ALONG WITH THOSE THAT COULD BE INTERESTING TO EXAMINE MORE CLOSELY REGARDING FUTURE INITIATIVES. THE INTENTION IS TO CONTRIBUTE TO THE FUNDAMENTAL DISCUSSIONS ABOUT TEACHING INNOVATION BY PRESENTING AND DISCUSSING RESULTS FROM, AND WITH SPECIAL FOCUS ON VOCATIONAL EDUCATION. IT IS ALSO OUR INTENTION TO HIGHLIGHT THE VALUE OF INTER-DISCIPLINARY INITIATIVES REGARDING THE DEVELOPMENT OF INNOVATION EDUCATION.

> "Forget Vækstforum[22] and other academic think-tanks. Give more money to initiatives like this one, because it rocks. There are fifteen ideas here that I can immediately turn into new products, because the people who work with it are practitioners". (Lasse Thomsen, LT Automation nKNOWation 2015, day 2, presentation on the importance of inter-disciplinary collaboration)

[22] (*) Vækstforum, literally translated as Growth Forum, is the name given to a regional business development initiative in collaboration between local business, education and government. See http://www.rn.dk/regional-udvikling/vaekstforum for more information.

Over the past ten years there has been increasing focus on the ability of our workforce to be innovative and creative, to secure Denmark's competitiveness in the global arena. That is especially true within several selected areas in which Denmark wishes to be ahead of the field (Ministry of Education and Research, 2012, s. 15).

Within the field of education this has meant a more proactive role in the development of innovation-courses, along with focus on new areas by the educational institutions (ibid., s. 27-289). Specifically, this has led to resources for development projects being prioritised. An example of this is the start-up and operation of the project *nKNOWation.* The project is part of a larger inter-institutional collaboration between Tech College Aalborg and SOSU Nord (Health College – VET) in North Jutland and, in addition to being inter-disciplinary, it also sets out to promote innovation competencies among vocational college students and to challenge the existing borders between different disciplines.

The purpose of this article is to describe the project and present the most significant results from the third, and most recent, generally positive internal evaluation[23] carried out in the autumn of 2015. The intention is to contribute to the discussion on innovation education from a vocational education perspective. This springs from practical experience with the nKNOWation initiative, as an alternative or supplement to the more traditional teaching *about* innovation that is used in many educational programmes, including those participating in nKNOWation.

In the following we briefly describe the background to the development of the nKNOWation-collaboration along with the inspiration behind its structure. We then describe the initiative itself, including how the workshop was run, and the practicalities of its evaluation by the steering committee in conjunction with last year's workshop. Finally, we summarize and discuss the results that the steering group considers to be most relevant about the evaluation. We conclude on the extent to which nKNOWation and similar inter-disciplinary initiatives seem able to offer participating educational programmes something additional to what they can achieve through their existing approaches, while, at the same time, being able to justify its costs to a reasonable degree.

Background and development

In 2011 both Tech College Aalborg (TCAA) and SOSU Nord (SOSUn) identified, independently of each other, an accelerated use of assistive technology throughout the entire Health and Home Care Sector leading to a desire, each for their own reasons, to intensify initiatives in that area. That led to a loose collaboration focused on exploring the field of assistive technology, which in turn led to a formal collaboration

[23] The internal evaluation report has not been prepared with the intention of external use, and neither is it particularly suitable for such. It is for that reason we have chosen to summarise and deliver the most important points in the form of an article.

agreement between SOSUn and TCAA in 2012. The Innovation workshop nKNOWation (which until 2014 went under the name X-Factor) is just one of a string of initiatives that resulted from that agreement.

The design of nKNOWation was inspired by, among others, Lotte Darsøe's thoughts on innovation pedagogy (Darsøe, 2011) and Lene Tangaard's on creativity (Tangaard, 2008), which have been coupled with ideas from local companies. The latter are typically companies that recruit students directly from either TCCA or SOSUn, or companies that have expressed interest in innovation generally or specifically about assistive technology. The didactic model for the workshop's learning practice is inspired, albeit in a looser, less controlled form, by *The Creative Platform* (Hansen & Byrge, 2008). Thus, the concept builds on the idea of bringing several disciplines into play and creating space for creative work on a real problem, so that the established competence-mix would provide fertile ground from which better and more innovative solutions could emerge than those the individual disciplines could have arrived at independently (Darsøe, 2011, s. 50-52; Hansen & Byrge, 2008, s. 59-60; Tangaard, 2008, s. 15). Fundamentally, nKNOWation views innovation as a form of focused creativity; i.e. the conscious and purposeful application of various forms of creative process to create value within one or more specific areas. That is one of the reasons for working with real, tangible problems within a practical workshop rather than a theoretical course. The objective is to develop practical competencies and a desire to work in this way; not just talk about it.

In many ways nKNOWation builds on ideas and principles borrowed from similar workshops held at Aalborg University (AAU) and University College North Jutland (UCN); for example, *WOFIE, U-CrAc and Solution Hub*[24]. Several members of the steering committee are involved with innovation education in general as well as some of these workshops to a greater or lesser degree. All of them have a positive impression of these workshops' effect on the students' desire to collaborate across disciplines. This led to some curiosity about whether, or to what extent, the same principles could be applied to vocational education.

Thus, there arose a desire to attempt to transfer these principles to vocational education programmes, and to find out what would happen when the students were put in a situation where they needed to understand a problem that stretched beyond their own disciplines. The hypothesis was that this would give them increased understanding and respect for their own and the other participant's disciplines. And, at the same time provide them with a positive experience of inter-disciplinary collaboration plus a positive example of being part of an innovation process, despite this not being traditionally seen as part of their respective professional cultures.

[24] (*) See: http://www.wofie.aau.dk/, http://ucrac.dk/ & http://www.solutionhub.dk/ for more information on these initiatives.

In this way, an educational initiative designed with the intention of promoting innovative thinking among students, must also develop the right attitudes and openness to the same extent as it must deliver practical knowledge and skills related to innovation and entrepreneurship. The basic assumption is that the students become capable of examining and testing their disciplines and professional knowledge along with their ability to identify new possibilities for the future conversion of ideas into value. In this way, we can develop the attitude that they can help to bring about change and innovation; something that hopefully can become a valuable societal resource immediately during the workshop, and especially when transferred to professional practice (Lund & Jensen, 2011).

These general ideas led to the development of an nKNOWation manual which, in addition to providing the guidelines for the practical aspects of the initiative also formed the basis for the subsequent evaluation. The innovation workshop was held for the first time in September 2013 and then annually, each time with small changes and adjustments, all of which are reflected in the manual.

The nKNOWation initiative

The initiative takes the form of a workshop where the students are divided into clusters, each of around 40 students. Each cluster is then divided into 5-6 groups, each with between 6 and 8 vocational students. Each cluster is assigned a room, which is arranged with a specific area for every group, plus a storage area with different materials and tools that can be used during the creative process. Standard items include *post-it* pads, colours, cardboard, modelling wax and similar basic creative aids, but the actual assortment is adjusted according to the subjects addressed. Typically, there are three facilitators attached to each cluster, always including at least one experienced facilitator; normally a member of the Steering Committee.

The students work inter-disciplinarily so the clusters and groups are pre-arranged distributing them as evenly as possible based on their educational subjects, gender, age and culture. Each contributes to the group work with his/her professional knowledge and experience. In 2015, TCAA students from the following departments participated: Metal Work, Industry Technician, Technical Design, IT specialist as well as Web and Media Design. From SOSUn there were students training to be Social and Health Assistants (SSA) and Pedagogical Assistants (PAU). The groups can get inspiration from the presentations held once or twice each day by invited speakers, and from various experts from fields relevant to the workshop theme. These experts move around between the clusters and groups and can be called on when needed. In addition to professional guidance, the job of the facilitators is to ensure that the groups get started, that participants communicate with confidence and respect for each other and that the process doesn't come to a halt. Several of the tools and techniques used in the process of generating ideas, organising and combining ideas and to get all the professional disciplines in play are borrowed from *The Creative Platform*. However, in practice the role of the facilitators is generally no different to what it would be in any other teaching situation that makes use of group work. Normally the groups

manage themselves for a large part of the time, which enables the facilitators in most cases to take a more advisory role based on their own professional experience once the process is under way.

When around two thirds of the allocated time have elapsed the work focus shifts from creating and developing an idea, to presenting it as a short *pitch* to a potential investor. Thus, there is a shift from innovation towards entrepreneurship which, on the final day, culminates with all groups presenting their ideas to a panel of judges; each judge having direct interest in the workshop theme. The focus at this point is not on the idea itself, but on its potential to be converted into value as a product or business plan. The judging panel is always composed of real investors and representatives of companies that work with the selected themes and /or related technologies.

Parallel presentations are held in the clusters, each with the participation of two judges from the judging panel. The judges choose one winning idea from each cluster, which then compete against each other in the final, where they face the entire panel of judges and all the workshop participants. So far, the main prize has been of a symbolic nature along with the honour of winning. However, the judges often indicate that they are willing to enter collaboration with groups on ideas in which they can see potential. On two occasions, students have received direct offers from judges who were willing to invest in their ideas.

The evaluation process

Our fundamental perspective on innovation is based in a systemic understanding of causality through which it is neither relevant nor possible to measure a direct causal *effect* after such a short period, if at all. Our approach to evaluation is inspired by Ray Pawson and Nick Tilley's thoughts on *Realistic Evaluation* (1997) and Peter Dahler-Larsen's Virkningsevaluering (Krogstrup & Dahler-Larsen, 2003 s,51-79). Focus was placed on process evaluation of the actors perceived experience during the event, rather than seeking to identify and evaluate an objective or direct causal effect of the workshop in practice. To that end, the following four actor-groups were identified (see side-bar), and data collected from among representatives of each group; either through short interviews or by questionnaire.

The framework for the evaluation was the *nKNOWation Manual*[25], which in this context came to function as a form of improvised programme-theory (Krogstrup & Dahler-Larsen, 2003, s,60-69), although it was not originally designed for that purpose. The manual's objective was broken down into four areas of interest within which each actor-group's data was analysed in relation to: *the practical aspects of inter-institutional collaboration, experiences with inter-disciplinary group-work, knowledge transfer between education and industry* and *the extent to which students appeared to demonstrate innovative and entrepreneurial behaviour*. Focus was exclusively placed on the practical work and not on its theoretical or ideological foundations.

The Steering Committee, *which includes the authors as well as several other educators and the directors from both participating institutions (3 evaluation discussions and 5 interviews).*

The Participant Group, *that includes all the students who participated in the workshop (qualitative questionnaire completed by 124 respondents out of 150 asked).*

The Facilitator Group, *consisting of educators from the represented educational programmes that were not also members of the Steering Committee (qualitative questionnaire with 9 respondents out of 16 asked).*

The Stakeholder Group, *that represents all external partners that have participated; for example, presenters, judges, expert and advisers from relevant companies and* organisations *(12 evaluation discussions during the workshop).*

Summary of results

The significant results of the internal evaluation of nKNOWation 2015 are examined here in relation to the above areas of focus. However, the results should also be seen in light of certain general data about the participant group.

The participant group was split from the start regarding their attitude towards the event. Participation is not voluntary. It is an element in the innovation disciplines of the respective educational programmes. From the moment participants were informed of the event 31% of them expressed the opinion that it was a waste of time and that they preferred normal classes. 20% were indifferent towards the format and 49% were positive about the idea of trying something other than classroom-based teaching.

The educational distribution was such that 59% came from SOSUn and the remaining 41% from TCAA. As Social and health Assistants and Pedagogical Assistants typically see themselves as being employed in the Public Sector (usually by the Municipal Authority), their interest in entrepreneurship was almost non-existent. By

[25] As the manual is very detailed, we do not describe it in depth in this paper.

contrast, most students from TCAA's educational programmes (83%) were open to the idea of starting their own enterprises at some point.

The gender distribution was characterised by an over-representation of female participants from SOSUn (85% females / 15% males) compared to a similar over-representation of male participants from TCAA (16% female / 84% male).

Thus, the workshop had a very stereotypical participant-mix of primarily females from health and pedagogical professions, and primarily males from skilled trades with a third of the total number of participants not wanting to be there.

Collaboration between institutions and educational programmes

Right from the beginning, the Steering Committee believed that collaboration between different educational programmes, and especially between different institutions would be the biggest barrier to overcome. However, despite savings and falling student numbers and the reform of commercial colleges that element of the initiative was surprisingly problem-free.

The evaluation has shown that members of nKNOWation's Steering Committee are agreed that it had been no more challenging to plan an inter-institutional workshop than it would have been to arrange something similar within the framework of their own institutions. Four fifths (80%) felt that it could be compared directly to similar mono-institutional courses or workshops that involved more than one teacher. Although, it is underlined that the planning of something new always requires extra resources the first time, which is even more apparent in an inter-institutional context. Basically, the increased distance combined with lack of insight into the specific activities and objectives of the respective educational programmes contribute to the increased amount of time needed to begin with; more so than with similar internal initiatives. On the other hand, and broadly speaking, it is felt that the probable differences between multi- and mono-institutional planning are already negligible on the second iteration of such an event; on the condition that there have not been any major changes to the Steering Committee in the meantime.

In addition, it has been found to be advantageous to allow educators to follow their respective classes by including them in the facilitator group. It is much more useful to have a facilitator group that knows the students and how to motivate them, than only to use people who are good at, or particularly keen on a specific method (as, for example *The Creative Platform*). The participant group is by nature very heterogeneous, for which reason earlier use of single methodology has done more harm than good. In the first attempt with nKNOWation almost 30% of the participants left after the first half hour during mandatory plenary use of 3D-cases from *The Creative Platform*. In 2015 were there practically none (apart from isolated cases of illness) who left the workshop. 3D-cases and similar methods are still used, but no longer to the same degree and not in plenary sessions. It is now up to the individual

facilitators to decide how they will work with a given group at a given time. Everyone in the facilitator group is presented in advance with a selection of common tools, which they can draw on along with methods and techniques with which they are already used to working. An additional benefit that arises from using the participants' own educators is purely economic, as it reduces the number of extra person-hours needed.

The deciding factor pointed to by members of the Steering Committee regarding this form of collaboration seems to be the need for a formal framework, and thereby support (and not least, flexibility) from the involved institutions' managements along with a stable, inner core of enthusiasts that drive the project forward year after year. With that established, there do not seem to be any major economic or time-wise differences between hosting multi- or mono-institutional events of the same type[26]. The central experience gained from nKNOWation within this area is that collaboration does not necessarily lead to compromise on pedagogical or learning objectives due to economic or resource limitations.

Inter-disciplinary group work

Most members of both the participant and facilitator groups are agreed that the group work, which is specifically designed to be inter-disciplinary, has been a positive experience. Participants see their differences either as an advantage, since it increases the group's collective knowledge-base which can be leveraged to solve the problem at hand, or as a hindrance when they cannot immediately see how knowledge from their own professional discipline can contribute. Both the participants and the facilitators experience continued shifts between these extremes throughout the entire process. However, almost all (participants and facilitators) remark that a change takes place in the process when participants stop thinking so much about *what* they (as individuals) can or should contribute and, instead, simply begin participating in the group work. Once that happens the majority begin to recognise the differences within the group as its strength. In this context, it is interesting to note that during the final evaluation, participants place much greater importance on the other group members' personalities and levels of engagement rather than which professional disciplines they represent.

How easily and quickly a group arrives at that change in attitude varies enormously. The more extrovert the group's members, the easier it seems to be for them to reach that point. By contrast, groups with more introvert members need more time, and maybe also more help from the facilitators. According to the facilitator group there are only a handful of individuals who, after the first day still insist that they have nothing to contribute. Given that a third of the participants were negative at the start, this doesn't seem too surprising. Subsequently 88% of the members of the participant group claimed to have had a positive group work experience, 49% commented that it

[26] It is assumed that participating institutions are not geographically too far apart, so the necessary costs of transport, accommodation etc. are not excessive.

had been a useful learning experience to need to explain something to others, that they took for granted themselves, and 77% felt that it had been an advantage having different professional perspectives represented during group work.

This implies that the precise professional composition in relation to the theme seems to be less important for the process than we had originally thought to be the case. That there is a difference between the participants; both professional and personal, is what really makes the difference. Mixing participants from different educational programmes and educational cultures is simply a convenient way to ensure a certain diversity. A greater professional spread initially increases the need for process facilitation. However, on the other hand one can imagine that greater professional distance from each other, and from the subject being worked with, could potentially make it easier for participants to overcome the idea that their professional perspective is the only thing they can contribute.

Between education and enterprise

Lasse Thomsen's quotation at the beginning of this article exemplifies very well what the Stakeholder group mentions each time we host nKNOWation. They are typically enthusiastic, both because the work is directed at generating ideas about known and real problems in which the stakeholders have a direct interest, or are particularly knowledgeable about, and for the ideas generated.

Having said that, we know of only very few cases where either the participants themselves or members of the stakeholder group continue to work with ideas and thoughts developed during an nKNOWation event. At the time of writing we know of just one student who has sought advice and office space with the entrepreneurial incubator initiative IgangZ (www.igangz.dk) in Aalborg, and two private companies that have offered to collaborate with a group of students on the development of an idea. However, we do not know if the students decided to take advantage of this offer.

Several members of the stakeholder group underline that the actual ideas produced are not the most important output. It is more that a new generation of workers begins thinking about problems which are of interest to their companies and institutions.

The participants highlight the enormous importance (for them) of working with real problems and then presenting their ideas to companies and organisations that have genuine interest in those problems and their proposed solutions. More than half (58%) mentioned in the evaluation that this had been a deciding factor towards their motivation during the workshop.

Considering the above, there is no doubt that nKNOWation and similar initiatives help to create closer contact between various educational and professional practices. So far, however, it seems that the advantages of this have mainly benefitted the students'

education, as it is still unclear what, or how much value the stakeholder group members derive from the collaboration.

One positive result could be that contact is established between students, companies and organisations that would not otherwise have sought each other out. That only happens as a direct consequence of bringing together students and companies physically, in the same room, to work together on the same subject. This is a simple principle that could easily be used to much greater effect than has been the case so far.

Thinking innovatively and being entrepreneurial

How much the way in which participants' work can be said to indicate the degree of either innovative or entrepreneurial behaviour is largely a theoretical question. There is no consensus about what working innovatively constitutes other than by assessing the perceived value of the results and ascribing the process significance retrospectively. As nKNOWation has not directly led to anything tangible that can be said to have created significant value within the field of assistive technology, or produced a significant number of participants who have subsequently become start-up entrepreneurs, we cannot evaluate this aspect in that way.

The process is, however, developed based on different suppositions about skills that are sought by enterprises employing students from the participating educational programmes. Examples of this are expressed in terms such as: inter-disciplinary collaboration, practical problem-solving, communication training and creative idea-generation. These terms can be said to come from, and to some extent represent professional practice (Haslam & Rosenstand, 2015, s67 and 69) and were all included in the development of the nKNOWation concept. Although they are also described in the manual, no precise goals were defined describing how these qualities are expected to manifest themselves.

As there are no measurable results that directly indicate either innovation or entrepreneurship we are unable to say anything about the process except that it was designed based on, and to the satisfaction of, the wishes of our representatives from professional practice along with those implied through the theoretical perspective on innovation processes we have applied.

Our evaluation results do, however, show that both the participants and stakeholders have a mostly positive impression of nKNOWation and its relevance. 87% of the participants were positive about the final products of their respective groups, while only 2% were negative. 52% felt that they would not have arrived at such a good result through mono-disciplinary group work within their respective educational programmes. Overall, 88% considered the group work in general to have been a positive experience while only 6% felt it was a negative experience.

We consider this to be a strong indication that the students felt they had contributed useful solutions to the practical problems with which they were faced, and that the process within the inter-disciplinary groups had been positive. As mentioned above, the stakeholders also expressed enthusiasm for the process, although this is potentially less indicative since they, unlike the participants, were willing participants from the beginning.

An interesting and unexpected result of the evaluation in the participant group was that 48% responded that they were interested in starting their own companies. That was not immediately eye-catching since students from several TCAA programmes often break-out on their own at some point during their career. However, it became apparent, that this did not only represent the attitude among TCAA students, but was also true for 34% of the social- and health assistants and as many as 44% of the pedagogical assistants. These are programmes typically aimed at employment in the Public Sector, and students who typically have absolutely no inclination towards starting their own companies. What these figures could mean is not clear, but are interpreted as further indication that the participants' experience of the event was positive; even though their immediate interest in self-employment might wane when the immediate excitement wears off.

Conclusions

Overall, nKNOWation seems to contribute something that the individual educational programmes cannot offer. The collaboration between students from different disciplines and different educational institutions is experienced positively by all parties. This gives increased respect for other professions and viewpoints as well as providing a clearer understanding of one's own profession and related competencies. It also seems to lead to enhanced interest and curiosity about working with other professional groups. Similarly, it appears to lead to increased awareness among the students that they really can make a difference if they want to, and that everyone, regardless of professional discipline has something to contribute in innovation processes. There can be no doubt that there are benefits to putting students from different backgrounds together, but it is interesting to note, that the specific constellation of professional backgrounds appears less significant.

The amount of knowledge transfer between educational and professional practice is limited. Students become aware of business sectors, technologies and problems they may not have encountered otherwise; at least not this early in their careers. In the same way, the stakeholders go home with the occasional good ideas and possibly different (more positive) views of educational programmes that they otherwise would not have thought to be of interest to them. However, the fact remains that that the event was arranged by educational programmes and primarily creates value for those programmes and their students.

As collaboration between institutions is not necessarily more complicated or costly than would be the case with similar events arranged within individual educational programmes this type of workshop is an interesting tool that can be used as a model for future initiatives with other disciplines and problem configurations. What seems to be a decisive element towards success is a stable Steering Committee ensuring that intentions, experiences and procedures are gathered from the start and not lost along the way.

To what extent there has really been a radical shift in perspective regarding self-employment among SOSUn students is unknown. Do they think of it of as starting something *in addition to* their permanent employment, or is it simply an expression of a moment's elation after the result of an enjoyable experience? That is something worthy of further inquiry. In the meantime, the experiences from this event and its evaluation can be transferred to and used in other parts of the educational system.

The evaluation cannot say anything about how close the event came to the overall objective that the government has set for its Innovation Strategy. That will require much more intense work with this type of project and with many more disciplines over a longer period. In practical terms, however, this event has shown itself to be an effective way of helping students to become familiar with project work of a more practical nature; partly because it brings together students from a range of different disciplines and partly because it works in a practical way with real problems. This, of course, implies that the approach reflects what can be experienced in real innovation processes. Even if there is any doubt about that, we still maintain that the project has value simply because most professional practices involve some degree of inter-disciplinary work, such as the students have experienced through nNKOWation.

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(P3a) nKNOWation: et sundhedsteknologisk innovationssamarbejde mellem to nordjyske erhvervsskoler

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nKNOWation

et sundhedsteknologisk innovationssamarbejde mellem to nordjyske erhvervsskoler

Denne artikel formidler og reflekterer over resultaterne fra den seneste evaluering af nKNOWation – et tværinstitutionelt undervisningsforløb, hvis formål er at fremme sundhedsteknologisk innovationstænkning hos erhvervsskoleelever. Artiklen præsenterer og diskuterer det, styregruppen anser som de væsentligste erfaringer fra evalueringen, samt resultater, der kunne være interessante at undersøge nærmere fremadrettet. Hensigten er at bidrage til den fundamentale diskussion om innovationsundervisning gennem formidling af resultater fra, og med særlig fokus på, erhvervsuddannelser. Ligeledes er hensigten at belyse værdien af tværfaglige undervisningsforløb til udvikling af innovationsfag.

"Glem Vækstforum og alle mulige akademiske tænketanke. Giv nogle flere penge til arrangementer som det her – fordi det rykker. Her er 15 ideer, som jeg kunne tage direkte og lave om til nye produkter, fordi det er praktikere, som arbejder med det."

Lasse Thomsen, LT Automation
nKNOWation 2015, dag 2, oplæg om vigtigheden af tværfagligt samarbejde.

Gennem det seneste årti er der kommet stigende fokus på vores arbejdsstyrkes evne til at være innovativ og nytænkende og derigennem sikre Danmarks konkurrenceevne på den globale arena. Dette gælder særligt inden for en række udvalgte indsatsområder, hvor Danmark ønskes at ligge forrest i feltet (Uddannelses- og forskningsministeriet, 2012, s. 15).

På uddannelsesområdet har det betydet en mere proaktiv rolle i udviklingen af innovationsfag samt nye faglige fokusområder hos uddannelsesinstitutionerne (ibid., s. 27-28). Helt konkret har dette medført, at der er blevet prioriteret midler til udviklingsprojekter. Et eksempel herpå er opstart og drift af projektet *nKNOWation*. Projektet er led i et større tværinstitutionelt samarbejde mellem Tech College Aalborg og de Sociale og Sundhedsfaglige Uddannelser i Nordjylland, og det har, ud over at være et tværfagligt undervisningsforløb, til hensigt at fremme innovationskompetencer hos erhvervsskoleelever samt udforske de eksisterende grænser mellem forskellige fag.

Formålet med denne artikel er at beskrive projektet samt formidle de væsentlige resultater fra den seneste, generelt positive, interne evaluering[1] af forløbet, der er afviklet for tredje gang i efteråret 2015. Hensigten er at bidrage til diskussionen om innovationsundervisning i et erhvervsuddannelsesperspektiv. Dette sker med afsæt i erfaringer fra nKNOWation-forløbet som et alternativ eller supplement til den mere traditionelle undervisning om innovation, der også benyttes på mange uddannelser, herunder dem, som er repræsenteret på nKNOWation.

I det efterfølgende beskriver vi kort baggrunden for udviklingen af nKNOWation-samarbejdet samt inspirationen til selve forløbets struktur. Dernæst beskriver vi selve forløbet, herunder hvordan det afvikles, samt det konkrete evalueringsarbejde, der blev foretaget af styregruppen i forbindelse med sidste års workshop. Slutteligt opsummeres og diskuteres de resultater, som styregruppen fandt mest relevante i forbindelse med denne evaluering. Der konkluderes på, hvorvidt nKNOWation og lignende tværfaglige initiativer synes at tilbyde uddannelserne noget ud over det, de ville kunne opnå på egen hånd, som samtidig i nogen grad retfærdiggør dets omkostninger.

Baggrund og udvikling

I 2011 identificerede Tech College Aalborg (TCAA) og de Sociale og Sundhedsfaglige Uddannelser i Nordjylland (SOSU Nord) hver for sig en accelererende anvendelse af velfærdsteknologi i hele sundheds- og plejesektoren og ønskede derfor, med hver sit udgangspunkt, at intensivere indsatsen på dette område. Dette førte til et løst samarbejde om udforskning af emnet velfærdsteknologi, der i 2012 ledte til en formel samarbejdsaftale mellem SOSU Nord og TCAA. Innovationsworkshoppen nKNOWation (der frem til 2014 gik under navnet X-Faktor) er ét ud af en stribe tiltag, der er opstået som resultat af denne aftale.

1 *Den interne evalueringsrapport er ikke udarbejdet med hensigt på eksternt formidling eller samlig egnet hertil, hvorfor vi vælger at opsummere og formidle dens væsentligste pointer i artikelform.*

nKNOWation: ET SUNDHEDSTEKNOLOGISK INNOVATIONS-SAMARBEJDE MELLEM TO NORDJYSKE ERHVERVSSKOLER

nKNOWation er designet med inspiration hentet fra bl.a. Lotte Darsøs tanker om innovationspædagogik (Darsø, 2011) og Lene Tanggaards om kreativitet (Tanggaard, 2008), som er blevet koblet med ideer fra lokale virksomheder. Det er typisk virksomheder, der enten direkte aftager elever fra TCAA eller SOSU Nord, eller virksomheder, der har udvist særlig interesse for innovationsforløb som sådan eller specifikt for sundhedsteknologi. Den didaktiske model for workshoppens læringspraksis er inspireret af Den Kreative Platform (Hansen & Byrge, 2008) om end i en noget løsere og knap så styret form. Konceptet bygger således på ideen om at bringe flere fagligheder i spil og skabe rum for at arbejde kreativt med en reel problemstilling, så det etablerede kompetencekryds ville give grobund for nogle bedre og mere innovative løsninger, end hvad hver faglighed havde kunnet hver for sig (Darsø, 2011, s. 50-52; Hansen & Byrge, 2008, s. 59-60; Tanggaard, 2008, s. 15). Grundlæggende set tager nKNOWation udgangspunkt i innovation som en form for målrettet kreativitet, altså at man bevist og målrettet benytter forskellige former for kreative processer til at skabe værdi inden for et eller flere specifikke områder. Dette er bl.a. årsagen til, at der arbejdes med konkrete og reelle problemstillinger, samt at der er tale om en praktisk workshop og ikke et teoretisk kursus. Målet er at fremelske kompetencerne og lysten til at arbejde på denne måde og ikke blot at berette om det.

På mange måder bygger nKNOWation på ideer og principper, som er lånt fra lignende workshops afholdt på Aalborg Universitet (AAU) og University College Nordjylland (UCN), som eksempelvis WOFIE, U-CrAc og Solution Hub. Flere af styregruppens medlemmer beskæftiger sig bredt med innovationsundervisning og er involverede i disse forløb i større eller mindre grad. Alle har en positiv opfattelse af forløbenes effekt på de studerendes lyst til at samarbejde på tværs. Dette affødte en nysgerrighed om, hvorvidt de samme principper ville kunne anvendes blandt erhvervsuddannelser.

Således opstod et ønske om at oversætte disse koncepter om innovationsundervisning til erhvervsuddannelser, men hensigten var også at afprøve, hvad der ville ske, når man satte eleverne i en situation, hvor de havde behov for at forstå et problem, der rakte ud over deres eget fagområde. Hypotesen var, at det ville medføre øget indsigt og respekt for egen og andres faglighed og give dem en positiv oplevelse af tværfagligt samarbejde samt en oplevelse af, at man kan være innovativ, selvom det ikke traditionelt anses som en del af ens faglige kultur.

Dermed anses et uddannelsesforløb, hvis hensigt det er at fremme innovationstænkning hos eleverne, at have til opgave at opbygge og fremme de rette holdninger og den rette åbenhed, i lige så høj grad som de har til opgave at videre-bringe konkret viden og færdigheder om innovation og entreprenørskab. De grundlæggende værdimæssige antagelser er, at eleverne sættes i stand til at udforske og afprøve deres faglige viden samt deres evne til at se nye muligheder for derefter at omsætte ideerne til værdi. Derigennem udvikles den holdning, at de hver især kan være med til at skabe forandring og innovation, noget, der forhåbentlig kan blive en værdifuld samfundsmæssig ressource allerede under forløbet og i særdeleshed, når den overføres til arbejdslivet (Lund & Jensen, 2011).

Disse overordnede ideer førte til udviklingen af en drejebog for nKNOWation, som, ud over at danne udgangspunkt for det praktiske arbejdet med forløbet, også blev fundament for det efterfølgende evalueringsarbejde. Innovationsworkshoppen blev afholdt første gang i september 2013 og gentaget hvert år derefter med små ændringer og tilpasninger, som alle afspejles i drejebogen.

nKNOWation-forløbet

Selve forløbet afvikles som en workshop, hvor eleverne er inddelt i klynger af ca. 40 personer. Hver klynge er igen opdelt i 5-6 grupper på mellem 6 og 8 erhvervsskoleelever. Hvert klyngelokale er indrettet med et område til hver gruppe samt et lager af forskellige materialer og redskaber, der kan bruges i den kreative proces. Faste bestanddele er post-it-sedler, farver, karton, modellervoks og lignende basale kreative remedier, men det nøjagtige indhold justeres, alt efter det emne der arbejdes med. Der er typisk 3 facilitatorer og heraf altid mindst én erfaren facilitator, normalt en fra styregruppen, knyttet til hver klynge.

Eleverne arbejder tværfagligt og sammensættes forud for workshoppen på tværs af uddannelser, køn, alder og kultur. De bidrager hver især med deres faglige viden og erfaringer i gruppearbejdet. Fra TCAA deltog i 2015 elever fra Smede-, Maskin-, Teknisk Design samt IT, Web og Medie uddannelserne, mens der fra SOSU Nord deltog elever fra uddannelserne til social- og sundhedsassistent (SSA) og pædagogisk assistent (PAU).

Grupperne kan få inspiration fra de faglige oplæg, der afholdes en eller to gange hver dag, samt fra forskellige eksperter inden for det pågældende tema. Sidstnævnte bevæger sig rundt mellem grupper og klynger og kan tilkaldes efter behov. Facilitatorernes opgave er, ud over faglig vejledning, at sørge for, at grupperne kommer i gang, at deltagerne kommunikerer med indbyrdes tillid og respekt over for hinanden, samt at processen ikke går i stå. Flere af de konkrete redskaber, der bruges til idegenerering, organisering og kombination af ideer samt til at få alle fagligheder i spil, er lånt fra Den Kreative Platform. Ofte er facilitatorernes rolle dog ikke anderledes end i enhver anden undervisningssituation, der benytter gruppearbejde. Normalt klarer grupperne sig selv langt hen advejen, hvorfor facilitatorerne i de fleste tilfælde primært indtager en mere vejledende rolle ud fra deres egen faglighed og erfaringer, når først processen er godt i gang.

Omkring to tredjedele inde i forløbet skifter arbejdet fokus fra at generere og udvikle en ide til at kunne præsentere den som et pitch til en potentiel investor. Der sker således en bevægelse fra innovation mod entreprenørskab, og denne del kulminerer i, at alle grupper præsenterer deres ide for et panel af dommere, der på hver sin måde er interessenter i forhold til temaet. Fokus er nu ikke kun på selve ideen, men også på dens realiserbarhed som produkt eller forretning. Dommerpanelet er sammensat af reelle investorer og repræsentanter for virksomheder, der arbejder med temaet eller relaterede teknologier.

Der holdes oplæg parallelt i hver klynge. Her er der to deltagere fra dommerpanelet, som vælger en vinderide fra hver klynge, og de udvalgte ideer konkurrerer mod hinanden i finalen, hvor de står over for det samlede dommerpanel og alle deltagerne. Præmier har indtil videre været symbolske, så det er primært æren, der kæmpes om. Dog giver dommerne ofte udtryk for, at de er parate til at indgå samarbejde med grupperne om ideer, de kan se et potentiale i. Det er sket to gange, at elever har modtaget direkte tilbud fra dommere, der er villige til at investere i deres ideer.

Evalueringsarbejdet

Vi anskuer grundlæggende innovation ud fra en systemisk kausalitetsforståelse og finder det dermed hverken relevant eller muligt at forsøge at måle en direkte kausal *effekt* efter så kort tid, om overhovedet. Vores tilgang til evalueringsarbejdet er inspireret af Ray Pawson og Nick Tilleys tanker om *Realistic Evaluation* (1997) samt Peter Dahler-Larsens *Virkningsevaluering* (Krogstrup & Dahler-Larsen, 2003, s. 51-79). Fokus blev lagt på procesevaluering af aktørernes konstruerede oplevelser af forløbet, frem for at forsøge at

identificere og vurdere en objektiv og direkte kausal effekt af denne i praksis. Til dette formål blev der identificeret følgende fire aktørgrupper, hvorefter der blev indsamlet kvalitative data blandt repræsentanter fra hver gruppe gennem enten korte interviews eller spørgeskema:

- **Styregruppen**, der foruden undertegnede m.fl. undervisere også inkluderer direktørerne fra begge deltagende institutioner (3 evalueringssamtaler og 5 interviews).
- **Deltagergruppen**, der udgør samtlige elever, der deltog i workshoppen (kvalitativt spørgeskema fra 124 respondenter af 150 adspurgte).
- **Facilitatorgruppen**, bestående af undervisere fra de repræsenterede uddannelser, som ikke er en del af styregruppen (kvalitativt spørgeskema fra 9 respondenter af 16 adspurgte).
- **Interessentgruppen**, der repræsenterer alle eksterne parter, som har deltaget, eksempelvis oplægsholdere, dommere, ekspertpaneler og vejledere fra relevante virksomheder og organisationer (12 evalueringssamtaler under forløbet).

Afsættet for evalueringen var forløbets drejebog[2], der i denne kontekst kom til at fungere som en form for improviseret programteori (Krogstrup & Dahler-Larsen, 2003, s. 60-69), da den ikke oprindeligt var skrevet med det formål. Drejebogens mål blev brudt ned til fire interesseområder, som hver aktørs data blev analyseret ud fra: *det praktiske samarbejde på tværs af institutioner og uddannelser, erfaringer og oplevelser med tværfagligt gruppearbejde, vidensoverførsel mellem uddannelser og erhverv*, samt hvorvidt eleverne syntes at udvise *innovativ og entreprenant adfærd*. Fokus var udelukkende på forløbets udførelse og ikke på det teoretiske eller ideologiske udgangspunkt.

Opsummering af resultater

De væsentlige resultater af den interne evaluering af nKNOWation 2015 gennemgås her ud fra de ovenstående interesseområder, som evalueringen har fokuseret på. Der er dog nogle overordnede data om deltagergruppen, som disse skal ses i lyset af.

Deltagergruppen var fra starten splittet med hensyn til deres holdning til forløbet. Deltagelse er ikke frivillig, men indgår som et element i de respektive uddannelsers innovationsfag. Allerede da deltagerne blev informeret om forløbet, gav 31 % udtryk for, at de syntes, det var spild af tid, og at de foretrak almindelig undervisning, 20 % var ligeglade med undervisningens form, og 49 % var positive over for ideen om at prøve noget andet end klasseundervisning.

Uddannelsesfordelingen var således, at 59 % kom fra SOSU Nord (Social- og Sundhedsassistenter & Pædagogiske Assistenter), og de resterende 41 % fra TCAA. Da Social- og Sundhedsassistenter og Pædagogiske Assistenter typisk ser sig selv i kommunal ansættelse efter endt uddannelse, var interessen for entreprenørskab nærmest ikkeeksisterende hos dette segment af deltagergruppen. Derimod var flertallet af elever fra TCAA's uddannelser (83 %) åbne over for tanken om at starte som selvstændig på et tidspunkt.

Kønsfordelingen var præget af en overvægt af kvindelige deltagere fra SOSU Nord (85 % Kvinder/15 % Mænd) mod en tilsvarende overvægt at mandlige deltagere fra Tech College Aalborg (16 % Kvinder/84 % Mænd).

Således var udgangspunktet for workshoppen en meget omkring en tredjedel af det totale antal deltagere ikke ønskede at være der.

Samarbejde på tværs af institutioner og uddannelser

Samarbejdet mellem uddannelserne og i særdeleshed mellem institutionerne var en ting, som styregruppen indledningsvis antog, ville være en af de største forhindringer. Det viste sig imidlertid, at netop dette punkt, trods bespa-relser, dalende elevtal og erhvervsskolereform har kørt overraskende gnidningsfrit.

Evalueringen har vist, at medlemmerne af nKNOWations styregruppe er enige om, at det ikke har været væsentlig mere udfordrende at planlægge en tværinstitutionel workshop, end det ville være at gøre noget tilsvarende inden for egen institutions rammer. Fire femtedele (80 %) mente, det kunne sammenlignes direkte med at planlægge et vilkårligt andet kursus eller en workshop, der involverer mere end en underviser. Dog fremhæves det, at planlægning af et nyt forløb altid kræver lidt ekstra første gang, hvilket ses tydeligere i en tværinstitutionel sammenhæng. Grundlæggende set er den øgende afstand kombineret med manglende indsigt i de respektive uddannelsers øvrige aktiviteter og faglige mål med til at forlænge processen i starten, og mere end ved nye, interne tiltag. Til gengæld synes eventuelle forskelle mellem multi- og monoinstitutionel planlægning stort set at være udlignet, allerede anden gang et forløb skal afholdes, under forudsætning af at der ikke i mellemtiden har været stor udskiftning i styregruppen.

Dertil har det vist sig at være en fordel at lade undervisere følge deres respektive hold ved at lade dem indgå i facilitatorgruppen. Det er betydelig mere relevant at have en facilitatorgruppe, der kender deres elever og ved, hvordan de skal motivere dem, end udelukkende at benytte nogle, der er gode til, eller særligt glade for, en bestemt metode (som fx Den Kreative Platform). Deltagergruppen er, i sagens natur, meget heterogen, hvorfor stringent brug af en enkelt metodik tidligere har gjort mere skade end gavn. I de første forsøg med nKNOWation udvandrede næste 30 % af deltagergruppen efter den første halve time med fælles 3D-cases fra Den Kreative Platform. I 2015 var der stort set ingen (ud over enkelte sygemeldinger etc.), der forlod workshoppen. 3D-cases og lignende metoder benyttes sta-

ter. En yderligere gevinst ved at benytte deltagende holds egne undervisere er rent økonomisk, da det holder antallet af ekstra mandetimer nede.

Den afgørende faktor, som styregruppens medlemmer peger på for denne type samarbejde, synes at være, at der er nogle formelle rammer og derigennem opbakning (og ikke mindst fleksibilitet) fra de involverede institutioners ledelser, samt at der er en stabil indre kerne af ildsjæle, der år for år driver projektet frem. Når dette er etableret, synes der ikke at være stor forskel hverken tidsmæssigt eller økonomisk på afholdelse af multi- eller monoinstitutionelle forløb af samme type[3]. Den centrale erfaring fra nKNOWation på dette punkt er således, at man ikke behøver gå på kompromis med pædagogiske og læringsmæssige mål for sådanne samarbejder på grund af økonomiske og ressourcemæssige begrænsninger.

Tværfagligt gruppearbejde

Langt størstedelen af medlemmerne af såvel deltagergruppen som facilitatorgruppen er enige om, at gruppearbejdet, der specifikt er designet til at være tværfaglig, har været en positiv oplevelse. Deltagerne forholder sig til deres indbyrdes forskellighed enten som en *fordel*, da det øger gruppens samlede viden, der kan sættes i spil over for problemet, eller som en *hindring*, når de ikke umiddelbart kan se, hvad netop deres faglighed kan bidrage med i en given situation. Både deltagerne og facilitatorerne oplever skift mellem disse ekstremer gennem hele processen. Næsten alle (deltagere og facilitatorer) bemærker dog, at der sker et skift i processen, når deltagerne holder op med at tænke så meget over, *hvad* de kan eller burde bidrage med, og blot begyndte at deltage i gruppearbejdet. Når først dette sker, begynder flertallet at betragte forskelligheden som en styrke for gruppen. Her er det interessant, at deltagerne i den afsluttende evaluering lægger meget større vægt på gruppemedlemmers personlighed og engagement end på, hvilken uddannelse de kommer fra.

Hvor nemt og hurtigt en gruppe når frem til dette holdningsskifte, varierer meget. Jo mere ekstroverte gruppernes medlemmer er, desto nemmere har de ved at nå dette punkt. Grupper med flere introverte gruppemedlemmer har derimod behov for mere tid og måske også mere hjælp fra facilitatorerne. Ifølge facilitatorgruppen er der dog højest

at en tredjedel af deltagerne var negativt stemt fra starten, synes dette ikke overraskende. Efterfølgende gav 88 % af deltagergruppen udtryk for, at gruppearbejdet havde været en positiv oplevelse, 49 % kommenterede, at de syntes, det var lærerigt at skulle forklare andre (faggrupper) noget, de selv tog for givet, og 77 % syntes, at det var en fordel med forskellige faglige perspektiver i gruppearbejdet.

Dette tyder på, at den nøjagtige faglige sammensætning i forhold til temaet i et sådan forløb har mindre betydning for processen, end vi oprindeligt havde antaget. Deltagernes forskellighed, såvel fagligt som personligt, er det, der gør forskellen. Det at blande deltagere fra forskellige uddannelser og uddannelseskulturer er blot en nem måde at sikre en vis diversitet. Større faglig spredning stiller indledningsvist større krav til faciliterering af processen, men omvendt kunne man forestille sig, at netop større faglig afstand fra hinanden og emnet, der arbejdes med, potentielt kunne gøre det lettere for deltagerne at sætte sig ud over ideen om, at det er kun er deres faglighed, de kan eller skal bidrage med.

Mellem uddannelser og erhverv

Lasse Thomsens citat i starten af denne artikel eksemplificerer ganske fint den generelle holdning, som interessentgruppen giver udtryk for, hver gang vi afholder nKNOWation. Der er typisk stor begejstring, både fordi der arbejdes direkte med at skabe ideer til kendte og reelle problemstillinger, som interessenterne har en direkte interesse i eller særlig

Vi er i skrivende stund bekendt med én elev, der har søgt rådgivning og kontorplads hos iværksætterinitiativet IgangZ (www.igangz.dk) i Aalborg, samt to private virksomheder, der har tilbudt at arbejde videre med en ide sammen med en gruppe elever. Vi ved dog ikke, om eleverne har valgt at tage mod disse tilbud.

Flere interessenter fremhæver, at selve de ideer, der produceres, ikke er det vigtigste. Det er snarere det, at en ny generation af arbejdskraft begynder at tænke over problemer, som deres virksomheder og organisationer interesserer sig for.

Fra deltagernes synspunkt fremhæves det, at det forhold, at der arbejdes med reelle problemstillinger, der præsenteres af virksomheder og organisationer med en reel interesse i deres løsning, har en enorm betydning. Over halvdelen (58 %) mente i evalueringen, at netop dette var afgørende for deres engagement i workshoppen.

I lyset af ovenstående er der ingen tvivl om, at tiltag som nKNOWation er med til at skabe kommunikation mellem uddannelserne og forskellige praksis. Indtil videre synes gevinsten dog primært at være på uddannelsernes/elevernes side, da det fortsat er uklart, hvilken eller hvor stor værdi interessenterne egentlig får ud af samarbejdet.

Et umiddelbart positivt resultat kunne være, at der skabes større kontakt mellem eleverne, virksomheder og organisationer, som ikke nødvendigvis ville have stiftet bekendtskab med hinanden ad andre veje. Dette sker alene som direkte konsekvens af at samle elever og virksomheder i samme fysiske rum for at arbejde med det samme emne. Det er et simpelt virkemiddel, der nemt kan benyttes meget mere målrettet, end det hidtil har været tilfældet.

Tænke Innovativt og være entreprenant

Hvorvidt den måde, deltagerne arbejder på, kan siges at være udtryk for en grad af enten innovativ eller entreprenant adfærd, er overvejende et teoretisk spørgsmål. Der er ikke nogen konsensus om, hvad det præcist indebærer at arbejde innovativt ud over ved at vurdere resultatets opfattede værdi og, derefter, tillægge processen betydning i retrospekt. Da nKNOWation ikke direkte har ført til noget håndgribeligt, der kan siges at have skabt reel værdi inden for sundhedsteknologi, eller har produceret et nævneværdigt antal deltagere, der efterfølgende er sprunget ud som entreprenører, kan vi ikke vurdere det på denne måde.

Forløbet er dog udviklet på basis af forskellige antagelser om færdigheder, der efterspørges af de respektive uddannelsers aftagere, og som de vurderer, er relevante for innovation. Eksempler på begreber, der er nævnt i denne sammenhæng er: tværfagligt samarbejde, praksisnære problemstillinger, kommunikationstræning og kreativ idegenerering. Disse betragtes således som at stamme fra, og i nogen grad repræsentere, fagpraksis (Haslam & Rosenstand, 2015, s. 67 og 69) og er alle indgået i konceptudviklingen af nKNOWation og dermed også i drejebogen, uden at der dog er opstillet konkrete mål for, hvordan de forventes at komme til udtryk.

Da der ikke er nogen målbare resultater, der direkte peger på hverken innovation eller entreprenørskab, kan vi ikke udlede noget om processen, ud over at den er designet ud fra og opfylder de ønsker, som vores repræsentanter fra fagpraksis og teorien, vi har benyttet, har peget på i forbindelse med innovationsprocesser.

Vores evalueringsresultater har dog vist, at både deltagere og interessenter har en overvejende positiv oplevelse af nKNOWation og dets relevans. Ifølge deltagerne fremgår det, at 87 % var positivt stemt med hensyn til deres gruppes slutprodukt, og kun 2 % var negativt stemt. 52% mente, at de ikke ville kunne komme frem til et lige så godt resultat, hvis der var tale om almindeligt monofagligt gruppearbejde på deres respektive uddannelser. Dertil syntes 88 %, at gruppearbejdet var en positiv oplevelse, og kun 6 % var negative.

Dette synes at være en stærk indikator for, at eleverne følte, at de bidrog med gode løsninger til de konkrete problemer, de blev præsenteret for, samt at processen i de tværfaglige grupper har været god. Interessenterne synes, som nævnt ovenfor, at give udtryk for en tilsvarende begejstring, men dette er måske mindre sigende, eftersom de, i modsætning til deltagerne, selv har valgt at deltage.

Et interessant og uventet resultat, der dukkede op i evalueringen i deltagergruppen, var, at 48 % svarede, at de godt kunne tænke sig at starte egen virksomhed. Umiddelbart var dette ikke iøjnefaldende, da flere af eleverne fra uddannelserne fra Tech College har tradition for, på et eller andet tidspunkt, at drive egen virksomhed. Det viser sig imidlertid, at dette tal også dækkede over 34 % af social- og sundhedsassistenterne og hele 44 % af de pædagogiske assistenter. Her er der tale om sundhedsfaglige og pædagogiske uddannelser, der typisk stiler mod offentlig ansættelse og bestemt ikke har tradition for iværksætteri. Hvad disse tal præcis er udtryk for, vides ikke, men om ikke andet tolkes de som positiv respons på deltagernes oplevelser under forløbet – også selvom iværksættertrangen muligvis aftager igen, når den umiddelbare begejstring aftager.

Konklusioner

Overordnet set synes nKNOWation at bidrage med noget, som de enkelte uddannelser ikke formår hver især. Samarbejdet mellem elever fra forskellige uddannelser og uddannelsesinstitutioner opleves generelt som positivt af alle parter. Det giver øget respekt for andres faglighed og perspektiver samt en skarpere forståelse af egen faglighed og kompetencer i relation til disse. Det synes også at skabe en større interesse og nysgerrighed for at arbejde sammen med andre faggrupper fremadrettet. Ligeledes opstår en bevidsthed hos eleverne om, at de faktisk kan gøre en forskel, hvis de vil, og at de alle, uanset fagområde, har noget at byde ind med i en innovationsproces. Der har uden tvivl været fordele ved at sætte elever med forskellige baggrunde sammen, men det er interessant, at konstellationen af faglige baggrunde tilsyneladende har været mindre relevant.

Det er begrænset, hvor meget formidling mellem uddannelse og praksis der er tale om. Elever bliver opmærksomme på brancher, teknologier og problemstillinger, de muligvis ikke havde stiftet bekendtskab med tidligere. På tilsvarende vis kommer interessenter hjem med enkelte gode input og måske blik for nogle uddannelser, de ellers ikke havde forestillet sig, kunne være interessante for dem. Der er dog stadig tale om en formidling, der er iværksat af uddannelserne og som primært skaber værdi for uddannelserne og deres elever.

Eftersom samarbejde på tværs af institutioner ikke nødvendigvis behøver være væsentlig mere besværligt eller omkostningsfuldt, end det ville være at udvikle tilsvarende forløb hos en enkelt uddannelse, er denne type workshop et interessant redskab, der kan benyttes som skabelon for arbejde med andre fagområder og problemstillinger. Det afgørende i denne sammenhæng synes at være en stabil styregruppe, så intentioner, erfaringer og procedurer fra de første forsøg ikke går tabt fra gang til gang.

Hvorvidt der virkelig er sket et radikalt skift af perspektiv om iværksættertrangen hos SOSU-eleverne er uvist. Er det udtryk for, at de kunne forestille sig at starte noget ved siden af deres 'faste' arbejde, eller er der blot tale om et øjebliks opløftethed oven på et par sjove dage? Dette er noget, der absolut synes værd at undersøge nærmere fremadrettet. I mellemtiden kan erfaringerne fra dette forløb samt dets evaluering uden videre overføres til, og anvendes, andre steder i uddannelsessystemet.

Evalueringen kan ikke sige noget om, hvorvidt vi er kommet nærmere de overordnede mål, som regeringen har sat i forbindelse med innovationsstrategien. Dette ville kræve et meget mere omfattende arbejde med denne type projekter inden for langt flere fag og over længere tid. Rent praktisk har det dog vist sig som en måde at give eleverne mulighed for at stifte bekendtskab med projektarbejde i en form, der kan siges at være mere praksisnær. Dels fordi den sammensætter deltagere på tværs af fagområder, og dels fordi den beskæftiger sig med reelle problemstillinger. Heri ligger selvfølgelig en antagelse om, at denne arbejdsform ligner det, man ser i virkelige innovationsprocesser. Selvom man skulle betvivle dette, mener vi dog fortsat, at projektet har værdi, i kraft af at de fleste fagområder trods alt involverer en grad af tværfagligt samarbejde, som eleverne her stifter bekendtskab med.

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(P4) Enabling consistent innovation in micro-, small and medium sized enterprises. Innovation, strategy and competitiveness – a dynamic perspective

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Enabling consistent innovation in micro-, small and medium sized enterprises.

Innovation, strategy and competitiveness – a dynamic perspective

1 Foreword

This book is motivated by the research of its respective authors and has innovation as a common denominator for them both, albeit in different ways. However, one thing which does not differ is their perception of the disparity between those who talk about the need for innovation, which for a long time has included us as well as those who need or desire to become innovators.

This is particularly in focus when those who talk of innovation often do so with grand examples of success in large, well known American corporations that surprised everyone by taking over a market, or even creating an entirely new one in unexpected ways. Conversely, those who listen to these stories, at least in Denmark where we reside, are often either small or micro-sized enterprises and have the problem of relating to the examples presented to them. They are not necessarily start-ups taking their first steps towards becoming huge, international behemoths. They are simply small businesses started and run by ordinary people who sensed an opportunity to be their own boss, pursue their own objectives and hopefully obtain some degree of freedom over their professional lives. They represent the educational and corporate diversity of their country and their main purpose is to be able to continue doing what do, and from which they make a comfortable living.

Much of the literature on innovation discusses and/or targets larger enterprises, with more resources and employees with many different sets of skills, and often involved in expanding their boundaries with new and exciting technologies. In that scenario it is not hard to understand why many of the smaller enterprises might feel that innovation is not for them.

During our research, we have encountered several innovation networks and been involved in seminars, workshops, conferences and educational initiatives which share the same imperative; to promote innovation within, and across industry and educational boundaries. Many of the people we have encountered during our work do not seek world domination, or even necessarily want to become much larger businesses than they already are. The metal worker who started his own company did so because he enjoys working with metal, and wants to have some freedom and control over the type of work he does, and when and where he does it. The physiotherapist, the marketing consultant, the plumber and the software

designer are often the same, and while they may not have much in common, they are equally at a loss as to how the high-profile American examples might apply to them.

While most of the business owners and employees we have talked to certainly do realise that the ability to innovate and re-new themselves is important to their long-term survival. Only few have any idea as to how they can or should go about it.

Some have tried various things while others have no idea where to start and have, therefore, done nothing. Common complaints include; how to know whether or not what they are doing is worth the effort, which types of activities to invest in, or the correct way to develop and test ideas they have been toying with. These are all good and relevant questions and there is no easy answer to any of them. In fact, we believe that the reason these questions are hard for many people to answer has more to do with the way we talk about and define innovation than to do with the difficulty of the actual tasks.

Good ideas do not come from a vacuum or by magic. They develop through a process; a process which is fraught with uncertainty. There are certainly no guarantees, but if we can at least aspire to understand this process from the perspective of a small business, we can also theorise as to how it can be managed in such a way as to recognise and address this uncertainty by a small business.

The purpose of this book is to attempt to understand innovation, and more importantly the process of innovation from the unique perspective of micro and small enterprises in a way that makes it useful to them.

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2 Introduction

The need to innovate or be innovative has, in recent years, become something that is often voiced at every level of society, be it policy, strategy, business plans, education or even slogans and motivational speeches in Denmark as well as at the EU level. The need itself is, for the most part, apparent. To paraphrase a cliché it represents a means to compete by working smarter rather than harder.

Phenomenon such as globalisation and with it increased competition from countries with low production costs makes it increasingly difficult for small businesses in particular to survive. Innovation is often presented as the catch-all solution to this problem: Maybe a new business model or technology will allow the business to compete on cost, volume or quality against larger corporations that outsource their production. Maybe a new product will disrupt the existing markets and take the competition completely by surprise. Maybe ideas will create entirely new markets for products that no one else has discovered. The basic idea is simple. Find new and creative approaches to your business to retain a competitive advantage in any situation. The need for innovation and the advantages of being consistently innovative seem obvious. Professor Ron Adner (2012) sums up the attention innovation has been receiving in his book *The Wide Lens* in the following way:

> *How can we increase profitable growth? Innovate! How can we become more efficient and reduce waste? Innovate! How can we improve loyalty and increase customer satisfaction? Innovate! Innovation is a problem for everyone because it is held up as the solution for everything.* (Adner, 2012, p.4)

How exactly to go about becoming an innovative, let alone consistently innovative business is, however, less obvious and for many entrepreneurs highly frustrating.

This book seeks to address some of the practical issues involved with becoming a consistently innovative business. However, it does so according to a particular set of criteria gleaned from conversations and collaborations with business owners and representatives during our research activities within the fields of experience economy and educational innovation at Aalborg University in Denmark. This means, we take on a Danish perspective although we would argue, that our findings are just as applicable in a broader European and even global context.

To do this, we must first look at how the term innovation is used in different ways. On the one hand, the word is often used in a popular way to mean “creative solutions to real problems (that work)”. In another perspective, innovation differs from creativity in that it contends with specific problems that a person or a company faces, and seeks to find creative solutions to these problems that can be used to solve them in a practical and immediate sense. In other

words, innovation needs to create some form of value by solving a problem. Creativity, in its pure form, does not (Csikszentmihalyi, 1996, pp. 1–8; Tanggaard, 2008, p. 13).

On the other hand, the academic literature within business studies tends to be specific in its use of the word innovation. Here, there are many definitions, often with subtle differences and variations. They distinguish between many different types of innovation: Innovative processes, technologies, business models, products, supply-chains, solutions, environments, breakthroughs, disruptions, employees etc. Some are similar, others are not; some are specific to certain business types, some are generally applicable; some are related to specific actions, some represent the effects of these actions. It can sometimes be difficult to decipher what is meant by innovation in these different contexts and to see how this is relevant to businesses.

In addition, there are all the applications of the word that stem from many other fields of study. Innovative education, innovative research groups, policy innovations, medical innovations. The list is almost endless, and with the increased interest in innovation as a catch-all solution, it continues to grow. This creates a situation where more and more businesses and organisations are becoming aware of the *need to innovate* without necessarily becoming any wiser as to *how* they should go about it. In this book, we propose a model for understanding and working with these different definitions in a simplified way. Removing some of the complexity and focusing on commonalities to create a framework useful in both strategic and analytical contexts.

Further, for many large companies, or at least those with large amounts of capital, it is possible to gamble that investing in several innovation initiatives is more likely to yield at least one success, and that over time this strategy, if managed correctly, will yield a net profit rather than a deficit. In other words, being willing and able to invest a certain amount of capital and resources, manage them wisely, and accept that direct evaluation may not be possible, are general aspects of an innovation strategy.

Although this does seem to work, to some extent at least, and there are many books and articles (Bower & Christensen, 1995; Brown & Katz, 2009; Henry W Chesbrough, 2003; Christensen, 2013; Goodman & Dingli, 2013; Kelley & Littman, 2004; Martin, 2009; Piore, 2004; Prahalad & Krishnan, 2008; Prahalad & Ramaswamy, 2004; Tidd & Bessant, 2014) on how exactly to incubate, select, manage and evaluate innovation initiatives, it still relies on the company's ability and willingness to engage in risky long-term investments (Tidd & Bessant, 2014, pp. 10–11). For many small to medium businesses this is simply not a viable model. They have neither the capital nor the resources to withstand potential failed investments over long periods of time.

This could simply be seen as a sign that larger scale strategic innovation is the primary domain of larger companies, whereas smaller ones should focus on lesser, incremental innovations if at all. It also suggests, that true breakthrough or disruptive innovations in small

companies or start-ups is mainly down to luck and persistence rather than strategy and skill making consistent, repetitive innovation unlikely in this segment.

Unfortunately, a large number of Scandinavian companies fall into this segment, with approximately 80 percent of Danish companies within the micro category (<10 employees / < 50 mill. annual turnover) by EU definitions (EU, n.d.). Thus, when the national innovation strategy (Danish Government, 2012) specifically states that Denmark's competitive advantage lies in its ability to innovate, not including small businesses would be to discount the majority of the Danish corporate landscape, thus effectively placing the competitive advantage of an entire nation in the hands of a small fraction of its companies. Just to underscore the importance of finding new and manageable ways for smaller companies, we would like to show in more detail how the structure of Danish and European businesses relate to their innovation activity. The structure of Danish companies is overwhelmingly made up of micro companies and small companies as shown in this table:

Distribution of Danish Enterprises by size			
	Denmark	**Scandinavia**	**EU-15**
Enterprises *- in percent -*			
Micro (0 - 9)	87,4	92,0	92,4
Small (10 - 49)	10,2	6,6	6,5
Medium (50 - 249)	1,9	1,1	0,9
Large (> 250)	0,5	0,3	0,2
Total	**100,0**	**100,0**	**100,0**

Figure 1 - Danske virksomheders størrelsesstruktur (DANMARK I DEN GLOBALE Økonomi. Sekretariatet for Ministerudvalget, 2005, p. 2)

If we look at the European business structure this pattern is even more distinct:

Size of European Enterprises			
	Number of enterprises	**Persons employed**	**Value added**
	(million)		**(EUR 1000 million)**
All enterprises	21.0	135.8	6176
All SMEs	20.9	90.6	3617
Micro	19.3	39.3	1348
Small	1.4	27.9	1147
Medium-sized	0.2	23.4	1122
Large	0.0	45.2	2559

Distribution of European Enterprises by Size				
	Number of enterprises	**Persons employed**	**Value added**	**Apparent labour productivity**
	Share in total (%)			**Relative to total (%)**
All enterprises	100.0	100.0	100.0	100.0
All SMEs	99.8	66.7	58.6	87.8
Micro	92.0	29.0	21.8	75.3
Small	6.7	20.5	18.6	90.5
Medium-sized	1.1	17.2	18.2	105.3
Large	0.2	33.3	41.4	124.5

Figure 2 - Size structure of European companies (Eurostat. European commission., 2011, p. 11)

Both figures show that to a very large extent the corporate structure in both Denmark and Europe is overwhelmingly made up of micro- and small and medium sized enterprises. It also shows that these enterprises create comparatively less value than the much fewer medium-sized and large enterprises. If we look at the innovation activities distributed by enterprise size it clearly shows that micro, small and medium sized enterprises are less innovative than large enterprises. We decided to use data from a new Danish study, carried out by Statistics Denmark and published in 2016. The report relies on definitions of innovation, innovation types and guidelines for measuring innovation developed by the OECD and available in the Oslo Manual (OECD & Eurostat, 2005). Its approach is not without problems since it is primarily based on self-reporting from contributing companies, and its purpose is to compare data across industry types and countries. The latter leading to a degree of abstraction which can make it hard to relate back to specific instances. However, for our purposes we believe that the report reflects the most thorough and accurate data available. The study shows that 44 % of all Danish enterprises introduced an innovation in 2014:

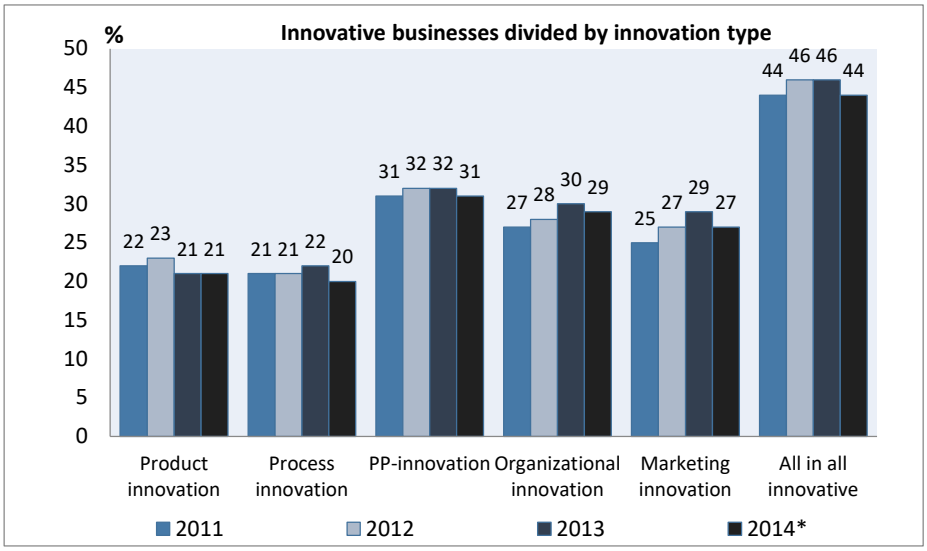


Figure 3 - Innovative virksomheder, fordelt på innovationstype (Danmarks Statistik, 2016, p. 69)

This is slightly less than the previous years. However, if we look at the relation between enterprise size and innovation activity we can see that particularly large enterprises are more innovative than the rest with the medium-sized enterprises in second place:

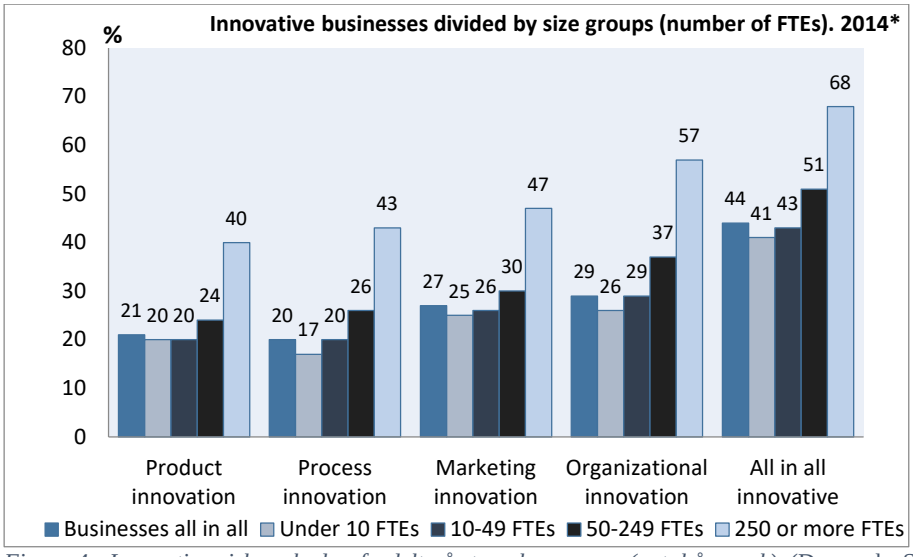


Figure 4 - Innovative virksomheder, fordelt på størrelsesgruppe (antal årsværk). (Danmarks Statistik, 2016, p. 70)

Altogether the correlation between company size and innovation activities make it clear that it is important from an economic and societal perspective to raise the innovative activity in micro, small and medium sized enterprises. Due to relative large proportion of enterprises within them we can only assume that an increase innovative activity within these categories would not only represent an increase in the national innovation capacity but also have a noticeable effect on the GDP.

In this book, we choose, not to accept the premise, that small companies cannot be strategic innovators because of lack of financial strength. Instead we try and address the question of how such companies can focus on innovation in a way that involves less risk and uncertainty, and what that form of innovation entails. To this end, we look at the concept of strategic innovation and attempt to create a framework that enables and supports a strategic approach to innovative initiatives which is equally useful for micro-enterprises and start-ups with limitations on both resources and financial stability.

Thirdly, the challenges of innovation are probably felt more acutely, the smaller the companies. Where larger companies may be able to afford to experiment, smaller ones typically cannot. Each hour spent directly on known, income generating activities represents, relatively speaking, a larger expense and thus more risk to a smaller company than a larger one, as illustrated in Figure 1. Thus, being able to evaluate the progress of such efforts in a timely and precise manner become that much more important. Especially with very small companies, where any new investment of time quite possibly would mean taking a larger percentage of time away from other, possibly profitable, activities:

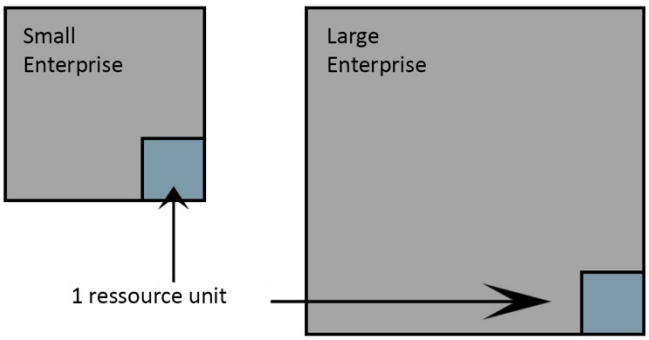


Figure 5: Relative value of resources in smaller vs larger enterprises.

With that in mind, the focus of this book is to address the issue of how companies can go about working with innovation, in a strategic and structured manner. To do this, we discuss the literature on innovation and business strategy in a broad historical perspective to identify central aspects from each. The goal, to provide a framework of innovation concepts or

parameters which can be used to analyse and operationalise said initiatives, while serving as the basis for evaluation at later stages of the process.

The fourth and final criterion, is an extension of the strategic perspective. It is concerned with the need to evaluate and reflect on innovation processes once they have been set in motion. For how long should you continue to invest resources in a particular initiative, and when should you pull the plug in favour of a different opportunity? Although there are still no certain answers to questions such as these, there is definitely a need for at structured approach to reflecting on them.

Despite having innovation practice as our focus, our intention is not to produce a handbook or guide for this demographic delving into how they should implement and manage innovation strategies. It is, first and foremost, meant as a contribution to the scientific literature which seeks to expand the idea of strategic practice in conjunction with systematic corporate innovation.

2.1 Structure and approach

To accomplish these goals, this book is split into three distinct, but interlinked parts. The first part examines the evolution and development of the term *innovation* in the literature over the past century. The second does the same with the concept of *strategy*, but only within the field of strategic management. Finally, the third presents a discussion of how these terms complement and detract from one another to identify central aspects of strategic management that are applicable in an innovation context, combined with a more nuanced understanding of innovation and what it means for the individual company to be innovative.

It is important to mention, that the first two parts are not attempts at extensive or comprehensive literature reviews since we consider this to be an almost impossible task given the amount of written material within each area. Their purpose is to present a longitudinal perspective through which we illustrate the evolution of each concept and thereby gain insight into their meaning; traversing what we consider to be central texts on each subject in the process. This is not to say that the texts used are randomly selected rather than being selected based solely on structured database queries. They have been chosen based on their perceived significance in their broader historical development. In practice this was determined by careful reading of relevant texts most often referenced when searching for historical works on strategy and innovation, and in significant metastudies on the literature of innovation and strategy (Jan Fagerberg, Fosaas, & Sapprasert, 2012).

3 What is innovation and why are we interested?

The idea for this book originally stems from the frustration we have encountered among others, and to some extent experienced ourselves, while discussing the practical aspects of innovation. Mostly, this has been with local businesses and start-ups at network meetings and innovation seminars. For example, through our engagement in the Danish Innovation Network Invio (www.invio-net.dk). Activities in Invio consist of industry-research collaboration through, among other things, workshops, match-making and cross-disciplinary educational initiatives.

In these cases, the companies have been relatively small, fitting the micro and SME statistic (henceforth referred to as MSME's) mentioned above, and aware that they need to be 'open' to ideas and opportunities that could give them the potential to innovate. At the same time, they have been frustrated regarding the practical aspects of doing so, largely, because they feel they are investing valuable time, if not necessarily money, in meetings, collaboration, networks etc., without having any way of evaluating whether or not what they are doing is worthwhile. In fact, most had the distinct feeling that it was not, but uncertainty and hope that patience and persistence would be rewarded led them to continue. One local business that consists of a single person who, on various projects either works alone or in loosely coupled partnership with one or more members of a business network, expresses it like this (Paraphrased in translation from Danish):

> *"Whenever I go to a network meeting that does not relate to a project, or solve a specific problem I am basically wasting money. It's just me, so every time I close my laptop or put my phone on silent I am effectively closed for business, and if that time isn't spent working towards finishing a project or otherwise generating revenue I am just taking a break and hoping for the best…"* (John Hird, Owner of Hird & Ko, April 2014)

The above quote is not in any way contrary to the notion of collaboration between small businesses as a profitable investment of time. It merely, underlines the necessity of specific goals and a clear sense of purpose when investing time in such activities; more so when there are only few people to balance out the cost of unprofitable investments.

Purely practical questions regarding when to pull out of a network or collaboration if it is not yielding any tangible results, which network to invest time in and how to asses in which idea or project to invest are what concerns them, and most of the time neither the political rhetoric nor the literature or our counsel could provide much help in answering them. Much of this frustration can be reduced to a question of what is meant by the term innovation. Specifically, that it may have different meanings to different types of businesses and what it means for them.

Acknowledging that innovation could be interpreted very differently across company types, geographical regions, markets etc. is not particularly helpful. However, it does present a

different perspective on the problem. It allows for a company to filter and choose between various strategies and principles.

In the section below, we look at what innovation is by looking at the various ways it is treated in the literature, and how this treatment and the concept itself have developed over the past century. The purpose being to gain a better understanding of the context in which it is commonly used today, and how this allows it to be interpreted by various types of businesses.

3.1 The concept of innovation in research?

Innovation is a complex and by no means new phenomena. Depending on how you look at it you could say that innovation has been around for as long as mankind itself since inventions have always been behind significant advances in civilization like the use of fire, development of new tools, sewerage, the wheel etc. (Jan Fagerberg, 2005). Or in a more modest understanding of the concept you could say it has been around for as long as mankind has organised trade of goods and services at markets in a capitalist economy, considering that innovation is normally defined as being about new solutions succeeding in the market.

However, this chapter is not about the detailed history of innovation. The purpose is more accurately to show how innovation has been perceived and defined, and how the understanding of innovation has evolved to its present state. We aim to show that the concept of innovation is a complex and multidisciplinary concept that has evolved over time due to changes in business, society, technology and markets.

Although an ancient important phenomenon that is obviously important to economic and societal development, the concept of innovation has not always been given the attention it deserves according to Fagerberg (2005). Subjects such as capital and markets have been more eagerly studied as factors in long-range change from an economical perspective than has innovation. However, this has changed in recent decades and there is now a much bigger and more diverse body of research on innovation. As Fagerberg and others point out these new research ventures have also focused on different aspects of innovation than the traditional focus on resources and economic effects within economics. What, for instance, nurtures the process of innovation, where does innovation take place, what competencies are required to be innovative and so forth. This broadening of the scope has, of course, made innovation studies a highly cross-disciplinary field and has vastly expanded the body of literature dealing with innovation. Fagerberg writes:

> *Two decades ago, it was still possible for a hard-working student to get a fairly good overview of the scholarly work on innovation by devoting a few years of intensive study to the subject. Not anymore. Today, the literature on innovation is so large and diverse that even keeping up-to-date with one specific field of research is very challenging.* (Jan Fagerberg, 2005, p. 4)

Bruland & Mowery also stress that innovation is a complex concept and that perhaps some historical accounts have overemphasised the role of one technology or economic development. They "emphasize the complex multi-sectorial character of innovation, and hence the need to take seriously the coexistence of a range of innovation modes, institutional processes, and organizational forms" (Bruland & Mowery, 2005, p. 350) in their account of innovation and developments in innovation through historical periods.

Despite the rising interest in the innovation concept, in recent literature a lot of research in innovation still takes place in silos or in specific communities. No academic society that covers all aspects of innovation has emerged even though steps are taken in that direction (Jan Fagerberg et al., 2012, p. 1133). Fagerberg does note, however, that different perspectives on the concept of innovation do not necessarily constitute a problem because many social phenomena are too complex to be analysed properly from a single disciplinary perspective. Arguably, innovation is a prime example of this (Jan Fagerberg, 2005, p. 21). However, according to Fagerberg it is important to bring these different research communities together and make them talk to each other if our understanding of innovation is to advance significantly from the current level.

Sundbo (1995, p. 400) takes the sign of silos in the innovation research further and suggests that one can, from a Kuhn'ian inspired perspective, identify three paradigms within innovation theory. Though theses paradigms are not as clearly separated as a genuine Kuhn'ian paradigm, and even though the innovation paradigms emerge in different historical periods a paradigmatic situation within innovation studies can, according to Sundbo, be identified. Researchers "organize separate scientific conferences; they rarely attend each other's conferences, or quote literature from another paradigm" (Sundbo, 1995, p. 400). All of which are, arguably, classic signs of paradigmatic silos or situations. However, it is probably rarer to see paradigms coexist and even build on top of one another through historical periods.

Sundbo's article is from 1995 and much may have changed since then. However, the later writings from Fagerberg and colleagues along with other sources we have identified suggest that the development only moves slowly in the direction of a paradigmatic shift for example (Baregheh, Rowley, & Sambrook, 2009; Crossan & Apaydin, 2010; Fagerberg, Fosaas, & Sapprasert, 2012; Fagerberg, Mowery, & Nelson, 2005; Rowley, Baregheh, & Sambrook, 2011). Furthermore, we will get back to the understanding of innovation within the three paradigms since they are important in explaining what might be called drivers of innovation. Some would argue that we are still in what Sundbo calls The Strategic Management Paradigm, while others would not. In this book, we lean towards the idea that innovation is still best understood within this paradigm; a perspective we will elaborate below. In the chapter where we go through different innovation concepts this discussion of paradigms makes it possible for us to relate the innovation concepts to general paradigms, or understandings of innovation.

Thus it is not our ambition to give a complete overview of the diverse field of innovation studies with a detailed, critical review of each of these strings of research. We will instead focus on the idea of what innovation is and how the understanding of it has evolved through time. In particular, we will in try to identify the ideas of where within and around an organization innovation can take place, and furthermore discuss and analyse the central external factors that shape innovation.

3.1.1 What does innovation mean?

Since the term is so frequently used, it can be useful at a general level to have a more precise idea of what innovation actually means. There are numerous attempts to define innovation in different ways and from different perspectives. The volume of definitions and the ranges of implications from these different definitions also suggest that there is no unifying consensus on what exactly innovation is, and that the understanding of innovation relies heavily on the perspective from which it is viewed and understood. To exemplify this, we will highlight a few definitions.

> *Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes in order to advance, compete and differentiate themselves successfully in their marketplace.* (Baregheh, Rowley, & Sambrook, 2009, p. 1334)

> *…innovation is a process of turning opportunity into new ideas and of putting these into widely used practice.* (Bessant & Tidd, 2009, p. 16)

> *…innovation is the process that turns an idea into value for the customer and results in sustainable profit for the enterprise.* (Carlson & Wilmot, 2006)

> *…innovation is the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organisational set-ups.* (Dosi, 1988, p. 222)

> *…is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations.* (OECD & Eurostat, 2005)

> *Innovation is the management of all the activities involved in the process of idea generation, technology development, manufacturing and marketing of a new (or improved) product or manufacturing process or equipment.* (Trott, 2008, p. 15)

We could continue listing more definitions, but the point here is not to be exhaustive. Instead we will discuss some of the implications of these definitions to identify some of the central issues, discussions and challenges for innovation research that they have in common.

Some of the definitions above are very broad and try to include many aspects while some are narrower and try to focus on a single activity or a single input or output. Some stress the idea of the creation process and some, the management of activities. And almost all the importance of putting ideas into practice inside or outside the organisation/company; for instance, at the market place. Furthermore, most theories and definitions agree that innovation includes a dimension of newness. However, newness in itself is not a sufficient condition – it may not even always be a necessary condition for innovation to occur. At least if we think of newness in terms of completely new inventions resulting in radical new products, e.g. products consumers have never seen before. This happens very rarely. All of this, of course, suggests that the landscape of innovation is much more detailed and complex, and there are many variants of types of innovation and innovation concepts. Let us try to get a clearer view of this landscape.

A classic distinction in the understanding of innovation is between the concepts of innovation and invention. This also makes sense regarding the different definitions above. Invention is about newness in the sense that an invention is something the world has not seen before. But as we have seen, invention is not sufficient for labelling something as innovation. The invention also must be implemented or brought to market and somehow have socioeconomic implications in its context. This can be within the company, for instance a revolutionary new production process, or it can be the introduction of an entirely new product that customers value highly and thus giving the company increased revenue. In this way we can say that the innovation is the attempt to bring the invention into practice (Jan Fagerberg, 2005, p. 4).

There have been various explanations of the differences between innovation and invention in the literature through the years. Some of these are summarised in this table from (Kotsemir, Abroskin, & Meissner, 2013, p. 7):

Definitions of Innovation and Invention		
Author(-s) of model	**Innovation**	**Invention**
Freeman, 1982	Innovation is the introduction of change via something new.	Invention is the creation of a new device or process.
Senge, 1990	'idea' becomes an innovation only when it can be replicated on a meaningful scale at practical costs.	Idea has been 'invented' when it is proven to work in the laboratory.
Rouse, 1992	Innovation is the introduction of change via something new.	Invention is the creation of a new device or process.
O'Sullivan and Dooley, 2009	Innovation is more than the creation of something novel. Innovation also includes the	Invention need not fulfil any useful customer need and need not include the

	exploitation for benefit by adding value to customers. Invention is often measured as the ability to patent an idea.	exploitation of the concept in the marketplace.

Figure 6: Different definitions of innovation and invention in the literature (Kotsemir et al., 2013, p. 7).

Again, these different distinctions suggest that there is an important difference between innovation and invention. Invention is defined by newness; i.e. it is something we have not known before. Its usefulness is not considered. Sometimes it might have a clear function and utility value. At other times we might not know what to with it at all – we can just see that it is new compared to what we have known so far. Innovation, on the other hand, is defined by relation to something; it is about creating change, about being productive and about creating value in different ways. According to Schumpeter invention can be seen as creativity while innovation can be seen as the act of applying invention. Invention does not in itself have economic importance, while innovation inherently has economic considerations (Joseph Alois Schumpeter, 1939, p. 15).

This difference between invention and innovation also results in a time lag between the two concepts. An invention can be done many years before it turns into an innovation. This can be due to different factors hindering an innovation based on an invention or a novel idea. It can be lack of materials, lack of an entrepreneur or lack of demand and so forth. For instance, though Leonardo da Vinci conceived ideas about airplanes he lacked materials and not least engine to drive the plane forward. Thus, sometimes inventions are dependent on subsequent inventions before it can turn into an actual innovation (Jan Fagerberg, 2005, p. 5).

A more recent example is the development of the tablet computer. The Apple iPad was by no means the first attempt to develop a tablet based computer. In fact, the core technology can be traced all the way back to 1963 with the RAND tablet. Microsoft also tried to launch a commercial version of the tablet in the early 2000s. However, it was not until Apple released the iPad in 2010 that the tablet market exploded. Somehow Apple had created the right mix of design, user-experience and utility coupled with a market that was ready to demand the product; largely helped by the rich App Store ecosystem already in place from the iPhone securing a host of independent developers ready to support the new platform. All of this was of course also nurtured by the success of the iPhone some years in advance (Lux, 2014). After some years of only peripheral importance the tablet, with the iPad, suddenly became an economically very important product. But could this have happened without the technological development preceding the iPad? Probably not, and this shows how an invention and even an innovation can have taken place years before it really has a major impact.

Furthermore, Fagerberg (2005, p. 5) points to the issue of continuous processes in innovation and invention. A product develops over the years, and after many years it may look very

different from when it was initially brought to market. Consider the example with the tablet above. We might say that the iPad, when it was released, might have built upon the experience of previous versions of the tablet. But it had also added additional technologies to develop it into the obviously appealing product it turned out to be. Neither did the iPad did resemble the earliest versions of tablets very much. Products evolve, and in complex ways turn into new kinds of innovations. Since the release of the first iPad it has developed quite a lot in performance, weight, screen quality, capacitive touch technology, connectivity etc. To use some of the basic concepts from Schumpeter we can also see that the initial introduction of the iPad is an example of radical innovation, while the subsequent development seems to be more of an incremental innovation process in which smaller adjustments and a few new features are added to each new product cycle (Jan Fagerberg, 2005, p. 7). Thus, the discussion of the iPad example illustrates the different processes and implications of the concept of innovation.

Through this discussion of innovation and invention we have also introduced Joseph Alois Schumpeter. Schumpeter is commonly hailed as one of the first and most important theoreticians and researchers of innovation. Therefore, we will now take a closer look at the innovation theories of Schumpeter.

3.1.2 Schumpeter's theory of innovation

Schumpeter's thoughts developed significantly over the years through his central publications which are *The Theory of Economic Development (1911/1934), Business Cycles (1939)* and *Capitalism, Socialism and Democracy (1943)*. Some of the central ideas should be mentioned however, because as stated, they have since been absolutely central for innovation studies.

Prior to Schumpeter it was commonly acknowledged that innovation was something that could not be planned for – it was mainly an effect of luck (Jan Fagerberg, 2005, p. 9). To Schumpeter this was not the case. He believed that certain personality traits and competencies were needed to succeed in the innovation process and that knowledge about this could explain the innovation process and its probable success. Certain character traits were required and these traits were descriptive of what came to be Schumpeter's central idea of the entrepreneur.

The entrepreneurs' traits were important because of three important aspects of the innovation process suggested by Schumpeter which were:

1. all innovation processes were marked by fundamental uncertainty – you can never be certain of success,
2. the ability to move quickly, before anybody else did and
3. resistance to all others that will try to destroy novelty and protect status quo in business and society at large (Jan Fagerberg, 2005, p. 9).

In the centre of these processes Schumpeter conceived of the individual entrepreneur as the central entity that could drive innovation forward. The Schumpeterian entrepreneur was thus to be seen as a sort of individual hero that could drive innovation processes forward and was able to move fast enough to both outpace competitors and the inertia of society and business at large.

The entrepreneur was not to be confused with an inventor, as discussed above. In Schumpeter's view innovation was in a sense the combination of existing resources in new ways and the combinatory activities were performed by entrepreneurs. The innovation itself can take place in different domains inside and outside the company but through activities performed by the entrepreneur. This can also be called types of innovation.

Schumpeter defined the following five types of innovation: *new products, new methods of production, new sources of supply, the exploitation of new markets and new ways to organize business* (Fagerberg, 2005, p. 6-9). This was the first effort in the literature to define specific types of innovation and the categories have remained central ever since. However, the understanding of the concepts has been riddled with some level of *fuzziness*, as Fagerberg puts it, due to the lack of communication between the different innovation research communities (Jan Fagerberg, 2005, p. 21).

As mentioned above, this fuzziness is a large part of the reason for writing this book since we have experienced confusion and ambiguity in the definition of these innovation types and concepts at first hand, as well as in the eyes of others. This makes it difficult to work with innovation in a practical context because there is no common agreement of what we mean when we talk about innovation.

3.1.3 Schumpeter and the history of innovation

Schumpeter's idea of the individual entrepreneur was well fitted to the industrial structure in Europe in the early part of the twentieth century. However, as firms grew considerably bigger in the first half of the 20th century through vertically integrated organization types and innovation based on large scale R&D initiatives became more common it also became evident that innovation could be a result of dedicated teamwork and did not necessarily have to rely solely on the individual entrepreneur. It could just as well take place in groups or teams within larger organizations.

Schumpeter acknowledged this in later writings but did apparently not look into it in closer detail even though it is commonly presented as Schumpeter Mark I and Mark II (Andersen, 2009, p. 204; Jan Fagerberg, 2005, p. 10). This development also marked another difference from the original idea of the entrepreneur as driver of innovation. The original Schumpeterian conception of the entrepreneur quite clearly stressed that the entrepreneur should realise the innovation for borrowed money and then exploit the competitive advantage for as long as possible to create greater revenue and be able to pay back the borrowed money and move on to new projects. A good credit system was thus a necessary condition for a capitalist

innovation-fuelled system for Schumpeter. The entrepreneur was not a company builder or owner in that sense.

In the period of technology driven innovation in larger corporations that superseded the entrepreneurial period innovation from around the 1930s and onwards capital became much more important and the innovation projects were supposed to develop the firms themselves (Sloth Andersen, 2004, p. 107).

There have been many discussions of innovation phases and development of innovation in the literature on innovation. And indeed, there have also been several accounts of trying to connect waves of innovation with economic development in general. For instance, this is what Schumpeter is talking about when he talks about business cycles and trying to connect these to different short-term and long-term waves of economic development.

Central ideas in this theory are about long-term Kondratieff waves (50-60 years) and shorter Juglar cycles (10 years) (Andersen, 2009, p. 202). Schumpeter's interest in these waves has its origins in his evolutionary perspective on economic development and the central placement of innovation in this development. Schumpeter found three of these Kondratieff waves in the period of capitalism he was able to meaningfully identify[1]: 1) The Kondratieff of industrial innovation, e.g. cotton textiles in England, 1787 - 1842, 2) Bourgeois Kondratieff or the age of railroads, steam and steel, 1843 – 1897, 3) The Neo-mercantilist Kondratieff or the age of electricity, chemistry and motors starting in 1898 and had not ended at the point of Schumpeter's analysis in 1939. A wave is typically characterized by a period of prosperity then crisis/recession and finally a recovery marking the beginning of a new wave.

This is in line with the evolutionary perspective of Schumpeter's economic theories in which a crisis or period of recession is viewed as part of the normal capitalist development. The role of crisis is to clean up a saturated economy where the contemporary ways of innovation and development of technology no longer fuel the economic development. After a period of economic development, the economy normally becomes static – or it enters an equilibrium. When this static market situation has been the case for long enough, innovators and entrepreneurs, will look for ways to break the equilibrium. Schumpeter goes so far as to call these fluctuations in the market "the heartbeat of the capitalist economy".

In this understanding a crisis becomes a positive thing because it marks the potential of a new wave of innovation despite the short term social and economic impact of the crisis (Sloth

[1] Schumpeter identifies the beginning of capitalism to creation of credit. There are examples of this as far back as the 12th and 13th century in southern Europe. However, the first centuries of capitalism had only local effect and were marginal to the surrounding economic system. Therefore, no Kondratieff waves can be expected to be found prior to the industrial Kondratieff. Furthermore, Schumpeter realized that no two waves can be similar, also due to the evolutionary process at the heart of capitalism (Andersen, 2009).

Andersen, 2004, p. 73).[2] Schumpeter's idea of Kondratieff waves has been much criticised due to lack of sufficient statistical evidence for the enormous developments taking place over such long time spans, and the obvious complexities of data to be considered for such an analysis (which Schumpeter insisted on doing himself). Some suggest leaving the idea of long waves entirely and, for example, speak of "…great surges of development" (Carlota Perez, 2007 in (Andersen, 2009, p. 210). However, the idea of evolutionary economy is still increasingly influential today and has been closely connected to the role of innovation.

Turning to the empirical research of the development in innovation, major developments seem to happen when the pressure from external institutional and societal pressure becomes too strong. Input factors of these changes have been technology, organisations, markets and, as we have seen above, entrepreneurs. New input factors can emerge in time and thus alter the common processes of innovation as we know them today. In an account of *Innovation Through Time* Bruland & Mowery (Bruland & Mowery, 2005) find and explain three broad phases of innovation that deal more with the significance of multiple input factors than Schumpeters preoccupation with economic development.

The first phase is connected to the first industrial revolution beginning in Britain and north western Europe around 1760. Of course, the technological breakthroughs such as cotton mills, steam, railroads etc., of this period were important. However, there were also other important factors such as organisational and institutional change in many sectors and industries. For instance, a rapid rise in patents can be seen, even though these were very expensive at the time. Other factors were new laws that better supported growth of companies and the introduction of the managerial function in production. Both of these innovations were important factors in the growth of factories (Bruland & Mowery, 2005, pp. 350–358).

The second phase started towards the end of the 19th century with the emergence of a number of new technologies and industries such as chemicals, optics and not least electricity. The second industrial revolution took place mainly in the United States and continental Europe. Important in the second industrial revolution were organisational innovations that paved the way for substantial new linkages between industry and formal science. New competencies among innovators were needed and firms evolved organisationally into large-scale vertically integrated enterprises. These bigger organisations had the ability to incorporate research, development and laboratories as structured departments or groups within the firms and would furthermore draw on external scientific knowledge from universities and research networks. Innovation was not only a task for the dynamic entrepreneur any longer, because these "…professionally managed firms of unprecedented size became the agents of Schumpeter's

[2] This is a central disagreement between The Schumperterian evolutionary economic paradigm and the neo-classical paradigm (and mains stream economy today) which favors the tendency towards equilibrium and would prefer to maintain this, whereas Schumpeter found it inevitable that the economy evolved from equilibrium to equilibrium through a period of crisis; also called a creative destruction.

"creative destruction" by the mid-twentieth century, as industrial innovation became a core component of corporate strategy" (Bruland & Mowery, 2005, p. 359).

The third phase covers the period from the end of the second world war and onwards. It is a time where entirely new industries such as ICT, semiconductor and biotech emerged, and it is also a time where scientific leadership shifted from Europe to the United States. The most important development in this phase, however has been the rising importance of the state in innovation and governmental spending on R&D. This factor was driven in the post-war period by concerns of national security and public-health. Bruland & Mowery (2005) find that at least three factors were fundamentally new to the post-war R&D system: "1) small, new firms were important entities in the commercialisation of new technologies; 2) defence-related R&D funding and procurement exercised a pervasive influence in the high-technology sectors of the US economy; and 3) US antitrust policy during the post-war period was unusually stringent" (Bruland & Mowery, 2005, p. 367).

To the new industries developing in ICT, semiconductors Biomed etc., it was important for dynamic new companies to commercialise the scientific breakthroughs. And the rising public R&D spending in universities and research departments became an important supplier of human capital to the increasingly knowledge driven innovation processes. This is the final important shift in innovation in the post-war period. Whereas the second industrial period was primarily marked by exploitation of natural resources and technology, this is not so much the case in the third industrial period of the post-war-period. In ICT and Biomed etc., the primary resource is knowledge and human capital, which can essentially be developed by investment in education and training – resources become manipulatable by societal investments (Bruland & Mowery, 2005, p. 373).

We have now seen that historical development of innovation is a complex phenomenon that has played a crucial role in the development of the economy and prosperity we have today. In this development we can see that innovation is closely related to inventions, technological development and institutional and organizational changes. And not least that there are different factors fuelling innovation and driving innovation in different historical periods.

3.1.4 Paradigms of innovation and the evolutionary dynamic

Sundbo (1995) has looked into this variety of factors and driving forces to try to see what determines innovation at both the macro- and microeconomic level; i.e. at the company level. Through a cross-disciplinary historical analysis of innovation Sundbo identifies three fundamental paradigms that give different explanations of the emergence of innovation and how the process could be managed (Sundbo, 1995, p. 399). These explanations add more depth to the Schumpeterian view of innovation and shed more light on the historical and theoretical development of innovation outlined above. The three paradigms Sundbo finds are:

1) The Entrepreneurship paradigm. Roughly, the first part of the 20th century.

2) The Technology-economic paradigm. Roughly, the the latter three quarters of the 20th century.
3) The strategic innovation paradigm. Roughly the last quarter of the 20th until present day.

Even though the paradigms have emerged historically in the order presented above they should not be understood as being consecutive. Each paradigm still exists today and in a way, they build upon each another so the separation between them is not absolute in a Kuhn'ian sense because there are significant overlaps. However, the historical development does imply that the newer paradigm is the most relevant in explaining the status of innovation, and which we will return to below.

The strategic innovation paradigm is also the broadest of the three in its theoretical definition, and therefore it would be logical to assume that it will outperform the others. As already mentioned there is also another explanation for paradigmatic silos; the lack of communication between research within the individual paradigms that both Sundbo and Fagerberg point to. We will now look briefly at the central features of these paradigms of innovation.

The Entrepreneurship paradigm is in many ways similar to the Schumpeterian conception of the innovative entrepreneur. The paradigm emerged in the late 19th century and marked the period of the great founders (Gründer period), and the individual entrepreneurs that established new companies much in the way described by Schumpeter about entrepreneurs. Thus, the new businesses of the entrepreneur challenge the equilibrium of the economic system, and for a period the entrepreneur will have the chance to make above average profit on his business due to the competitive advantage of the innovation in the entrepreneurial business. After a period of approximately 10 years, according to Schumpeter, other entrepreneurs will have caught up with the original entrepreneur and the competitive advantage of the first moving entrepreneur fades.

As already mentioned, the relation between the entrepreneur and innovation is central in Schumpeters understanding of economics and the role innovation plays in economic development. We will therefore devote a few passages to explain the central elements in Schumpeter's theories of economic development. This will also explain briefly what is meant by an evolutionary theory of economic development.[3]

Some would argue that Schumpeter's theoretical goal was indeed to put innovation at the centre of capitalist economy (Andersen, 2009). We have already mentioned the phases of development in larger economic cycles. Schumpeter in fact a proposed a scheme for this economic development, though this was meant more as a vision of analysis than an actual

[3] In the early days of Schumpeter's work he was particularly opposed to the theory of economic equilibrium proposed by the Swiss-French economist Leon Walras who was one of the masterminds behind neoclassical economy. In fact, Schumpeter's evolutionary theory stressed that the role of the innovator was to bring disorder to this equilibrium in order to develop it.

research based result. However, it gives an excellent understanding of dynamics of evolutionary economics. This scheme consists of (Andersen, 2009, p. 12):

- *Initial equilibrium.* The economy and societal functions are to a high degree become routine in this phase. The degree of innovation is low.
- *Economic innovations: The initial equilibrium breaks down.* Entrepreneurs start to develop new products, organisational changes and other types of innovation. The development can be fuelled by new technology, new inventions or in other ways. First there will be a few pioneering entrepreneurs with great success. As the advantages of these early innovations become evident more and more entrepreneurs will follow, creating essentially what Schumpeter calls an entrepreneurial swarm. This process will for some time create a macroeconomic rise until the concentration of the swarm becomes too large and the economic system no longer can support or reward the entrepreneurial effort. We will then have reached a new equilibrium. Sometimes though with a crisis in between.
- *Creative destruction and renewed equilibrium.* The renewed equilibrium is a new version of industry and economic status compared to initial equilibrium. The process of entrepreneurial activity has effectively transformed industries and economic processes in the system to an extend that we can say that it as a new equilibrium – the old one is no longer found. The old routines and economic processes has been changed "…in the perennial gale of creative destruction" (Joseph A Schumpeter, 1994, p. 84).
- *Long-term economic evolution.* As this process continues it will lead to a continuous evolution of the economy that we have already discussed in relation to economic waves. This lies at the heart of capitalist economic system.

As is evident from this description the entrepreneur plays a fundamental role in driving the changing process forward and disturbing the equilibrium in the existing system. The entrepreneur is, so to speak, the fuel in the evolutionary economic process. Thus the entrepreneur is an integrated part of the capitalist system – not something that can be removed from the system.
Returning to Sundbo, he remarks that the entrepreneurial paradigm lost its prominence around 1930. This is in the light of the historical development we summarised above. However, he also claims that it became important again in the 1980's as an answer to the recessions of the 1970's. Among other things, due to industrial- and innovation policies that had supported entrepreneurial effort in the 1980s and 1990s.

The Technology-economic paradigm develops from around 1930 and onwards. As we have seen companies had grown into well-organised large corporations at this point. The lonely entrepreneur lost her dynamic function in the economy. The number of engineers and technicians were booming, especially in the United States, and technological development became the core element in this innovation paradigm (Sundbo, 1995, p. 402). The paradigm

is mainly push-oriented in the sense that technological inventions create innovations, however the demand in the market also plays an important role. In the 1980's and 1990's the market oriented factor has become more important and technological innovation has become part of firms' strategies thus bringing the perspective of the paradigm beyond the scope of the R&D department. This points towards the next paradigm.

The Strategic Innovation Paradigm was according to Sundbo not completely unfolded at the time of the article (Sundbo, 1995). We believe however that the observations made by Sundbo at the time have proven correct and that we indeed still witness the unfolding of this paradigm. This paradigm is basically about seeing new opportunities in the market and it is thus pull dominated. It has its theoretical basis in Leavitt (Leavitt, 1960) who holds that "…that there is no industry with an imminent growth potential caused by a specific technology. Only possibilities and exploitation of possibilities on the market exist" (Sundbo, 1995, p. 403).

Following this argumentation, we can also point to Penrose and The Theory of the Growth of The Firm (Penrose, 1995) and its subsequent inspiration for the resource-based view of the firm. This tradition within strategic management theory stresses the importance of the firm's own unique resources in growth and innovation. There are good explanations for this shift in focus directed towards the market. At the time of its emergence markets had been saturated. Growth was to a lesser extent marked by growth in consumption and therefore the innovation process must include observations of shifts in the markets, demands in the markets and other developments potentially affecting the competition.

This has important implications that have continued to unfold until today. First, the managerial role became the central agent of the innovation process. All decisions and observations must to some extent be managed and decided upon. Then the rising focus on markets puts more focus on involving customers in development processes and since value is often created in the process or dialogue between firms and customers the marketing function also becomes highly relevant. Finally, the need to oscillate between the specific resources and the demands of the markets puts more emphasis on strategy and innovation management. Sundbo writes:

> *The crucial element for the development of the enterprise is its (or in practice its managers') ability to see new possibilities in the market, then to induce innovations within the firm that can exploit these possibilities by utilizing the firm's specific resources. This is the same as saying that the enterprise should have a proper strategy.* (Sundbo, 1995, p. 404)

Thus, Sundbo notes the relation between the strategic innovation paradigm and theories of strategy including the resource-based view of the firm theories. We will deal in length with

the issue of strategy and its relations to innovation and competitiveness below in chapter 5. In the strategic innovation paradigm, these concepts are effectively integrated which makes sense in our view. Innovation types in the strategic innovation paradigm can be many things. It can be product innovation, process innovation, marketing innovation, user-driven innovation, network-driven innovation etc. The important factor is that it is driven by needs and possibilities in the market and these inputs must somehow be managed and processed by the company through innovation. It is thus a quite broad and elastic paradigm which can have many input factors and many types of results. Furthermore, and as noted above, Sundbo relates these different innovation paradigms to the different market situations of their emergence which may explain to some extent why they have emerged at the given time that they have.

The market situation has very important implications for the factors of innovation processes. This means that price reduction will have still less significance in saturated markets and societies of affluence and will be an increasingly difficult parameter of competition. Instead quality, product innovation and the marketing function becomes increasingly important in differentiating products and creating competitive advantage (Sundbo, 1995, p. 404). We might add to these differentiating factors service and experience innovation, however we will not elaborate on this here since these factors can also be included in the above mentioned factors (Pine & Gilmore, 1999; Sundbo, 1998). Thus, a more detailed analysis where the above mentioned concepts should be broken further down in order to get a clear view of their potential and sub-categories could be needed.

Sundbo summarises these different innovation paradigms and their market situations in the following way:

Sundbo's paradigms				
Innovation paradigm	**Entrepreneurship paradigm**	**Technology-economic paradigm**	**Strategic paradigm**	**Market situations**
Determinant of innovation	Entrepreneurship	Technology development	Market-oriented strategy	Markets in constitution (19th century)
Explanation of innovation	Psychological	Technological	Sociological	Constituted but not fully exploited markets (first three quarters of 20th century)
Agent	The gründer (amateur)	Technician	The professional manager	Tendentially saturated markets, complex and

				quickly changing (from around 1975 -)
Result	Economic growth and development of enterprises			

Figure 7: Comparison of Sundbo's paradigms – the column of Market situations is added to Sundbo's original scheme (Sundbo, 1995, p. 405).

Other writers have suggested expansions and developments to this understanding of innovations paradigms. For instance, Østergaard et al. (Østergaard, Rosenstand, Gertsen, & Lervang, 2013) have tried to add another dimension to the model, namely that of network-driven innovation. In their article they do not use the paradigm concept but instead talk about surges of innovation. In this way they talk instead of primary goals of innovation which however seem more or less equivalent with Sundbo's paradigms. The extended matrix of Østergaard et al. looks like this:

Extended Innovation Paradigms				
Surge of innovation	**First:** Cost-driven*	**Second:** Development-driven*	**Third:** Market-driven*	**Fourth:** Network-driven*
Year	1880-1892	1930-1960	1980-1999	1999 - *
Society	Industrial society*	Industrial society*	Industrial society*	Knowledge society*
Basis of innovation	Cognitive skills*	Technology	Sociology	Hyper-complexity*
Driver of innovation	Entrepreneurship	Development of technology	Determined by market	Global interconnectedness*
Innovation Management	Entrepreneur	Engineer	Market analyzer*	Integrator*
Effect	Societal welfare*			

Figure 8: Extended innovation paradigms matrix (Østergaard et al., 2013).

An important defining factor in this fourth surge is the hyper-complexity of modern society which has resulted in markets that make it very uncertain to predict market-development and consumer behaviour which is why agility and networks become the primary resources for firms instead. In this way the entrepreneur also becomes relevant again. Østergaard et al. writes:

> *As opposed to the third surge of innovation, innovative entrepreneurial companies of the fourth surge are not entirely determined by markets. Instead they focus on creating new markets. The company culture is network-driven, which makes it possible to see opportunities in markets that mature companies cannot see, with a traditional hierarchical organisation structure, where the operative and structural*

> *organisation are aligned. Mature companies simply do not access the potentially relevant expertise; the potentially relevant expertise is not a part of the culture.* (Østergaard et al., 2013, pp. 8–9)

This is an interesting perspective reflecting observations in business and society that we have also witnessed. It is a development that is also represented in literature on strategy with its focus on agility and short term cycles and not least the design-thinking approach to strategy and business. We will return to this in chapter 5. However, we do find it is questionable whether this marks a new paradigm or a truly new surge. It could also be argued that the rise of networks, user-innovation methods and the like are new elements in the strategic innovation paradigm. They are so to speak new tools for management to see and get inspiration about new possibilities in the markets that the company can exploit through new innovations. But in any case this process still has to managed. It is of course also possible we are witnessing a deeper, structural shift in innovation paradigms or a new surge. A shift where firms and markets are fundamentally changing.

Indicators of this can be seen in ideas of platform economy, sharing economy, sustainable business models, circular economy, social innovation and related concepts. We are probably still in the beginning of this change. However, this remains speculative from our current perspective and these subjects are not at the centre of this book.

3.2 Why is innovation so difficult?

After these broad strokes about the history and main themes of innovation and innovation theory we will now turn to investigate more specific subjects of innovation in a firm context with a specific focus on MSME's. In many ways, it seems that the process of innovation itself should be a relatively simple one. In its base form an innovative company would appear to be in a constant process of reflection and refinement. Questioning and evaluating every initiative to determine whether they should be continued, optimised, re-thought or discontinued. Constantly keeping a watchful eye on new and existing markets, emerging trends and new technologies to quickly identify potential gains or opportunities for the company, while always striving to maintain a lean and agile organisation that can quickly adapt to take advantage of new opportunities.

This sounds simple enough, although, as it is with many things, practice turns out to be much more challenging than the principles suggest. In the following we will run through some central areas that can present challenges for companies trying to implement above mentioned practices.

3.2.1 Vulnerability in large versus small companies

As mentioned at the beginning of this book, companies with large amounts of capital and other resources available to them have certain capabilities that others do not. One being the opportunity to invest in several initiatives and activities, and relying on the profits from

successes to balance out the deficits of the less successful. Another is the ability to engage in long term investments that are not expected to generate return in the same fiscal year. If these investments average out on the side of net profit it does not matter to the companies what the rate of success to failure is.

In the previous chapter, discussing Schumpeter's ideas on innovation (see section 3.1.2), it is established that there is always a certain amount of uncertainty involved with innovation. In other words, it is not thought to be possible (in the Schumpeterian view) to approach innovation as a purely deterministic process; regardless of one's philosophical perspective on determinism the argument is, that there are simply too many variables and unknowns for this to be viable.

In business terms this means, that it is impossible to know or guarantee that any investment in an innovation initiative will break even, let alone turn a profit, and even if does it may well be impossible to properly evaluate why this was so.

For companies that do not have the luxury of levelling out profits and losses over multiple investments this presents a higher risk, and when core business activities are doing well it can be hard to argue that taking these risks is worthwhile. In many cases companies, even those that can afford to lose their investments, will wait until they are in a position where they are forced to act; when they are on a so called 'burning platform'. Unfortunately, this is often too late, and even solid investments may not be able to produce the necessary effect.

The proverb 'necessity is the mother of invention'[4] comes to mind, and although we have determined that invention and innovation are two very different processes it applies just as well to the latter.

Of course, it is always possible to invest time and thought in activities that do not present a direct and immediate cost. For example, spending a couple of hours a month participating in meetings of a local innovation network may not represent a direct cost since the employee would be paid for her time regardless. If there is no guarantee that she would otherwise be engaged in more profitable activities this may not be considered an investment at all, making it difficult to assess the true value of the network to the company.

Where larger companies with more capital can choose to invest their employees' time like this without any means to evaluate the return it may, this may not be the case for a smaller one. In these cases, it becomes much more important to be able to quickly demonstrate clear returns on even trivial investments, before being forced to consider re-allocation of these resources.

[4] The origins of the prober/proverb? are unknown, however, it is thought to first appear in print in William Hormans Latin textbook 'Vulgaria' published in 1519. It appears as the Latin translation: 'Mater artium necessitas'. Even assuming this is the very first instance of its use, it would still suggest that the idea of necessity as the main imperative to act is a relatively old concept.

3.2.2 Collaboration is key

Another consideration that applies no matter the size of the company in question, but seems more acute in smaller businesses, is that of collaboration.

Since innovation requires an element of 'newness' (see section 3.1.1) it is quite well established, that various forms of collaboration or external awareness (Kelley, 2005, pp. 68–89) can be instrumental in bringing this 'newness' into the process. Two participants in Invio activities express it like this:

> *It was extremely interesting for us to meet other companies with which we can possibly work together to develop something completely new. This is really useful for us.* (Anders Løvik, Svinøya Rorbuer – participant in Invio Innovationstur til Lofoten 2015)

> *I feel that I gained a new and exciting additions to my network. It also provided new insight into different ways of thinking. For me, it confirmed that interdisciplinary collaboration really is key.* (Kathrine Skovsgaard, CEO Events by Skovsgaard – participant in Wild North Workshop 2014)

Although both, and indeed most, participants experience collaboration as valuable to their businesses it is not without challenges. It often requires an investment of resources similar to that in the network example above and through added administration in regards to establishing new supply-chains, or direct collaboration with other companies. This is also expressed in the previous quote by John Hird in section 3.

3.2.3 Myriads of innovation types

When reading academic and popular innovation literature it quickly becomes apparent, that different authors use a myriad of different typologies to sub-divide and differentiate their definition of innovation from the many others in use today (Baregheh et al., 2009; Crossan & Apaydin, 2010; Fagerberg et al., 2012; Kotsemir, Abroskin, & Meissner, 2013; Rowley et al., 2011).

On one hand, this adds a layer of nuance to the concept which makes the term itself much more useful; particularly in an academic context since it allows for more precise analysis and comparisons between case studies. On the other hand, it also leads to confusion as to what innovation is, and how to work and evaluate it from a practical standpoint. The latter is especially true within business practice, but also to a certain extent academia where gaining an overview of current innovation research is crucial and, in this case, not entirely unproblematic.

The problem is, that the term innovation on the one hand describes a simple everyday concept to which most people can relate. On the other hand, it is used in a myriad of different analytical contexts in various academic and business literature (Chesbrough & Appleyard, 2007; Kelley, 2005; Kelley & Littman, 2004; Piore, 2004; Prahalad & Krishnan, 2008). Thus, the term innovation by itself is much too general without some form of qualifier to help the reader understand precisely what is meant. Conversely, there is no standard set of qualifiers for systematic comparison, or any easy way of gaining more precise understanding of its use.

In other words, we have come to regard the various *types* of innovation not so much as distinct types, but more as arbitrary *parameters* which tell us something about the analytical context and descriptive purpose within which the term is being used. In most cases, the term innovation seems to have the same base definition at its core, which has changed little since Schumpeter is credited with coining the term in its modern usage (see chapter 2). In chapter two we also noticed that few of the definitions of innovation consider the specific target of the innovation process; be it process, product, organisation or other. In other words, we will rely more on a holistic understanding of innovation and try create a framework which encompass the different typologies of innovation after carefully considering the position, resources and capabilities of the company. Taken together this creates a strong platform for creating a competitive innovation strategy.

For example, the simple distinction between *process*- and *product* innovation tells us something about *what* the specific innovation concerns, and does not usually imply a fundamentally different understanding of innovation as such. Likewise, differentiating between *open* and *closed* innovation processes or *incremental* and *radical* innovations, to name a few of the more common "types", are merely telling us something about *where* the innovation process is taking place along with the *relation* between the innovating parties (Open/Closed) and the perceived *effect* of the innovation process (Incremental/Radical). Reduced to a standard set of parameters, which can be combined and expanded upon as the need arises to indicate the significance of an innovation in a specific situation, this could potentially provide the foundation for a uniform method of meaningful analysis and comparison.

This distinction may seem superfluous, since it does not provide an immediate solution as to how we can work with a term that is both so general as to be vague and at the same time has many highly specific meanings. However, it does focus our attention on what is being described as innovative, and why we regard it to be so, rather than distinguishing between distinct types of innovation. This is much more forgiving, and allows for overlapping and ambiguous definitions to a much greater extent, which seems to resemble what is found in innovation literature much more accurately. From a pragmatic point of view, one could argue that there is a reason that there is no apparent uniform and distinct typology of innovation. Apparently, there is a need for a way to describe properties of any given innovation that is not satisfied by lumping every case into one of a series of predefined types. However, by evaluating the need for this differentiation and identifying the areas where it commonly arises

we can focus on what characterises the parameters typically used to differentiate between types. We suggest that this can lead to a more practically applicable understanding of innovation that can be applied in a uniform manner during analysis and strategic planning.

To work with the term innovation in a practical sense, both from a strategic and an analytical perspective, this understanding centres attention on raising and answering questions that qualify defining and using the term in a way specific to the situation, rather than trying to decide which predefined and unique label to apply to the situation that a formal typology implies.

To help illustrate how this works we suggest a model of innovation parameters, rather than types, which can be used analytically and strategically to highlight relevant aspects of the given situation in a useful way.

Based on our readings of various academically recognised papers and books of significance to the study of innovation referenced in this text, we have identified various parameters which seem to be common throughout the various definitions presented. This parameter-based perspective can be visualised as follows:

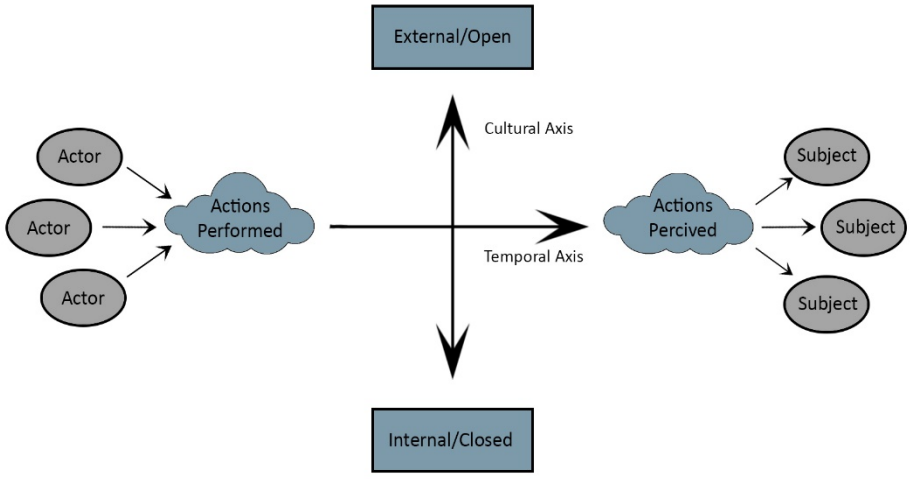


Figure 9 - Parameter-based view - Action to effect flow. Model developed by the authors

Firstly, there seems to be an implicit temporal dimension to most innovation types. For example, a *product innovation* is often used about some aspect of a new product's development; as such, a *present* or *near present* intentional action. Conversely, *disruptive*

innovation (Bower & Christensen, 1995)[5] typically refers to a set of perceived effects of a given set of actions. Thus, the *present* on a temporal axis is concerned with the intentional actions performed to innovate whereas the *future* on the same axis is concerned with the effects of these actions as perceived after they occur.

Similarly, many definitions are linked to a cultural component, concerning *where* various aspects of the innovation take place. Examples of this could be *Open Innovation* (Chesbrough, 2003) or *R&D-Based Innovation* (Tidd & Bessant, 2014, p. 120), the latter taking place in an inter-organisational setting whereas the former refers to varying degrees of intra-organisational processes. Moreover, this encapsulates the concept of *actors*; those who are performing the action or actions in non-specific terms. In both extremes of the cultural axis, there are implicitly one or more actors, who may or may not be related in an endless amount of ways, *doing something;* performing the actions themselves.

Opposite the actors, and related to the perceived effects rather than the performed actions, are the *subjects* of the process. The subjects are those affected by the actions; those who experience the effects in one way or another. Hopefully, one or more of the actors would also be the subjects allowing them to take advantage of their innovations value, however, this is not necessarily the case. Some innovations could solely be for the benefit of others, while many almost certainly affect subjects well beyond the obvious and immediate targets.

In some cases, it may be advantageous to sub-divide into various types of actors and subjects depending on the scope and focus of the analysis being performed. For example, there may be situations where several orders of actions take place among non-related actors; the former making the latter possible by creating favourable *circumstances*. These circumstantial actions or events may not be direct or intentional parts of the innovation process; however, they are significantly contributing to its perceived effects. Whether it makes sense to attempt to identify and include these in an analysis will depend entirely on what is being studied and for what purpose.

To some degree the same can be said of subjects. Major innovations will sometimes cause ripple effects that could not be accurately predicted at the time of innovation. An example could be market disruptions such as the advent of the Smartphone disrupting the established mobile phone market. Apart from transferring the market for handheld devices to the Smartphone proprietors and thereby sending unsuspecting producers into a financial tailspin, these two primary effects would certainly cause many others among sub-contractors, application developers, consumers etc. How far to delve into this and where to draw the line would again depend on the analysis and its focus.

[5] We recognise, that disruptive innovation along with several other types of innovation are in fact much more than simple parameters or specialised definitions, and in fact represent entire theories of innovation. However, in this instance only the core terms themselves, and not the body of ideas encompassed in the theory, are considered.

The main point here is, that most of the typologies we have come across, in some way encapsulate these parameters to some degree, either implicitly or explicitly. We do not mean to imply, that this is by any means an exhaustive, or comprehensive set of parameters. However, we do find a parameter-based perspective to be both appropriate and useful in the context of this book and the parameters listed here also seem to be a good, generic, starting point for describing most of the innovation types we have come across.

The table illustrates the abstract relationship between its elements, which themselves can be defined and sorted into the three categories shown in the table below:

Categories and element definitions		
Category	**Element**	**General Definition**
Dimensions	*Temporal*	Parameters concerned with the *action* (before innovation) or with the *effect* (after innovation). Thus, the first half of the axis is related to the actions performed by the actors whereas, the second half is related to the effects of these actions on the subjects. The Cultural axis separates the two, thereby implicitly signifying the *point of innovation* in an abstract sense.
	Cultural	Parameters concerned with *where* the various elements of the innovation process, in an abstract sense, take place i.e. organisational, user-centred, open (between actors) etc. This axis illustrates the overall innovation culture which in turn describes the actors and their relation to each other. For example, if they are part of the same company and thus working together towards a common goal, if they are merely part of the same supply chain and possibly have different albeit overlapping motivations or if they are totally unrelated and one simply paves the way for the other. The latter meaning that only a subset of the total identified actions are intentional – depending on the analytical perspective One takes.
Participants	*Actors*	Actors represent participants that take an active role in the actions performed. In other words, they are the ones performing the action, hence: actors. This is usually a conscious and deliberate action through willing participation although sometimes actions and actors are identified retrospectively once it has been established that

		they have resulted in an innovation. This does not mean that the actions were not deliberate or performed with intent to innovate, but simply that they were not of analytical interest until their actions effects were established. In some cases, however, it might make sense to list coincidental actors whose actions, although not intentional, are significant.
	Subjects	Subjects are, first and foremost, the recipients rather than the participants, although they may often be both. They are the entities which derive value from the specific innovation in question. These could be intended recipients, but also coincidental or derived. There could also be first and second order subjects based on derived effects etc. Often one or more of the actors would also be subjects since the actor's motivation for action is to receive value from the action; this is not always the case though. It is important to note, that the effect of the innovation may affect the various subjects in different ways, although this is not a given.
Events	*Actions*	Actions are, as the name implies, the actual actions performed by the actors. These can be single, isolated actions or entire strategies depending on the analytical perspective taken. However, they are usually categorised as intentional and not incidental; the notable exception being *circumstantial actions*.
	Effects	The effects describe how the actions affect each of the subjects. The difference being, that effects could be viewed in abstract terms such as 'market disruption' whereas those who, as part of the market, are affected would be described as the subjects.

Figure 10 - Relation between model categories and elements. Table developed by the authors.

These elements would likely not all be known during any given analysis, and can each be described with varying levels of detail. However, being able to visualise them and how they are related can be a powerful tool; both analytically and strategically. Many case studies on innovation often begin when a particularly impressive effect has been observed and deemed the result of some form of innovation process. In this situation, it is often desirable to analyse

these effects and actions leading up to them in the hope that it could provide valuable insight into how to create similar innovations in other businesses. By identifying what we can, and cannot describe in any detail we can ask questions relevant to uncovering what we do not know and thereby gaining a deeper understanding of the process itself. These questions help identify: What is being done (Action)? Who is doing it (Actors)? Where it is taking place (Innovation culture)? When 'we' decided, it was innovative (Temporal Placement)? What it changed (Effect)? Who was affected by this change (subject)? And, what, if any, circumstantial actions are of notable significance or consequence?

The above model begs these general questions regarding every innovation you attempt to plot into it. These can, in turn, easily be framed as both an analytical and a strategic tool as exemplified below:

Analytical	Strategic
Which actions were performed?	What can be done?
Who performed the actions?	…by whom?
Where did the actions take place?	Do we collaborate, and with whom?
Where there any significant circumstances?	What is our success dependant on?
When does the action become innovation?	How do we know if we are achieving our goals?
What is the effect?	What are our goals?
Who is affected?	Where do we measure the effects?

Figure 11: Analytical vs Strategic Questions. Table developed by the authors

To clarify how these questions might be used in an analytical as well as a strategic fashion, we will use a simplified and fictional, example:

In this case, a small tourist hotel in a seasonal tourist destination in Northern Jutland. The hotel has 25 rooms and about 20 employees; a little more in the busy season. The hotel has a successful packaging deal, in which any stay at the hotel is seamlessly mixed with a variety of experiences: trips, activities and fittingly themed gastronomical experiences at the hotel restaurant. The hotels interior decoration has been carefully designed to support the concept as well. All this, has led to the hotel becoming slightly more competitive compared to the other hotels and hospitality services in the area.

From an analytical perspective, we are interested in uncovering which circumstances and decisions have led the hotel to be in this situation. Presumably, so we may learn from their experiences so they may be converted and emulated in other businesses to similar effect.

In this situation, the analyser can begin by asking the above questions while perceiving the case with the clarity of an outside observer looking back in time at a sequence of events. This

first means trying to establish a set of states representing the hotel before and after the development process, along with a timeframe for the process itself. Similarly, it is necessary to establish the level of detail with which the analysis is concerned. This is to identify and isolate actions along with their effects and the actors who perform or influence them.
From there, the analyst can then start by asking which actions were performed to get from the before- to the after-state. This could, for example, be the introduction of new products or processes such as the packaging tours or the new gastronomical experiences, which in turn, could be due to management's decision to hire new staff with special competencies.

The next two questions are concerned with how these actions came about? Where did they originate, and who drove them forward? Maybe the entire staff participated in an ideation workshop and management selected some ideas to implement. Maybe it was a single individual, an existing employee or a new hire, with a good idea and the skills to convince management to give it a try, or maybe it was the result of engaging an external consultant or network with experience in this sort of thing.

Often, the actions themselves and actors performing them are not enough. There may be specific circumstances, outside the hotels control, which in retrospect be identified as significant enablers aiding the process. Examples of this could be special resources incidentally available to the hotel at the time, or actions performed by competitors that affect the process for our hotel in some way.

This leads to questioning what the actual innovation is, and when it became and innovation rather than simply a development process? In the case of the hotel, maybe it is not the package deals or the experience elements that are the real innovation. It could be that it is the marketing of these products or the underlying business model supporting them that represents the real innovation. When did it become apparent, that the changes made were having a significant effect?

Determining the effect is the final step. Who is affected and how? For example, how do we know that the recent changes have given the hotel a competitive advantage and are we certain that the two are related? Has the hotel improved its economic performance due to the innovation, its image, its customer satisfaction or something else? Have the new innovations affected the hotels position in the market and its relation to competitors?

From a strategic perspective, the questions are instead focused on uncovering opportunities so they may be prioritised before selecting those to systematically and reflectively explore. In contrast to the analytical perspective this is typically done by the hotels staff and management while in the analytical perspectives pre-innovation state.

Asking what can be done, and by who, is one way of uncovering some of the hotels capabilities and resources. What are they particularly good at? Which features and aspects of the hotel sets them apart? What resources are available to them? We will return to these

parameters in length below since they are central to understanding and developing strategic competitiveness

For now, determining these things allows for discussion of what is both desirable (to the hotel) and realistic. In this case, establishing a new packaged experience product seems reasonable since it allows for the introduction of something new (with which to differentiate) without requiring a large investment up front, and with little risk of alienating existing clients.

Moving on from there, the hotel can look at what it needs to begin developing such a product. Does it have all the resources in-house or does it need to acquire expertise in certain areas? Next, should this expertise be in the form of a new hire, a partnership or professional services? In this example a new chef may be hired to develop and manage the gastronomical aspects, while partnerships with external partners provide other aspects of the experience packages. Finally, the interior design could simply be done by purchasing the services of a professional design team.

All of this still requires clear short- and long-term goals to be defined at the beginning of the process to continuously evaluate and revise the innovation process. Is the concept appealing to customers, do they react in a positive manner and is it good for the general business of the hotel?

In this case, success is not necessarily a question of reaching every goal, every time. Rather it is a question of keeping track of the new concepts and how they are performing combined with a willingness to quickly change course if something does not seem to be having the desired effect within the expected timeframe.

3.3 Abductive by nature; design principles and innovation

Above, we mention the element of uncertainty in the innovation process as an important barrier to conducting innovation in business at a systematic, strategic level. Because of the nature of business structure this potentially becomes a problem to MSME's due to lack of flexible capital and resources. As we have explained the element of newness is a central issue of the innovation process and since newness per definition includes something that we have no certain knowledge of there will always be an element of uncertainty in the innovation. Call it newness, X-factor, black-box, magic, creativity; the synonyms are certainly many, but the central focus of the company must be how to handle this process of uncertainty in the best way. This goes for small companies as well as large companies, however as we argue bigger companies might be resource-wise better accustomed to make innovation an integrated part of their business. This cannot, however, necessarily be taken as certain; large companies also have their share of obstacles to innovation, which could for example be a rigid organisational structure, cloudy decision making, bureaucracy or opposing shareholder interests just to name a few.

Of course, this issue is at the very heart of what is called innovation management and many answers can be supplied about to how to handle this process[6]. However, we will argue here that there is a kind of thinking that can help us better understand this process of uncertainty and that there might also be a discipline that holds comprehensive experience in dealing with this element of uncertainty. This being abductive processes and the discipline of design.

The business thinker Roger Martin has in his book, *The Design of Business* (Martin, 2009), argued convincingly that all successful business propositions should somehow be an answer to a problem or a need. The process of answering such a call will most often start with a situation of mystery which entails deep intuitive thinking about this problem and suggestions about to answer it. Then follows a phase of heuristics and experimenting where the company obtains more structural, systematic knowledge of the phenomena. This understanding can focus the effort of the company in order to transform knowledge into commercially viable business propositions. Finally, the company can use the gathered knowledge about a phenomenon and it can put its heuristics into a systematic operation; a sort of formula to exploit a certain idea or specific understanding of a problem through products or services. The heuristic is turned into an algorithm which is the phase where a company can make most revenues from its efforts in the mystery and heuristic phases. This process Martin calls the Knowledge Funnel:

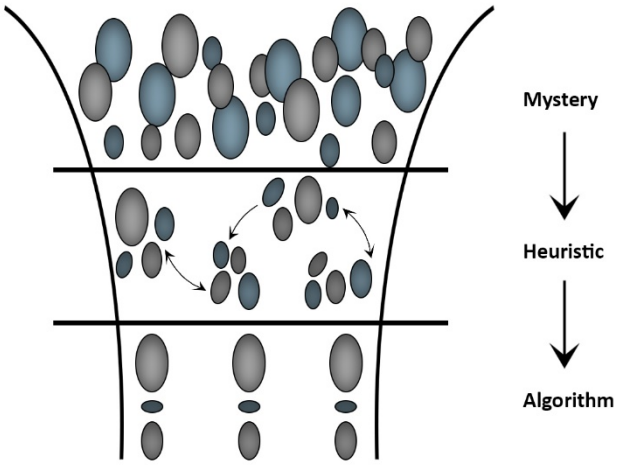


Figure 12 - The Knowledge Funnel (Martin, 2009, p. 8).

The noticing of a mystery begins with a hunch called pre-linguistic intuition. This somehow guides our way in situations of uncertainty. Heuristics are rule of thumb; they do not offer

[6] For instance, (Bessant & Tidd, 2009)

any guarantee that using them will produce the desired result but they might be the best response we have in a certain situation. Algorithms are "certified production processes" (Martin, 2009), that guarantee to produce the desired result unless unforeseen circumstances intervene. The stage of the algorithm is the final stage of knowledge creation where we know with almost complete certainty how phenomena work and how environments respond to our inputs. To develop a business proposition to the stage of algorithm creates a significant platform for exploiting value from these products and services. Some business sectors, of course, have a hard time making it to the algorithm stage; i.e., arts, music and certain types of services because it is their nature to change and surprise their customers all the time.

Most successful business we see today have, according to Martin, made their way through The Knowledge Funnel:

> *The vast majority of businesses follow a common path. The company is birthed through a creative act that converts a mystery to a heuristic through intuitive thinking. It then hones and refines that heuristic through increasingly pervasive analytical thinking and enters a long phase in which the administration of business dominates. And in due course, a competitor stares at the mystery that provided the spark for this company, comes up with a more powerful heuristic, and supplants the original business.* (Martin, 2009, p. 20)

The quote above points to both the strengths and the challenges of this process. If a company becomes too satisfied with exploiting its algorithm, competitors with better heuristics and algorithms will eventually come along with a better or more relevant answer to the original mystery.

In order to avoid this pitfall companies should be careful to continuously move back and forth in the knowledge funnel. In this way it will be able to revisit the original mystery or identify new ones and thus continuously adjust the algorithm or indeed develop entirely new ones. Far too many companies fail in this process and the list of giant companies of the past that have succumbed to competitors with better heuristics and better algorithms is long. We only have to mention Kodak Eastman and the current situation in the telecom business to point the attention to a few spectacular examples.

The balancing between these two poles of completely intuitive thinking and the systematic thinking of the algorithm stage, Martin identifies as design thinking. Using design thinking will help the company to move continuously up and down the Knowledge Funnel and make the necessary leaps from stage to stage (Martin, 2009). The modern large company or corporation is challenged by this, since at a certain point management and operations fall prone to reliability and analytical thinking. Shareholders do not like to invest resources in activities that do not guarantee a certain result and revenue. The companies thus forget to

focus on intuitive thinking and the higher validity perspective this entails. Why? Because it is uncertain. This is where design thinking provides an answer, because the logic offers a connection between the intuitive thinking of the mystery phase and the analytical thinking of the algorithm phase:

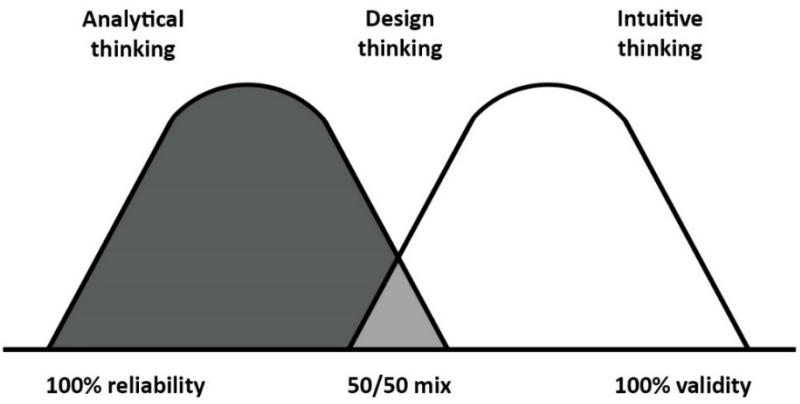


Figure13 - The predilection gap by Roger Martin (Martin, 2009, p. 54)

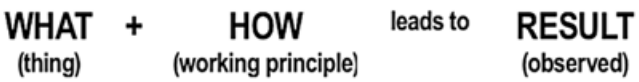
It is easy to see that this reasoning and design thinking could be a central work logic in innovation processes and provide an idea of how to handle the uncertainty of innovation processes. This is not the place to go into specific processes and methods of design thinking in more detail. There has been some effort in this respect, however it is our impression that this development is still unfolding in the design community and strategic management community with discussion of how to merge, bridge or expand these two paradigms. In this respect we refer to e.g. (Brown, 2008; Brown & Katz, 2009; Brown & Martin, 2015; Dorst, 2015; Kelley & Littman, 2004; Martin, 2009; Rowe, 1987) for further exploration. Following Dorst (2011), however we can quite comprehensively sum up the relation between business and design:

> *Studying the way designers work and adopting some design practices could be interesting to these organisations because designers have been dealing with open, complex problems for many years, and the designing disciplines have developed elaborate professional practices to do this.* (Dorst, 2011, p. 522)

Design thinking is characterized by being driven forward through what is also called abductive reasoning. Especially since it can be hard to explain how designers move from inputs from the world around us to the actual designs they develop. Jon Kolko argues that synthesis is crucial in drawing conncetions between unrelated elements, which is the way that research in environments lead to actual design propositions. Synthesis in this respect can be viewed as an “abductive sense-making process” (Kolko, 2010, p. 17).

Abduction as such is an ancient concept but has most notably been scrutinised by the thinking of the pragmatist philosopher Charles Sanders Peirce throughout his writings. We will not delve into too much detail with the philosophical undercurrents of abduction. However, it is instructional to discuss the epistemological logic of abduction compared to other fundamental models of reasoning in order to better understand the connection between design thinking and innovation and the fundamental challenges these disciplines face. We will follow Dorst (2011) in this venture. Abduction is often explained compared to deductive and inductive inferences, which we will also do here.

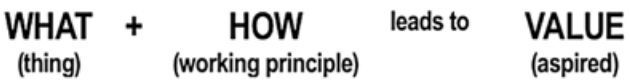
In deduction we infer from knowledge of rules and know that if we follow these we can be certain of the outcome. In other words, we know both *the what* and *the how*:



In induction we move from observations of a phenomenon to inferring that the pattern we observe can be made into a general rule or a certain result within design. Formulating the rules, the *how*, is a creative process in which hypotheses must be repeatedly proposed and tested:

The inductive and deductive forms of reasoning are the central approaches within science because they are well suited to create new knowledge about the world. Inductive hypotheses can be deductively tested, and so forth.

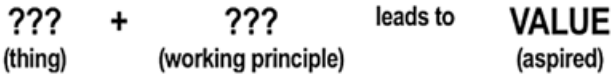
According to Dorst, designers aim to create value within the situations and environments in which they work. The end goal is then not new knowledge or fact-based result. This changes the equation:



This is the outset of abductive reasoning which comes in two forms. The first one is the simplest and is associated with closed problem solving and creative processes. We know the

value we aspire for and the principle of how to get there. What is needed is a concept, a product, a system or a service to get us there; the what. Dorst calls this process Abduction-1.

Finally, Dorst introduces Abduction-2 which is a more complex form of productive reasoning because in this case neither the what nor the how is known. Only the end value strived for is known. The designer will start this process by suggesting a framing a perspective from which the situation is perceived. The designer can move back and forth in the equation testing different scenarios to attain the desired value.



This is much closer to the tradition of conceptual design practice than the other reasoning principles. These are much more open processes than the ones utilised under Abductions-1. Both working principle and thing must be made up. And this process also resembles the idea of the mystery and heuristics of The Knowledge Funnel mentioned above. Roger Martin characterises abduction as “the logic of what might be” (Martin, 2009). However, Kolko (2010) adjusts this somewhat to propose the following definition:

“Instead, abduction can be thought of as the argument to the best explanation. It is the hypothesis that makes the most sense given observed phenomenon or data and based on prior experience. Abduction is a logical way of considering inference or "best guess" leaps.” (Kolko, 2010)

The abductive reasoning principle obviously is applicable to the understanding of the innovation process as well. And even though innovation processes are not always as uncertain as Abduction-2 suggest the logic is still applicable.

4 Why innovate?

As is obvious from the former chapters our primary aim in this book is to discuss and systematise the concepts of innovation and propose a meta-model of innovation's processes that can be used both analytically and strategically. These proposals are based on an analysis of the innovation literature. In this way we hope to create a clearer understanding of what innovation is and in which different phases and contexts we might seek to innovate. And not least, to become aware of the drivers and methods of innovation that can give companies a clearer idea of where and how to become innovative. In this approach the value of innovation is rather implied. However, since innovation entails the involvement of resources and can be costly it could be useful to take a step back and ask the question of why we should innovate in the first place.

There is certainly no shortage of encouragement to embrace innovation of any kind these days. From our own daily viewpoint, we regularly stumble into and get involved with innovation networks, innovation strategies and what we call innovation projects in many different contexts. There are innovation counsellors, innovation conferences, and newspaper supplements to promote innovation in specific business sectors or for the business community in general. Furthermore, public institutions, the educational system and trade organisations regularly promote themselves as the pinnacles of innovation. Even the odd transport and logistics truck roaring along the highways stage themselves as being innovative; *innovation in motion.*[7] The concept of innovation is thus promoted and utilised to such an extent that it seems unthinkable that anyone could state; "innovation is not something we strive for in our organisation".

But what is the motivation and what are the needs and pressures of embracing innovation that has brought this agenda about? Why should companies or institutions try to create innovative organisations and promote innovative behaviour, culture and processes? Even regions and countries are competing to become the most innovative players in the class these days, as has already been shown by the Danish Government's innovation strategy (Danish Government, 2012). Why? And what do we believe will be the outcome of this race for innovation? What are the deeper economic, cultural and business reasons for this significant focus on innovation? Is it more than just a trend? Part of the reason is probably that it *is* a trend but, as we shall see, another part of the reason is that innovation is embedded in the capitalist economic system.

We will address these questions below in order to get a clearer understanding of the underlying factors driving innovation and apparently pushing the demands for innovation to a still greater degree. The chapter will thus seek to identify and clarify the underlying reasons for why we should innovate and perhaps why innovation has come to the forefront more than ever before in recent years. Accepting that we should indeed innovate, these questions lead to more practical considerations of how best to tackle the task.

[7] One example of this was a lorry identified at the Danish Highway E45 around the city of Horsens.

4.1 Historical Developments

There is no doubt that developments in different macro-factors provide substantial reasons for the rising interest in innovation that we have seen since around 1980, and even more since the breakdown of the communist block around 1990. And, of course, then the establishment of the World Trade Organisation in 1995 to promote and develop global trade, which has increased significantly since then. These factors include, but are not limited to, a rise in international trade and trade agreements, transparency in competition, globalisation, financial deregulation, shorter production cycles, accelerated technological development and, not least, an ever more market-oriented business mind-set. Businesses cannot just push their products onto the market anymore and find that consumers take what they are offered! They have to find or create a market, and sometimes they fail because they misread the needs and wants of the consumer. The consumer has now become a much more central player and this nurtures the pressure on companies to innovate in order to continually remain as the most relevant provider in the eyes of the consumers. In an influential paper from 1994 Prahalad and Hamel mention a number of factors for these structural shifts in industrial competition (Prahalad & Hamel, 1994). They are:

- Deregulation
- Structural changes
- Excess capacity
- Mergers and acquisitions
- Environmental concerns
- Less protectionism
- Changing customer expectations
- Technological discontinuities
- Emergence of trade blocks
- Global competition

All these factors, and more, heavily influence the competitive situation for firms and create "pressure for Radical Rethinking". We might also say that it creates pressure for innovation. This was a development that to some extent was missed by strategic management theoreticians in the 1980s, but which from the 1990s onwards has fostered significant new thinking in the strategy paradigm (Prahalad & Hamel, 1994). The development has by no means slowed down in the years that have passed since Prahalads and Hamels paper and it has, as we shall see, important implications for business strategy and the role of innovation.

However, the goal here is not to identify and analyse the megatrends in an economic, cultural, technological and sociological perspective that can be said to be the primary drivers of this rising focus on innovation. Instead the goal is to explain and analyse the underlying assumptions concerning the qualities and advantages innovation can provide to businesses and to society at large. We do this by identifying and explaining some key concepts in

innovation and business theory and try to link these concepts to the role innovation can play. This will provide a comprehensive explanation of why even smaller companies have to be innovative and what they can do to become so.

4.2 Competitiveness

A powerful motivation for embracing innovation is the chance to obtain competitive advantage. The main argument in this line of thinking is that innovation can be the key to obtain and sustain competitive advantage (Porter, 1998). However, we can ask ourselves whether innovation really is the direct path to competitiveness and the key to sustained competitive advantage. To address this question, we must explore what competitiveness and competitive advantage means?

There is no clear and unequivocal definition of competitiveness apart from the logical assumption that it is in some way about performing better than your competitors. This is because there are different answers to what is meant by *being better*, and that there can also be multiple answers to the same question depending on the position from which it is asked. This is hardly too surprising given that the nature of business organisations, production, markets and consumptions is highly complicated and differentiated. Thus, we should not expect to develop a one-stop generalised explanation of issues such as competitiveness and competitive advantage. Never the less, there are some definitions and explanations of these concepts available to us.

As noted above, one basic way of approaching competitiveness is to accept that it is about performance. And if your company performs better than others you have somehow gained a competitive advantage. Thus, in this understanding better performance is the end goal of competitive advantage and Competitiveness becomes subordinated to performance. According to Stephane Garelli of the IMD World Competitiveness Centre, the concept of competitiveness was scarcely used before the 1970s, but three decades later had transformed into one of the of the most used economic terms (Garelli, 2006, p. XIII). According to Fagerberg (1996) there is a straightforward explanation for this. Competitiveness and especially the notion of international competitiveness between countries is not a theoretical concept conceived in economics. The importance and implications of competitiveness was largely ignored by the dominating neoclassical economics theoreticians, who to some extent neglected trade as an important growth factor (J. Fagerberg, 1996, p. 41). Rather, it has been developed and promoted by practical people close to policy-making who probably have had a need to develop, measure and evaluate policy initiatives.[8]

Of course, Garelli's book, is about competition and competitiveness, and how this seems to affect all parts of both the modern individual and society where the overall goal is to increase the prosperity of societies, nations and their people. According to Garelli, a nation's overall prosperity results from the interaction of three forces:

[8] As we shall see later competitiveness has been seminal to other traditions of economics, most notably the evolutionary economy of Schumpeter.

> *competitiveness of firms: focused on profitability;*
>
> *competitiveness of people: focused on personal wellbeing;*
>
> *competitiveness of nations: focused on sustainable prosperity"* (Garelli, 2006, p. XIII).

In this understanding competitiveness has big implications and, therefore, no wonder that the concept is widely discussed and promoted by policymakers, trade-organisations, multinational companies and the like. Even though not everyone has agreed on the importance or worth of competitiveness between nations. However, for reasons mentioned above (e.g. Krugman, 1994) this view is declining according to Garelli (Garelli, 2006, p. 4). The original discussion about this perspective has been focused on whether trade, which frames the competitiveness concept, is an adequate measurement for comparing countries and their relative competitiveness. However, more and more consensus has emerged among economists about this issue though there are, of course, still debates about the level and the importance of competition between nations and about which measures should be used to advance our understanding of this competition.

The concept of competitiveness integrates many different subthemes from economics and management into guidelines on how a nation or firm reaches prosperity. Or in the case of the firm, which is our primary focus here, how to improve performance. Securing competitiveness is about managing the many different resources of the firm in an integrative way. In Garelli's words: "Competitiveness analyses how nations and firms manage the totality of their competencies to achieve prosperity or profit" (Garelli, 2006, p. 3). And competitiveness is not just about what can be measured in metrics but also about intangible resources and about long-term appropriateness and sustainability of resources and competencies. A country might want to examine whether the present education system will provide the workforce in 15 – 20 years that will be necessary for the country to prosper, and a company might ask itself whether its employees' competencies are right for the products it will be producing ten years into the future. In this way the competitiveness concept deals with much the same considerations as does the field of strategy or strategic management, as we will show later. This becomes even clearer when summing up the major points of what we might call the theory of competitiveness:

> *In summary, this first chapter illustrates how the theory of competitiveness provides a more comprehensives, holistic approach to those interested in identifying what drives prosperity, and how to enhance it. Firms and their managers cannot forever thrive on dividing up everything – production, markets, customers, goals, even business units and competencies. Neither can nations neglect the development of a common value system, a cohesive set of goals, and an established,*

> *widely-accepted blue print for the creation of prosperity. Divergent goals and means need to be reconciled within any organisation – typically at the most senior leadership level – so that they can provide a guiding sense of purpose for the future.* (Garelli, 2006, p. 28)

This of course turns into quite a comprehensive systemic perspective and, with that in mind it is hardly surprising that the idea of competitiveness has only come to light within the last three or four decades as theory of economics and strategic management has evolved and advanced.

Another dimension central to competitiveness is innovation and Schumpeters idea of creative destruction (Joseph A Schumpeter, 1994), which we have presented above. Garelli argues that the Schumpeterian breaks in the economy due to entrepreneurial driven industrial innovation (new technology, production systems, business models etc.), are crucial to the continuous prosperity of firms and nations (Garelli, 2006, p. 44). However, to sustain this form of development in the capitalist system there is also a continuous pressure to develop new forms of management structures and organisational set-ups, which can balance competitiveness (Garelli, 2006, pp. 46–48).

When reading through policy catalogues about productivity, education and the already mentioned Danish Innovation Strategy (Danish Government, 2012), and listening to the public debate in general, it is obvious that these idea of competitiveness are quite influential on the formation of policies and strategies, and that the concept of competitiveness theoretically and ideologically lies beneath much of what is assumed and planned. The research and conclusions of the competitiveness paradigm - a discipline of economics - can thus be said to be influential in many different ways.

We will leave these very broad strokes behind for now. This is, after all, not primarily a book about economics but about how innovation is to be understood and how it has been presented in various strains of academic literature: And how we can bring it into use in a hopefully clear and practical way. In our view, innovation in practice deals first and foremost with the company level. Or, we can say that innovation at least centres around the structure and performance of the firm since it is essentially about how firms can improve their performance and competitiveness through changes, new ideas and new products, and the other categories of innovation that we have dealt with above. Thus we will narrow our scope in this investigation to focus primarily on the level of the firm; the micro economic perspective of innovation. We will however bear in mind that strategy and innovation are two central dimensions of competitiveness and performance. With that in mind we will proceed with the discussion of the competitiveness concept.

In linking the competitiveness concept between the large scope of nations and the somewhat narrower scope of firms, we can use Porter's broad determinants of national advantage; the determinants that shape the environment in which firms compete. These are:

1. Factor conditions. The nation's position in factors of production, such as skilled labour or infrastructure, necessary to compete in a given industry.
2. Demand conditions. The nature of home demand for the industry's products or service.
3. Related and supporting industries. The presence or absence in the nation of supplier industries and related industries that are internationally competitive.
4. Firm strategy, structure and rivalry. The national conditions governing how companies are created, organised and managed, and the nature of domestic rivalry. (Porter, 1998, p. 71).

These determinants[9] highlight that the relation between the competitiveness of the firm and the competitiveness of a nation are interrelated and highly complex. The system is mutual; i.e. reinforcement and changes in one determinant can affect others, even though favourable conditions in one determinant need not lead to competitive advantage in others and vice versa. For instance, abundance of well-educated employees need not lead to competitive advantage for a given firm if it has a poor strategy or lacks capabilities in other fields. We include this perspective here to show the delicate connections between the resources and the management hereof within the firm and other determinants. However, as mentioned above our primary perspective lies with the firm, but it is not possible in a meaningful way to completely separate the internal firm structure from its context. We will return to this issue in the strategy section, chapter 5, where we will also touch upon Porters notion of the Five Forces.

Many other authors have dealt with the competitiveness issue and, as already mentioned there are different perceptions of how competitiveness is to be understood and how it should be applied in an industrial context. In a study on *The Competitiveness of Small and Medium Enterprises* Man & Chan point out that "the competitiveness concept involves different disciplines, such as comparative advantage and/or the price competitiveness perspective, the strategy and management perspective, and the historical and sociocultural perspectives" (Man, Lau, & Chan, 2002, p. 126). Thus competitiveness should be considered a multidimensional concept and not all of these dimensions are directly relevant to the firm-level since they include both internal and external factors that align with the understanding we have already seen from Porter. Similarly, Clark and Guy (Clark & Guy, 1998, p. 364) have pointed out that competitiveness in traditional economic theory has been about competing on price through factors such as being able to produce more cheaply and thus

[9] The factor conditions are also the anchors in Porter's famous Diamond Model, which explains how nations can create the most favorable conditions for their firms to succeed and, thereby, for the nation to prosper (Porter, 1998). The Diamond Model pretty much lies at the end of Porter's work with competitive strategy in which he starts out from an industrial economics framework and defines the five forces that affect the competitive environment of the firm (Porter, 2004) and further define the firms' value chain framework and how this is connected to the context of the firm, which is an important factor in creating competitive advantage for the firm (Porter, 1985).

increase firm size, profitability and market share. However, developments in the strategic management paradigm from the mid 1980's and onwards has consistently pointed to non-price factors as being at least equally relevant (Clark & Guy, 1998; Sundbo, 1995; Teece, 1986; Wernerfelt, 1984).

We will now highlight some of the most important competitiveness factors and subsequent implications for our study regarding the concept of innovation. Man & Chan further discuss different conceptions of competitiveness from the literature; e.g. Buckley, Pass, & Prescott (1988) who did an early review on the subject, and even though these concepts stress different things and measures, they overall agree upon the fact that competitiveness is about possessing resources and assets combined with what you do with these. We can also say that the firm has some potential along with its capability to take advantage of this potentials to shape its competitiveness. One model taken from Buckley, Pass, & Prescott (1988) shows this:

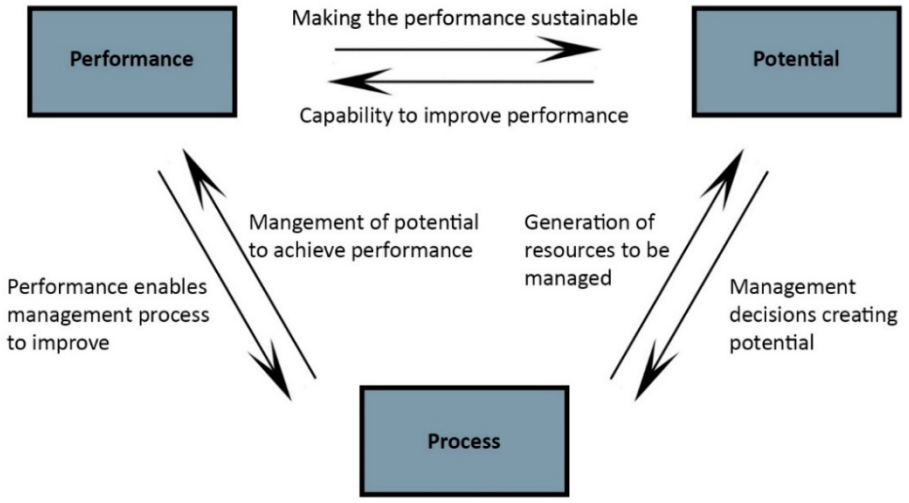


Figure 14: Showing competitiveness as a result of interrelationships between potential, management of these and performance (Man, Lau, & Chan, 2002, p. 127)

The model shows how the interrelationship between potential, management and performance can turn into a mutual reinforcing system that will strengthen competitiveness. Man et al. further propose four characteristics of the concept of competitiveness that should be kept in mind (Man, Lau, & Chan, 2002, p. 128):

1. Long-term oriented. It is not about tactics and sudden quick fixes for the firm.
2. It is to an extent controllable due to its relation to the assets of the firm and what is done with these
3. It is also relative in nature due to the firm's competition with the rest of industry and how this performs.

4. It is dynamic due the process of transforming potential or assets into performance.

As we shall see later these characteristics are closely related to the understanding of strategy and innovation. We can thus begin to understand that strategy and innovation must also be closely related to the concept of competitiveness and ultimate performance.

We can proceed by asking what resources and assets (potential) it is that the firm can process or manage into better performance. They are of course many and diverse and no two companies are similar in this regard. However, some theoretical work has been done in order to try and identify the resources that a company can work with in order to strengthen its competitiveness. Barney (1991) suggests that resources are both physical and more intangible assets like knowledge and information, as long as they are resources that the company controls. To further specify this issue he places resources into three broad categories each of which can each contain subcategories:

> *Physical capital resources include the physical technology used in a firm, a firm's plant and equipment, its geographic location, and its access to raw material. Human capital resources include the training, experience, judgement, intelligence, relationships, and insight of individual managers and workers in a firm. Organisational capital resources include a firm's formal reporting structure, its formal and informal planning, controlling and coordinating systems as well as informal relations among groups within a firm, and between a firm and those in its environment.* (J. Barney, 1991, p. 101)

Thus Barney identifies non-price factors of competitiveness to be linked to physical, human and organisational resources in the organisation. Later on Barney also identifies financial capital resources and thereby ends up with four central resource categories (J. Barney & Clark, 2007, p. 24). These categories comprise the potential that should be transformed into the firm's performance. The notion of non-prize competitiveness is important since the idea of competitive advantage in many ways is associated with the idea of imperfect competition. According to neo-classical economics theory, firm-level profits would quickly be *imitated away* in what are called perfectly competitive markets. The observation that some firms continuously out-performs others thus suggests that other factors must somehow play an important role: There are some things that cannot readily be identified and imitated, and this is what gives some companies a competitive advantage. It is this hidden factor and lack of transparency that creates the idea of imperfect competition. If everything was perfectly transparent the dynamics of perfect markets would quickly create an equilibrium in the market and make competition obsolete. There are other factors besides price that can strengthen a firms' competitiveness and give it a competitive advantage (Manral, 2013). How the firm should manage navigate these hidden factors is fundamentally a question of strategy and we will deal with this in chapter 5. Prior to that we will, however, try to get a final understanding of what it means to be competitive and have a competitive advantage.

4.3 Competitive advantage

In its simplest form competitive advantage occurs when a given firm holds and manages resources that make it able to outperform its rivals over a sustained period of time (Manral, 2013). A firm's competitive advantage is created, regulated and sustained through its strategy.

The idea of competitive advantage has numerous theoretical inspirations from industrial organisation economics and strategic management literature moving from a mainly normative discipline to a positive science seeking empirical answers to its central questions. However, Michael Porter's work on competitive strategy and competitive advantage in many ways marks the beginning of the concept within strategic management (Huggins & Izushi, 2011; Manral, 2013).

In continuation of the market discussion from the section above we can say that competitive advantage is something that gives firms a monopolistic advantage for a lot longer than they would have had in perfectly competitive markets that move quickly towards equilibrium. But clearly markets do not work that way for many different reasons, some of which have already been mentioned. There are different factors that can stall or alter the movement towards equilibrium. And those firms that are able to work continually with these factors will, in theory, be able to gain a sustained competitive advantage. In the terminology of economics these firms can be said to achieve so called Ricardian rents due to possessing and exploiting resources or positions in a way their competitors cannot imitate, and thereby gaining higher value from its outputs than would otherwise have been the result in perfect competitive markets (Barney, 1991; Manral, 2013; Teece, Pisano, & Shuen, 1991).

We can thus supply many detailed and complex explanations of what could constitute competitive advantage in specific firms. However, here we will limit ourselves to a general theoretical understanding of the concept since we will go into more detail about two specific strategic approaches to creation of competitive advantage in the section on strategy. We will discuss what competitive advantage means in relation to value, and what significance this has for the understanding of innovation. The understanding of the concept of competitive advantage can be most precisely clarified with reference to an economic terminology. The goal, however, is not to develop an economics framework of competitive advantage and innovation. It is just to get a more precise understanding of these concepts that are, after all, connected to economic theory.
In this respect Peteraf and Barney propose a definition of competitive advantage:

> *An enterprise has a Competitive Advantage if it is able to create more economic value than the marginal (breakeven) competitor in its product market.* (Peteraf and Barney 2003: 314 as cited in Barney & Clark, 2007, P. 24)

This definition is in line with most perceptions of competitive advantage including Porter (1985). However, it is dependent on a clear understanding of what it means to create economic value, which they subsequently also define:

> *The Economic Value created by an enterprise in the course of providing a good or service is the difference between the perceived benefits gained by the purchasers of the good and the economic cost to the enterprise.* (Peteraf and Barney 2003: 314 as cited in Barney & Clark, 2007, P. 24)

This is a definition related closely to common economic principles, and also importantly it emphasises that the costs on behalf of the company need not be related to the perceived value on behalf of the customer, and thus to what the customer is willing to pay. This also suggests that value is not an embedded phenomenon in the good or service as such but is related to the customer's perception. This perception can be altered, which is in line with a theoretic marketing perspective of how value is created. It also means that the firm can take specific strategic steps to try to affect the perception of the product or to lower the cost. Finally, the two definitions imply that the firm can either produce greater benefits for the same cost, or produce the same benefits for the same cost in order to gain a sustained competitive advantage (Barney & Clark, 2007, p. 25). Thus competitive advantage means the ability of a firm to create relatively more value than a competitor. The firm does not have to be the best performer in all dimensions. Barney and Clark (2007) use these definitions to connect competitive advantage to economic rents. The greater the economic value a firm can create the more economic rents it will create. If one company can create for 180 £ of value per unit of output and a competitor can only create for 150 £ of value per unit of output, and each firm delivers 100 £ level of benefits for the consumer, we can say that the first firm has what is called a residual value that exceeds the second firm by 30 £. Residual value is the value that is left for other claimants in the value creation process once the consumer has claimed his/her share of the total value. Thus the differences in the firms' residual values can be equalled to the first firm's competitive advantage. Barney and Clark offer the following illustration of this:

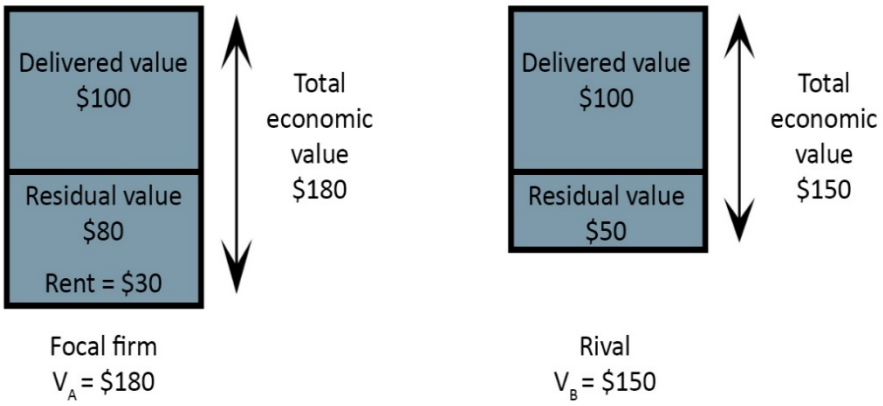


Figure 15: Greater economic value supports the generation of rents (Barney & Clark, 2007, p. 27)

Economic rents in this respect can be defined as "returns to a factor in excess of its opportunity cost" (Barney & Clark, 2007, p. 28). In other word it is an ability to get the most out of the resources and the concept of rents in this respect is not just about land in a Ricardian sense. The central question in regards to the connection between competitive advantage and rent is whether these rents can be sustained for a longer period of time. The complete understanding of this can be illustrated in the following model:

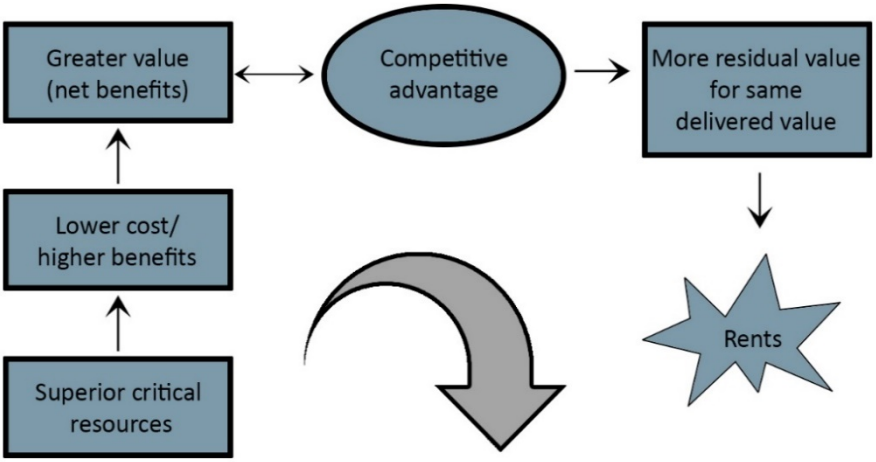


Figure 16: The chain of logic from resources to rent (Barney & Clark, 2007, p. 29)

This short discussion gives us an impression of what it means to create competitive advantage in a general economic sense. This view is furthermore in alignment with the view on strategy expressed by Michael Porter in a 1996 Harvard Business Review article (Porter, 1996). A firm can only outperform its rivals if it can deliver greater value to customers or if it can deliver comparable value at a lower price. And if it can at the same time preserve or sustain this position. We have now seen that the field of strategic management provides us with some theoretical notion of how to create competitive advantage. The important question now becomes what role innovation plays in competitive advantage and how competitive advantage and innovation can be dealt with in practice.

4.4 Competitiveness and innovation

We can now see that there is a connection between the concept of competitiveness and innovation. In many ways innovation can be seen as a practice leading to being competitive or having a competitive advantage. As Michael Porter also notes, firms can create competitive advantage by "perceiving and discovering new and better ways to compete in an industry and bringing them to market, which is ultimately an act of innovation" (Porter, 1998, p. 45). Porter further notes that an innovation cannot be separated from a firm's strategic and competitive context. Innovation has the capacity to change competitive advantages if a company finds a new and better way of doing things that competitors fail to imitate or otherwise respond to (Porter, 1998, p. 45). Most often, innovations will be small, incremental changes by finding new uses or combinations of what is already known. But sometimes true shifts in competitive advantage occur. Such a shift will most likely grow out of change in the industry's structure, or the structure of its context. Porter lists five structural causes of innovation that can significantly change the nature of competition within an industry: 1) new technologies, 2) new or shifting buyer needs, 3) the emergence of a new industry segment, 4) shifting input costs or availability, 5) changes in government regulations (Porter, 1998, pp. 45–47). It is important in this respect to notice that big breaks in innovation are often pushed by these structural shifts.

The relation between innovation and competitiveness is also noted by Clark & Guy (Clark & Guy, 1998). However, they also note that it is unclear how innovation should be promoted and nurtured, especially from a policy perspective as it is very complicated to forecast which innovations and actions will succeed. Thus, innovation policy has a hard time evaluating its initiatives through traditional metric measures. They conclude that "Innovation, experimentation and evaluation are key words for the future" in order to develop our knowledge of innovation and how to nurture it (Clark & Guy, 1998, p. 391). As noted earlier, we primarily look at the level of the firm in this book However, an important point is that the success and effects of innovation cannot be foreseen; they must, to a large extent, be prototyped and tested. We have already touched on this in the chapter about abduction and design thinking (Chapter 3).

The broader discussion of innovation, innovation policy and competitiveness has a long history and is often unfolded within the field of Innovation Systems study. Though there may

difficulties in creating metrics that can evaluate the innovation policies, others stress that we do know quite a lot about the nature of innovation and how it creates value and competitiveness. Cantwell (2009) finds that the relationship and interactions between firms is important in creating competitiveness for local clusters or regions. Locally created differentiated capabilities are needed to sustain competitiveness in international competition, and these capabilities are created precisely through innovation. Because of the rising interaction between innovators this creates a sustained learning environment where local or regional innovators can improve together. Competitiveness through innovation is thus also dependent on what others are doing. And it has clear positive implications according to Cantwell:

> *Innovation is a positive sum game that consists of the efforts, often of many, to develop new fields of value creation in which, on average, the complementarities or spillovers between innovators tend to outweigh negative feedback or substitution effects, even if there are generally at least some actors that lose ground or fail.* (Cantwell, 2009, p. 561)

Thus, innovation and innovation activities have a tendency to improve both the competitiveness of the individual firm. But there also seem to be important reciprocal effects of competitiveness because of the interaction between innovators.

Baumol (Baumol, 2002) directly links competition and innovation. In a comprehensive analysis of *The Growth Miracle of Capitalism* he claims that innovation is at the heart of capitalist growth machine[10] which is unparalleled in history in creating growth and prosperity (Baumol, 2002, p. 13). Baumol proposes that the high level of competition in the capitalist economy is exactly what makes it necessary for companies to innovate. This race of innovation has become so fierce that the most advanced companies have routinised innovation; innovation has become an integrated function of these companies. This, of course, significantly minimises the traditional risk of innovation and it has become a competitive prerequisite in certain sectors. Examples of this could be the tech industries where most companies upgrade their product cycles once a year or even more frequently. In the automobile industry it is every second or third year. In the first line of the book Baumol concludes that, in the markets where huge companies dominate "…innovation has become the preferred competitive weapon. Indeed, the contest for better new products and processes becomes an arms race, with failure to keep up constituting a threat to the firm's survival. This is a force that contributes substantially to capitalist growth" (Baumol, 2002, p. 11).

[10] Innovation is closely rivaled by investment in human capital, education and health, and physical capital, production facilities. However, as Baumol points, these factors also existed in the communist planned economy of The Soviet Union. Only the rate of innovation is exclusive to the capitalist economy which apparently leads Baumol to propose that innovation is the most important factor in the capitalist growth machine and a condition for the other factors.

Competition demands innovation, which creates value and ultimately affects the prosperity of societies with free market economies.

5 Strategic planning in a world of innovative enterprises

Creating competitiveness, or competitive advantage, is an issue mostly dealt with within the discipline of strategic management called strategy. There are numerous schools of strategic thinking and ways to apply strategy. Henry Mintzberg has identified five types of strategy (Mintzberg & Hunsicker, 1988) and later developed this into 10 schools of strategic thought (Mintzberg, Ahlstrand, & Lampel, 2009). Other authors have identified different schools and types of strategy. We will not pursue this further here because it would be beyond the scope of this book and also somewhat beside the subject. What we will do is to briefly introduce the discipline of strategic management and then present two of the most influential and widely known schools of strategic thinking because these best serve our purpose and, in many ways, complement each other.

As we have seen, traditional economics, especially in the neo-classical tradition, deal with a fairly simplistic or limited view of economic behaviour. This tradition assumes that markets will move towards equilibrium and that all actors in the market will behave rationally based on all available information. However, it is hard to give advice to entrepreneurs and management about how to stay competitive from this theoretical perspective due to its somewhat limited and rational analytical approach. Others may have already overtaken you by the time you start to take action. According to Faulkner & Campbell (2006, p. 3) it was clear that a way to help entrepreneurs and businesses with knowledge about how to handle growth, how to prosper, how to survive etc., was increasingly needed from around 1980. This is where the discipline of *Strategic Management* found its central role. Neo-classical economics deal primarily with administration of perfect markets whereas strategic management deals with how imperfection in markets can give a company a competitive advantage (Faulkner & Campbell, 2006, p. 3). Strategic management, or strategy, is thus about achieving a firm's objectives and taking advantages of internal and external resources and opportunities (forces). The discipline had its early grounding under the name Research Policy in the 1950s and 1960s and its tools were further developed in the 1970s and 1980s by international consulting companies such as The Boston Consulting Group and McKinsey & Co. This was where the framework for analysing Strengths, Weaknesses, Opportunities and Threats (SWOT) was developed. In the academic context the development was driven largely by The Long Range Planning movement in the 1970s. However, more abstract and theoretically informed frameworks were needed and the beginning of this can be said to emerge with Michael Porters contributions from around 1980 and onwards (Faulkner & Campbell, 2006, pp. 3–4). However, most introductions stress that strategy is a complex issue because of the many possible variables involved in the creation and execution of a strategy. A unifying paradigm of strategic management might, therefore, be too much to hope for. And because strategies are about the future and the objectives of the firm, it cannot be viewed as an exact science. Most schools would, however, agree that having a strategy is better than not having one, and the theoretical currents underpinning the field have certainly advance since the early days (Faulkner & Campbell, 2006; Pettigrew, Thomas, & Whittington, 2006).

According to Barney & Clark (Barney & Clark, 2007, P. 3) the central question of the research field of strategic management is *Why do some firms persistently outperform others?* Or in other words, how do some firms maintain a consistent competitive advantage? They (Barney & Clark, 2007) claim that there are essentially two fundamental explanations of why some firms persistently outperforms others. One explanation, which was primarily developed by Michael Porter focuses on a firm's market power and the barriers within industrial sectors that allow some companies to keep prices above competitive levels.[11] This line of explanations is also called position based theories of strategy. Another line of explanation focuses on the ability of some companies to be more efficient in their response to customer needs in ways that are hard for competitors to imitate. One theory in this line of explanations is also called the Resource Based View of the Firm (Barney & Clark, 2007, p. 4). The two types of explanations or views of competitive advantage are not mutually exclusive. The first have a primary focus on the context of the firm and the forces of this context, while the latter focus more on the firm itself and its resources and capabilities. They therefore complement each other fairly well, which is why we will give a brief introduction to both of them. In our opinion these basic conceptions of strategy give us much of the fundamental understanding of why the business community and academia has been so increasingly preoccupied with innovation and understandings of innovation. As strategy increasingly becomes dynamic due to external pressures and drivers in a capitalist economic system it becomes clear that innovation becomes a central pillar in sustaining competitive advantage. Let us now look at foundations of strategy and how they point in that direction.

5.1 Michael Porter and strategy

As already mentioned, Michael Porter started out working with the Industrial Organisation economics and then became interested in the daily work of managers and how these could best improve the performance of their organisations. Porter's thinking and theories in many ways reflect an attempt to bridge economics and strategic management issues (Huggins & Izushi, 2011) and can be divided into three broad phases:

1. A theory and a model of industry structure analysis and competitive advantage.
2. A theory and a model of how a company can put generic strategies into action through its many activities.
3. A theory and a model of competition between nations and what factors and forces make certain industries prosper in certain countries despite intense global competition.

We will briefly outline the major implications of each of these phases.

[11] Even though Porter also develops aa analysis and model of firms' internal structure in his book *Competitive Advantage* (Porter, 1985). Porter thus tackles both the external forces and the internal structures affecting competitive advantage. Apparently this is not always acknowledged.

The first phase is described in Porter's book Competitive Strategy, originally published in 1980 (Porter, 2004). In this book Porter argues that:

> *…industry structure has a strong influence in determining the competitive rules of the game, with the ultimate profit potential in an industry being determined by the collective strength of five forces; threat of new entrants, intensity of rivalry among existing competitors, threat of substitute products, bargaining power of buyers and bargaining powers of suppliers.* (Huggins & Izushi, 2011, p. 6)

This is reflected in the now famous model of the Five Forces that affect the profitability of a given industry and should affect a firms' strategy. Even though industries on the surface can seem very different these forces are, according to Porter, underlying all industries (Porter, 2008). The forces show the competitive situation in an industry and can disclose whether an industry is highly profitable or riddled with low profit margins. The strategy of the firm will determine how a company positions itself in relation to these forces, defensively or offensively, and ultimately how competitive the firm will be. The Five Forces framework is shown in this model:

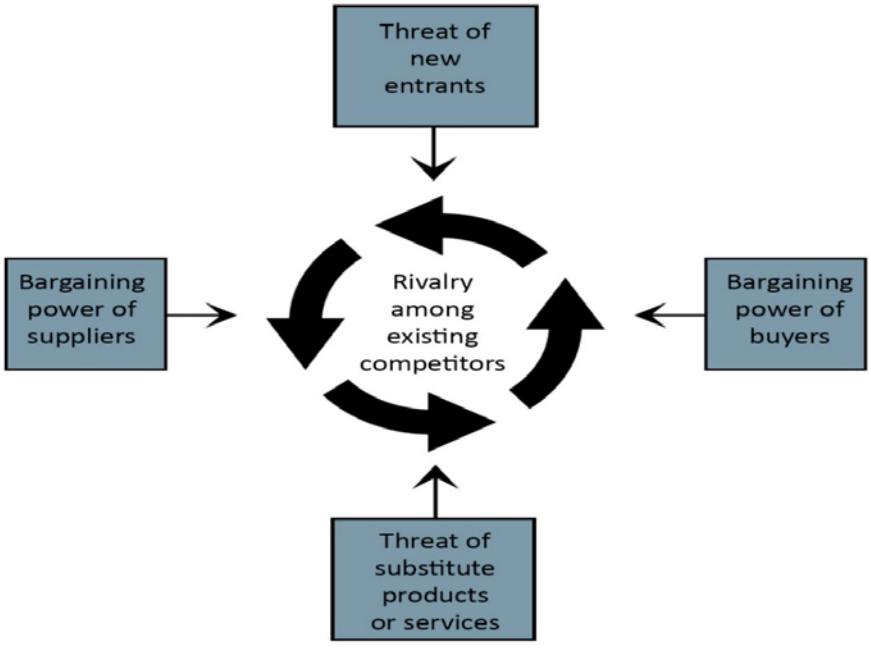


Figure 17: Michael Porters Five Forces (Porter, 2004, p.4)

The second phase is marked by the book *Competitive Advantage*, originally published in 1985 (Porter, 1985). This book focuses more onto the internal structures of a given company and how it can work with the strategic implications from Competitive Strategy in practice. In Porter's view. the value a firm creates is a result of its generic strategy. However, this value is created through the many different activities of the firm that substantiate the given strategy. Activities could be production, marketing, sales, design, procurement, customer-service and so forth. Different activities take the driver's seat depending on the strategy laid out for the firm. In this respect it becomes important to "accurately identify and map those activities which generate the value a firm seeks to create with the chosen generic strategy" (Huggins & Izushi, 2011, p. 7). To support this process, Porter proposes the Value Chain Framework in which he lays out nine generic activity categories that are "technologically and strategically distinct" (Huggins & Izushi, 2011). The Value Chain Framework is shown in this model:

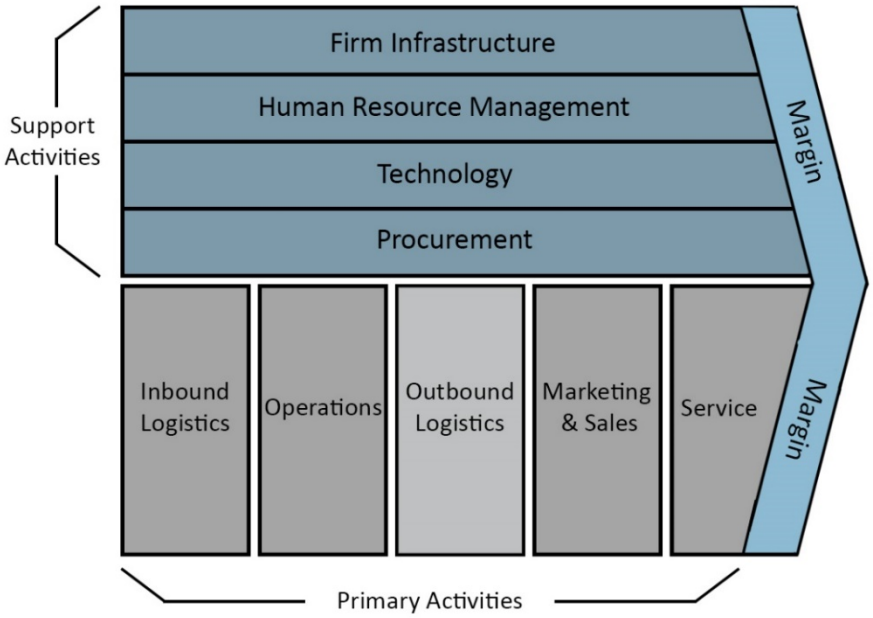


Figure 18: Michael Porters Value-Chain Framework (Porter, 1985, p.37)

Although the way the firm manages and regulates these activities has an impact on the firm's value creation and competitiveness, it is still to some degree subject to the industry structure governed by the five forces. For instance, the value a firm creates for its customers is a perceived value and can thus be bargained between the firm and the customer, who divide the total value between them. In this case the forces to be reckoned with are the bargaining

power of buyers, and the activities on behalf of the company to create perceived value would be marketing, advertising and sales (Huggins & Izushi, 2011, p. 8). So, it becomes clear, according to Porter, that there is a delicate relationship between the external structures of the firm and its internal activities, although Porter is mostly acclaimed for his contribution on the role of the forces of the industry structure. These are the foundations of Porter's conception of strategy, which we will now examine.

In a 1996 article on strategy in Harvard Business Review Porter summarises his complete view of the role of strategy, how it works and how it is formed (Porter, 1996) as he asks the rhetorical question: *What is Strategy*.

According to Porter there are two basic ways in which a firm can improve its performance. A firm can distinguish itself either by delivering greater value to customers than its competitors, or it can deliver the same value at a lower price. This can be done either through operational effectiveness or competitive strategy. Both concepts are important but they are not the same and they work in quite different ways (Porter, 1996, p. 61). Operational effectiveness is about improving efficiency so that the firm performs activities better than its rival. This lowers the cost of the company's products. Competitive strategy is about being different. It is about assuming a position that competitors find hard to imitate. This will make it possible to create greater value for customers and thereby demand higher prices. Even though improvement in operational efficiency is immensely important in creating profits, this style of competition will eventually run into trouble according to Porter because it is quite easy for competitors to imitate these steps (Porter, 1996, p. 64). As the pace picks up the competition between firms on operational efficiency will become still harder and the gains will become correspondingly smaller. This will eventually lead to wars of attrition in a zero sum scenario (Porter, 1996, p. 64).

Because of this Porter finds it more advisable to opt for a differentiating strategy to create competitive advantage for the firm. The positioning is central in this respect because "competitive strategy is about being different. It means deliberately choosing a different set of activities to deliver a unique mix of value" (Porter, 1996, p. 64). Strategic positioning is derived from three general sources:

1. Variety-based positioning based on choice of products and services rather than on customer segments.
2. Needs-based positioning, which tries to meet the needs and demands of a customer group in a particular industry.
3. Access-based positioning, which is about segmenting customers who are accessible in different ways.

The three sources are not exclusive – more than one can play a role in a specific strategic plan and they often overlap. Having defined this substance of strategy Porter goes on to define strategy as "…the creation of a unique and valuable position, involving a different set of

activities. If there were only one ideal position there would be no need for strategy" (Porter, 1996, p. 68).

Porter then goes a little more into detail about how to sustain a strategic position and thereby maintain competitive advantage. Once a firm has found a valuable position it will immediately attract imitators. Most importantly any position requires trade-offs' (Porter, 1996, p. 68). Trade-offs are about choice, as it underscores that firms cannot hold many incompatible positions simultaneously. It must choose where to be, which means that when a firm captures a valuable position it will have to let go of other things. Thus strategy also guides companies in what not to do (Porter, 1996, p. 70).

To further exemplify the strength of competitive advantage Porter introduces the concept of fit. Fit is essentially about how a firms' activities "fit and reinforce on one another" (Porter, 1996, p. 70). This fit creates a chain or specific way of doing things that will lock out competitors. Porter identifies three types or levels of fit (Porter, 1996, pp. 70–73):

1. First, simple consistency in which there is a direct relation between the overall strategy and each activity carried out.
2. Second, activities are reinforcing, which means that different activities affect each other and thereby potentially lower the cost of some activities since they have already been partly addressed by another type of activity.
3. The third, is a little more complex; what Porter calls optimisation of effort. This is about trying to coordinate and optimise exchange and information between activities in order to minimise repitition and improve efficiency.

All of these types of fit stress that strategy is about the whole of the company. Competitive advantage is not created or explained by one type of activity alone. It is about have the entire system of activities blend and fit together and thus create a unique position of value. Porter explains:

> *Competitive advantage grows out of the entire system of activities. The fit among activities substantially reduces cost or increases differentiation. Beyond that, the competitive value of individual activities – or the associated skills, competencies, or resources – cannot be decoupled from the system or the strategy. Thus in competitive companies it can be misleading to explain success by specifying individual strengths, core competencies, or critical resources.* (Porter, 1996, p. 73)

According to Porter, building a position based on fit between activities will also sustain the competitive advantage of a given company and make it much harder for a competitor to

imitate the position. A company can imitate one or two activities but it cannot imitate an inter-locked system of activities; i.e. an integrated fit of activities. Importantly Porter also stresses that strategic positions are not short-sighted ventures. A solid strategic position should have at least a horizon of a decade or more. Continuity is important, and shifts in positions are not only costly but also very difficult. Changing and realigning not only individual activities but entire systems is difficult and some activities may never catch-up (Porter, 1996, p. 74).

Even though not made explicit in this article, the focus on the relation between the entire system and the fit of single activities in the system to some extent criticises other predominant views of strategy that emerged in the late 1980s and early 1990s and tended to focus more on single activities or elements of the firm, rather than the firm as a total system. For instance, this could be The Resource-based View of the Firm theories. This is not the place to go deeply into this quarrel. However, we do note that Porter's thinking on strategy has evolved to some extent since Competitive Advantage in 1980, and that he put more emphasis on the idea of seeing the firm as a system performing activities that can either substantiate strategy or tear it apart. This could indicate that Porter indeed has some openness to the suggestions of new theoretical developments and tries to incorporate these in his thinking about strategy.

Even though Porter thus tries to incorporate some other traits of strategic thinking we will now briefly turn our attention to one of the other dominant conceptions of strategy. This is the Resource-based View of the Firm theory (RBV).

5.2 Resource-based view of the firm theory

According to Newbert (2013) "resources and capabilities are the fundamental sources of firm-level value creation from which firms can create competitive advantages that may in turn improve their overall performance" (Newbert 2013, P. 666). The RBV has become one of the widely accepted and influential theories within the strategic management paradigm in explaining performance differentials or competitive advantage. Many articles and books have been based on the RBV theoretical framework, although with divergent conclusions and various levels of agreement (Newbert, 2013, p. 669). Due to this volume of research, impact and differentiation we will only deal with some of the very basic ideas and concepts of RBV proposed in a number of seminal strategic management publications in order to get an understanding of this approach to strategic thinking.

According to Barney & Clark (2007, P. 5-13) the RBV theory is based on at least four sources:

1. The traditional study of distinctive competencies. The question of why some companies consistently outperform others.
2. Ricardo's analysis of land rents. Certain resources, competencies, management, culture etc. of the firm may be inelastic in supply and can be exploited by firms to create economic rents. This exploitation and rent creation signifies that the firm

gains an advantage it could not have anticipated in a perfect competitive market. We already been talking about this in the section on Competitive Advantage.

3. Edith Penrose's 1959 publication *The theory of the growth of the firm* (Penrose, 1995). Penrose switched the analysis of growth processes in firms from traditional neo-classical microeconomics to a view of firms in which it was seen as an administrative framework that coordinates activities, and as a bundle of productive resources. Managers should exploit these bundles of resources through the firms' administrative framework.
4. The study of the antitrust implications of economics. This line of theory has dealt with how monopolies and anti-trust regulations affects firms' competitiveness and social welfare. Particularly within the *structure-conduct-performance* paradigm. In the 1970s some scholars began to question whether a monopolistic position could only be due to market failure, or if it could also be because of the firms' abilities to exploit resources more skilfully than their competitors can.

Barney & Clark (2007) suggest linking the RBV framework with the position-based strategy theories of firms' environments through the old strategic management framework of the SWOT analysis. This elegantly bridges the different strategy frameworks in the following way:

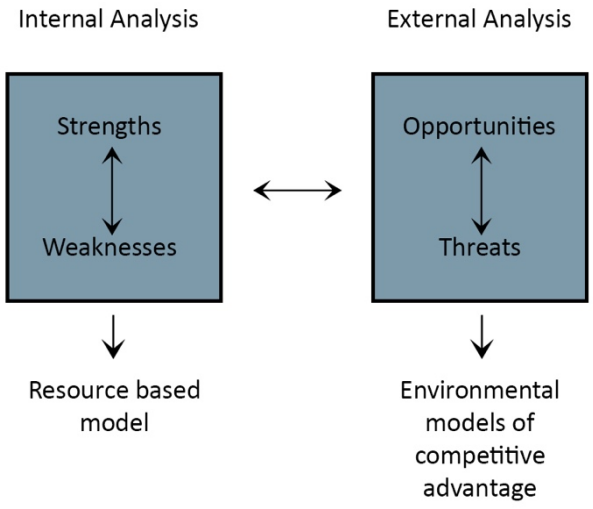


Figure 19: The relationship between traditional "strengths-weaknesses-opportunities-threats" analysis, the resource-based model, and models of industry attractiveness (J. Barney & Clark, 2007, p. 50)

There are numerous rich theoretical inspirations to the RBV. SWOT analysis has the advantage of including both the internal factors and resources as well as basic external

factors, although not as comprehensive as does Porter's five forces framework. However, a fundamental problem about the SWOT framework is that is offers no guidance or logic about how to identify internal strengths and weaknesses. This leads to what is sometimes called “decision-making by list length” where the companies compile very long lists of strategically un-prioritised understandings of what strengths and weaknesses the firm possesses. Some tools are needed to be able to perform this analysis in an informed way.

According to Barney & Clark the link between a firm's internal characteristics and its performance should also consider resource heterogeneity and immobility as important factors of sustained competitive advantage. Even within the same industry resources may difer from firm to firm and not all resources are equally mobile. Furthermore, resources do not represent equal economic value to the firm. Some resources are bound to put more cost on the firm than others. Resources should therefore be employed differently in competitive strategy (J. Barney & Clark, 2007, p. 51).

5.2.1 Firm resources and capabilities

In chapter 4 we have already described from Barney (1991) that a firm's resources can be divided into four broad categories; physical, financial, human and organisational capital. We will now take a closer look at how we can characterise a firm's resources in relation to sustained competitive advantage, and in this process include a specific framework for evaluating these resources in strategy process. According to Barney & Clark (2007, P. 17) early founders (Barney, 1986; Dierickx & Cool, 1989; Wernerfelt, 1984) of the RBV paradigm identified some of the attributes that resources must possess if they are to generate sustained competitive advantage and also suggested that, ”it is the bundle of unique resources possessed by a firm that may enable a firm to gain and sustain superior performance” (Barney & Clark, 2007, P. 18). Furthermore, parallel contributions have been given by scholars such as Prahalad, Hamel and Teece (Prahalad & Hamel, 1990; Teece, 1980) though not always explicitly placing themselves in the RBV paradigm. We will take a brief look at these resources.

Barney (1991) identifies four fundamental requirements for firms' resources to hold the potential for sustained competitive advantage. These are (J. Barney, 1991, p. 106):

- Valuable resources: Resources can only be valuable when they enable a firm to improve its efficiency or effectiveness.
- Rare resources: If a valuable resource is possessed by a large number of firms they all have the capability to exploit this resource and therefore it cannot be a source of competitive advantage.
- Imitability: If valuable and rare resources are a source of sustained competitive advantage it is essential that firms that do not already possess these resource cannot obtain them. They must be imperfectly imitable. There are three general reasons for resources to be imperfectly imitable: 1) Unique historical conditions for instance organisationally, 2) casually ambiguous link between the resources possessed by a

firm and its sustained competitive advantages making it difficult for others to imitate the strategy and, 3) socially complex resources. Complex social structures are hard to imitate due to the lack of transparency of how they work.

- Substitutability: there must be no strategically equivalent valuable resource which is not rare or imitable. If there are strategically equivalent valuable resources, then competitors might copy these in order to gain competitive advantage, and the sustained competitive advantage will be lost. A competitor can for instance exploit a similar resource or they might be quite different resources. As long as enough competitors can exploit the strategically equivalent resources in forming similar strategies none of the firms will have a sustained competitive advantage.

Barney & Clark (2007), add the following element to the original framework proposed by Barney (1991):

- Organisation is the fourth necessary condition of realising sustained competitive advantage. The organisational resources cannot create competitive advantage on their own, but they are important in complementing other resources and capabilities. They are, for instance, formal reporting structures, management control systems and compensation policies.

The combination of resource heterogeneity and immobility and the described resource types create the platform for sustained competitive advantage. In order to get a clearer picture of the potential of specific firm resources to exploit in developing competitive strategy these concepts can be put into a framework that can be used practically in analysing and assessing specific firm resources. This is called the VRIO (Value, Rareness, Imitability, Organisation) framework (J. Barney & Clark, 2007, p. 72). The entire framework can be summarised in the following model:

VRIO Resources					
Is a resource or capability . . .					
Valuable?	*Rare?*	*Costly to imitate?*	*Exploited by organization?*	*Competitive implications*	*Economic performance*
No	-	-	No	Competitive disadvantage	Below normal
Yes	No	-		Competitive parity	Normal
Yes	Yes	No		Temporary competitive advantage	Above normal
Yes	Yes	Yes	Yes	Sustained competitive advantage	Above normal

Figure 20: VRIO resources (J. Barney & Clark, 2007, p. 71)

The framework shows that the more of the VRIO resources the company possess and exploit organisationally in strategy the better the economic performance will supposedly be. We find that this framework can also be used to isolate those areas and resources where a strategic innovation effort could be most appropriate. Another option would be to develop the resources that score low in the given framework and make them valuable. This could arguably also be an effort of innovation. It becomes part of the analysis of where a firm should put its innovative effort.

However, in this framework of the RBV theory so far, the idea of resources and capabilities is still to a certain extent quite abstract. We will, therefore, in the following outline more specifically what resources and capabilities can be more than just being physical, human, financial and organisational (J. Barney, 1991; J. Barney & Clark, 2007).

First, Barney (1991) does not seem to distinguish between resources and capabilities, apparently grouping all the firms' assets under resources. The category from Barney that most resembles capabilities is the one he calls human resource capital. However, it is still understood in the same way as the other resources in Barneys theory of sustained competitive advantage. This gives a rather stationary, theoretical perspective of a firms' strategic exploitations of resources and capabilities. However, later developments have proved it worthwhile to introduce such a distinction. A basic distinction is offered by Amit & Schoemaker (1993) where they define resources as the "stocks of available factors that are owned or controlled by the firm". (Amit & Schoemaker, 1993, p. 35). Resources are converted into final products or services by the different mechanisms of the firm; technology, management, incentives etc. These can be traded. On the other hand, capabilities refer to the

ability to deploy resources. They are more like built-up, firm-specific processes that can be tangible or intangible. Capabilities are connected to the human capital of the firm and it links the firm's specific resources through information, and thus performs an intermediary role in developing the strategy. Examples of corporate capabilities can be diverse phenomena such as highly reliable service, repeated process or product innovations, manufacturing flexibility, responsiveness to market trends, and short product development cycles (Amit & Schoemaker, 1993, p. 35). Adding to this (Makadok, 2001, p. 389) defines a capability "as a special type of resource—specifically, an organisationally embedded, non-transferable firm-specific resource for which the purpose is to improve the productivity of the other resources possessed by the firm". Makadok develops this view further into an idea of the resource-picking mechanism and the capability-building mechanism. The resource-picking mechanism is about how firms try to acquire resources most valuable to the firm in combination with the other resources the firm controls (Makadok, 2001, pp. 387–388). On the other hand, capabilities are about how the firm deploys, develops and structures its resources. Capabilities enhance the value of the resources (Makadok, 2001, p. 389). In this way it is fair to say the capabilities become a special kind of firm resource. Following this logic, we can also say that the resource-picking mechanism affects economic profit even before resources are acquired, while capabilities can only affect performance after the right resources are acquired (Makadok, 2001, p. 389).

It thus shows that the capability concept introduces a more dynamic perspective to rent seeking and firm performance. While the resource concept is mainly understood statically as acquired resources of physical, human, financial and organisational type, capabilities are resources to employ and enhance these resources by connecting them in the right way. Capabilities then become closely connected to management and learning, and these factors become important resources in this line of theory of strategy development. And this is probably also due to the fact that in reality, of course, business circumstances are not stable and they have indeed become increasingly dynamic in recent decades (as argued earlier on). A theory of strategy would thus be at pains to include an answer to this dynamic perspective in order to stay relevant. We will therefore, conclude this discussion of strategy by having a look at dynamic capabilities and dynamic perspectives in strategy.

5.3 Dynamic Capabilities and Strategy

As already mentioned, dynamic capabilities can be thought of as "the firm's ability to integrate, build, and reconfigure internal and external resources to address and shape rapidly changing business environments" (Teece, 2013, p. 222). As such, it provides a much more dynamic perspective to the competitive strategy perspective than the position-based view of strategy. This idea of dynamic capabilities was introduced in the 1990s and the paradigm is still evolving (Amit & Schoemaker, 1993; Prahalad & Hamel, 1990; Teece, 2013; Teece et al., 1997). Teece (2013) provides an instructional separation between what he calls ordinary capabilities and dynamic capabilities. Ordinary capabilities fall into the categories of administration and operations, and serve specific requirements due to the tasks of the company. They can also be called competences. In normal circumstances these are not

supposed to change. On the other hand, the change process is an integral part of dynamic capabilities. They “determine whether the enterprise is currently making the right products and addressing the right market segment, and whether its future plans are appropriately matched to consumer needs and technological and competitive opportunities” (Teece, 2013). Therefore, dynamic capabilities also encompass creative and innovative entrepreneurial and managerial activities as part of the company's activities and strategy development. We now begin to see the convergance of strategic thinking and innovative procedures in theory and practice. However, we will unfold the dynamic capabilities concept a little more.

In a 1990 article Prahalad & Hamel (Prahalad & Hamel, 1990), introduced the idea of the core competence of the corporation as the central element of competitive advantage, performance and growth. According to Prahalad & Hamel “the real sources of competitive advantage are to be found in management’s ability to consolidate corporate-wide technologies and production skills into competencies that empower individual businesses to adapt quickly to changing opportunities” (Prahalad & Hamel, 1990, p. 81). We thus see a clear leaning toward a more agile and dynamic conception of strategy and competitive advantage. Core competencies are difficult to identify as single elements or units that can be managed because they constitute the collective learning in the organisation. It expands and flows in all parts of the organisation as it is about both “communication and involvement, and a deep commitment to working across organisational boundaries. It involves many levels of people and all functions (Prahalad & Hamel, 1990, p. 82)”. However, core competencies are carried by employees and can be developed and managed through these. In this way it becomes an issue for top-management and strategy.

Teece et al. (1997) highlight exactly the more dynamic nature of strategy and the internal structures of the firm. The central question for this paper is to understand why and how firms can build competitive advantage in their rapidly changing environments. Dynamic capabilities in this respect become a question of managing competences to respond to changes (Teece et al., 1997, p. 516). This approach is especially relevant in a “Schumpeterian world of innovation-based competition, price/performance rivalry, increasing returns, and the 'creative destruction' of existing competence (Teece et al., 1997, p. 509)”. This approach, of course, fits well with our claim that increasingly there is a redundancy or conversion between competitive strategy and innovation. Or at least it becomes clearer that innovation ought to be a central element in competitive strategy.

Dynamic capabilities are about firms being able to respond quickly to changes in the marketplace by developing competences to recognise and reconfigure internally. This is a managerial or organisational issue (how things are done) shaped by its position and its paths, and which is about its available strategic alternatives. Dynamic capabilities also come to be about the organisational and individual learning processes required in order to perform tasks better and quicker, and to develop a routine that responds better to changes (Teece et al., 1997, p. 521). Learning in this way also enhances the ability and senses to reconfigure the firm's structures to enable them to respond to changes, which is especially valuable in “rapidly changing environments” (Teece et al., 1997, p. 520). The dynamic capabilities

approach thus provides us with a more dynamic framework for understanding the strategically important elements of competitive advantage. It is, however, important to add that the general ideas of the RBV theories still apply since "competences can provide competitive advantage and generate rents only if they are based on a collection of routines, skills, and complementary assets that are difficult to imitate" (Teece et al., 1997, p. 520). There is still no complete consensus about what dynamic capabilities are, and as a concept and a stream of research are still evolving there are numerous other efforts to define the concept. Barreto (Barreto, 2010) summarises some of these definitions in a 2010 review of dynamic capabilities. We show this summary below:

Main Definitions of Dynamic Capabilities	
Study	**Definition**
Teece & Pisano (1994)	The subset of the competences and capabilities that allow the firm to create new products and processes and respond to changing market circumstances
Teece, Pisano, & Shuen (1997)	The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments
Eisenhardt & Martin (2000)	The firm's process that use resources - specifically the processes to integrate, reconfigure, gain and release resources - to match and even create market change; dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, spilt, evolve, and die
Teece (2000)	The ability to sense and then seize opportunities quickly and proficiently
Zollo & Winter (2002)	A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness
Winter (2003)	Those (capabilities) that operate to extend, modify, or create ordinary capabilities

Zahra, Sapienza, & Davidsson (2006)	The abilities to reconfigure a firm's resources and routines in the manner envisioned and deemed appropriate by its principal decision maker(s)
Helfat et al. (2007)	The capacity of an organization to purposefully create, extend, or modify its resource base
Teece (2007)	Dynamic capabilities can be disaggregated into the capacity (a) to sense and shape opportunities and threats, (b) to seize opportunities, and (c) to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets

Figure 21 - Main definitions of Dynamic Capabilities (Barreto, 2010, p. 260)

Based on these definitions Barreto suggests his own definition:

> *A dynamic capability is the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base* (Barreto, 2010, p. 271).

Thus the definition is a multidimensional construction; a composite consisting of four different parameters that should all be taken into account in the utilisation of the concept.

The dynamic capabilities concept has also received some criticism over the years for being mysterious, elusive, tautological and lacking empirical foundation (Barreto, 2010). However, we still find that the concept is compelling and serves our purposes in this book very well. From the discussion and definitions above we can infer that the dynamic perspective and the ability of the firm to react agilely to shifts in its environment based on the resources it controls, becomes the main issue and competence as well as an enabler of creating competitive advantage. It is to a large extent developed through the collective learning of the organisation and the structures that make this learning possible, and the mechanisms driving the experiences from learning back into the executive processes of the firm (Eisenhardt & Martin, 2000) This, in our view, is well suited for the business situation that we see today and this accounts for both larger companies and SME's, although in different forms and through different processes and resources.

The idea of dynamics and agility in business processes and strategy also resonates in broader developments of business theory than those found in the RBV and Dynamic Capabilities perspectives.

Already in 1995 McGrath & MacMillan (1995) stressed that the beginning of an innovation or strategy process is characterised by lack of knowledge and uncertainty. Instead of the traditional platform-based approach of established firms and businesses they find that the process of the entrepreneur and new venture should be discovery-driven planning. In contrast to the platform-based planning process, the discovery-driven process "forces managers to articulate what they don't know, and it forces a discipline for learning. As a planning tool, it thus raises the visibility of the make-or-break uncertainties common to new ventures and helps managers address them at the lowest possible cost" (McGrath & MacMillan, 1995, p. 54). The argument of planning, experiencing and learning in many ways resembles some of the central arguments from the dynamic capabilities theories discussed above. It also hints towards a prototyping, iterative approach towards business development and strategy that can be traced to ideas from design. Business concepts and strategies are proposed, evaluated and revised by managers as we go along. This is not coincidental and will be explored further below.

In a later publication, called *The End of Competitive Advantage* (McGrath, 2013), the market uncertainties and the perspective of creating competitive advantage is further radicalised. The central point of this book is that the development of business and markets have become too complex to create competitive advantage with long-term strategy planning. Instead McGrath (2013) offers a perspective on strategy that is "based on the idea of transient competitive advantage: that to win in volatile and uncertain environments, executives need to learn how to exploit short-lived opportunities with speed and decisiveness" (McGrath, 2013, p. xi). This of course requires an agile management and company structure, that can observe, learn and react upon the developments in the environment of the business. McGrath in this respect metaphorically talks about moving from competing in industries to competing in arenas (McGrath, 2013, p. 12). The competitive advantage becomes shorter lived in this thinking. McGrath does not believe in sustained competitive advantage within a stable industry anymore. Instead short-lived opportunities should be exploited as mentioned above. Thus, particular competitive advantages can be pursued in different arenas. The development of such a process follows certain phases, what McGrath calls the wave of transient advantage. This is a process that, according to McGrath, needs to be integrated in the basic elements of the firm. The phases look roughly like this:

- Launch: the firm observes and organises to follow a new opportunity. Innovation is important in this phase.
- Ramp up: the firm starts to centre resources around the opportunity. It is taken from experiments to full-scale market introductions. Speed is critical to beat competitors.
- Exploitation of opportunity – generating profit. This can be for a longer or shorter time.

- Disengagement and reconfigure: the opportunity is eroded – the firm needs to pull out and dispose of assets devoted to the opportunity. This process should not be fought by the firm, it should be embraced and be part of the business logic.
- Search for new opportunities.

The process can be modelled like this:

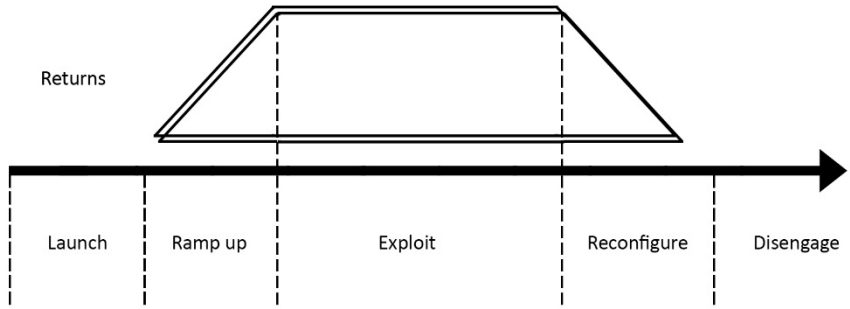


Figure 22 - How to compete: the wave of transient advantage (McGrath, 2013, p.13)

In business logic like McGrath's which follows a long development within strategic management, it becomes clear that innovation takes centre stage of the strategy development (McGrath, 2013, p. 45). It is not the only element, of course. Regular management elements are also vital, but the ontological assumption behind this business philosophy is clearly evolutionary and the strategy scheme proposed by McGrath here is surprisingly similar to that of Schumpeter's entrepreneur driven innovation process proposed almost a hundred years earlier. We infer this to mean that innovation has actually become central in business strategy and development, and that it has also become recognised. We also take it to mean that we are in fact still in the strategic innovation paradigm described by Sundbo elsewhere in this book. It might be that innovation cycles have become shorter, and it might be that different companies get their knowledge, capabilities and sense of opportunities from different sources. However, they still need to figure out what to do with theses inputs and the process still needs to be managed.

We also find that there is a short leap from his understanding of strategy and innovation to the description of how entrepreneurs or companies pursuing new ideas need to act. Teece (2010) has dealt with this issue:

> *Especially in the pre-paradigmatic industry evolution phase, it is necessary to stay flexible, experiment with the product and the business model and learn, both from one's own and one's competitors' activities, and to keep sufficient financial resources on hand to remain an industry participant - and hopefully the market leader - by the time the 'dominant design emerges in the market.* (Teece, 2010, p. 191)

Of course, Teece talks about business model development, however this concept resembles that of strategy to a surprising degree and it does look as if the business model concept is in many ways a continuation of the strategy discussion; albeit with a new name. And this also seems to be part of the conclusion in Teeces' article.

6 Thoughts on strategic innovation; putting it all together

In the previous chapters, we have drawn forward several key issues concerning the nature and history of innovation as well as, the evolution of strategic planning as a business tool.

In the following, we will present these issues as a collected set, and relate them to each other; essentially combining the two and in a way that seeks compromise between the fundamentally abductive nature of innovation process and the more inductive / deductive reasoning implied by traditional approaches to strategic management (chapter 3): Ideally preserving the best of both worlds in the process.

The purpose is to allow for more deliberate and structured use of innovation processes thereby reducing the risks they pose to companies; especially very small ones, where these risks are experienced more acutely. This offers a metaphorical middle ground to companies that would otherwise choose not to risk investing resources in a purely abductive venture. It no longer becomes solely an issue of whether to invest in innovation initiatives, but also one of when to do so, with which initiatives, to what purpose, and to what extent.

By graduating the decision-making process, we are also acknowledging that innovation, and indeed other forms of creative processes, can be framed or harnessed in this way. Although, at the same time, it is important to realise that this may also fundamentally change them. While it is entirely possible, this does not necessarily make them worse or in any way less effective. It simply makes them different from the wild, un-checked innovation initiatives that can produce truly unforeseen and unintended results, although with an exponentially higher risk of not producing anything at all.

This presents MSME's with limited resources the opportunity to strategically engage in innovation activities without risking either their investment or losing the ability to evaluate them. Of course, it is not limited to companies of a certain size. The same principles apply to all types of companies. However, as we have mentioned before, the benefits for smaller businesses could mean the difference between attempting any form of initiative or simply concluding that innovation is the sole domain of larger businesses.

In the following section, we start by re-iterating the main points from the previous chapters' renditions of innovation and strategic theory in the context of strategic innovation. Later, we attempt to arrange these into a framework for working with strategic innovation. And finally, we expand on each element to describe its particular purpose and any activities or processes implicitly contained within it.

6.1 What have we learned; identifying key issues

In the previous chapters, where we have looked at the evolution of innovation and strategy respectively, it has become clear that each represents a vast, ever expanding and complex body of knowledge. Our run-through of the concepts of innovation, competitiveness and strategy should therefore not be viewed as the final exhaustive version of this story.

However, our intention is not to understand every aspect of every nuance of each field. Nor to faithfully represent all the subtleties and differences between various perspectives on them. There are many works available that serve this purpose for Innovation Studies and Strategic Management alike, and which do so very well. In this text, our purpose is simply to understand enough to uncover what it entails to work with innovation in a strategic manner and to show that innovation and strategy to a large extent have become intertwined, and how an innovation strategy can provide companies with a competitive advantage. The fast pace of today's markets and strategic horizons almost inevitably entails an element of innovation. To this end, the previous chapters should be seen as summations of the fields they represent, with explanations of how they relate to each other whereas the following takes a more analytical view of their relevance to each other in the context of strategic innovation; extrapolating the elements we would argue as being central to this purpose in a forward looking manner for each in turn.

6.1.1 On Innovation

Probably the main reason for recent years' rising interest in innovation is the lure of competitive advantage that is implicit within the concept and the competitive changes for companies in general. As previously mentioned, a central theme in innovation strategies, and calls to innovate, be they by countries, companies or otherwise, is the need to compete and remain competitive.

In simple terms, we propose that innovation can be reduced to the following summarisation of the definitions previously mentioned: *"the creative process of discovering new ways to gain, retain or increase competitive advantage in the marketplace in such a way that value can be obtained from it"* (see section 3.1.1).

This statement can be broken down into several key parts: The nature of the innovation *process*, the concept of *competitive advantage*, a *market* and by extension re-sellers and consumers along with the notion of *value*; either to the innovating company, the market (re-sellers & consumers) or both.

The latter three of these are based upon, and in many ways a consequence of, capitalist reasoning and rely on this particular economic paradigm to have meaning. Since it is not the purpose of this book to contest capitalism we simply state this as a premise for the entire notion of innovation in this context; nothing more. However, we wish to be clear that we understand and interpret the notion of value in this context. That is not to say that there are not, or cannot be many forms of value or that innovation cannot contend with other

understandings of value. It is simply not the context with which we are concerned. We are interested in a scenario where a company is interested in making money by selling its products or services in one or more specific markets comprised of various re-sellers or end consumers. Definitions of value that do not directly or indirectly lend themselves to this goal (societal altruism and social innovation for example although this could technically be seen as a cynical form of branding) are outside the scope of this text.

What makes innovation interesting in this context is not the basic premise of capitalism or the idea of a free market. It is the way in which we approach this dynamic. In other words, the act of being competitive and making money by selling your wares/goods and services in a market are no different than they have always been for any company of any size in existence today. The difference is in the process that the idea of innovation has come to represent.

This goes all the way back to Schumpeter and his notion that an entrepreneurial mind set was what allowed innovation to take place. In other words, the ability to identify opportunities that arise by circumstance along with the vision, instincts and willingness to gamble on exploiting them (see sections 3.1.2 & 3.1.3) Schumpeter even goes so far as to suggest that companies seek out and employ entrepreneurs so that they may harness and exploit these traits for their competitive advantage. He does not, however, in any way imply that the entrepreneurial approach is superior to, or should fully replace the more traditional approaches to business. They are seen as two different things each presenting different, albeit complementary, strengths and weaknesses; hence his call for both to be present if a company wishes to maintain a sustained competitive advantage. To be fair though, Schumpeter does seem to view the entrepreneur as a spice with which to keep the business interesting rather, than a component necessary in equal measure with traditional practices (Schumpeter, 1962; Sloth Andersen, 2004, p. 37) acknowledging the need for a transition from an entrepreneurial to a managerial mind-set at some point.

In principal, this reasoning hasn't changed much since Schumpeter's time. What has changed is the pace with which *non-deterministic opportunities rise through circumstance*; be they technological, consumer trends, market shifts caused by other companies or complex interactions in other areas of business, the rise of new business models or a host of other factors.

This is nicely represented by the sheer size, and continuous expansion, of the innovation literature available today. As previously mentioned, Jan Fagerberg writes in the Oxford Handbook of Innovation that it is now a substantial challenge to even keep up-to-date in one specific area, let alone the entire body of innovation literature (see page 14).

Not only is the amount of literature expanding very quickly, but so is the diversity of fields within innovation studies; many of which focus on specific aspects of specific types of innovation. For example, allowing consumer need and want to drive product and service development (User-driven Innovation), developing and cultivating new markets (Market innovation), optimising internal business processes, external processes and business models

(Organisational, Supply-chain and Business model innovation) and many more. On top of that there are also sub-definitions and types of innovation primarily concerned with the perceived effects of these processes on the market (Breakthrough, Radical and Incremental innovation), the drivers that allow innovation opportunities to arise (Technological innovation, Cross-Pollination, Network innovation, user-driven) and the entire theories of innovation (Disruptive and Open innovation) to mention but a few. See (Crossan & Apaydin, 2010; Fagerberg et al., 2012; Kotsemir et al., 2013; Rowley et al., 2011) for example

The result is a quite bewildering landscape of terms, types, definitions, categories, theories and sub-types (see section 3.2.3). As scholars of innovation, it took us quite a long time to conclude, that acquiring and maintaining a deep understanding of each of these types was not the most useful way of studying innovation. Since every business is different, exists in its own context and is subject to its own complex dynamics and interactions it is no surprise that the literature seems, and will probably continue to have such a diverse array of focal points. The realisation that they are all in some way concerned with the process of determining, and acting on opportunities that arise through these complex, and many times highly specific circumstances are what relates them.

Entrepreneurial spirit or not, if a company is not aware of these circumstances, or cannot identify potential opportunities from them, their willingness to take risks by acting on them amounts to nothing. Similarly, being highly attuned to these circumstances, and identifying opportunities they present means nothing if it is not coupled with a willingness to risk existing stability in the expectation of achieving something better.

This seems to indicate, that the fundamental nature of innovation processes is non-deterministic and thereby involves a substantial risk of failure whenever a potential opportunity is acted upon. It may turn out, that what appeared to be an opportunity was not, or it may be that the way in which the opportunity was acted upon was less than ideal. In short, there are so many variables in play, that innovation can easily come down to intuition or qualified guesswork.

In academic terms we could liken this to the process of abductive reasoning as the nearest form of logical inference comparable to the process of innovation. Along the same line of reasoning, the more traditional business paradigm represented by strategic management (see page 59) can be likened to a mixture of inductive and deductive reasoning in that it assumes a certain causal logic based on experiences so far, and inductively formulates plans based on the validity of those assumptions. Then it breaks these plans down deductively into actionable parts that describe the process of realising those plans. The inherent purpose of innovation is, in some way, to break with or circumnavigate those assumptions in a manner that is unpredictable and thus infers greater risk, but also the potential for great rewards unforeseen by competitors.

Thus, the issue on hand becomes one of how to effectively work with innovation processes, without counteracting their fundamental nature and while, at the same time allowing for some

degree of control. Quite simply, we would like to be able to work with innovation in a way that presents us with as many of the benefits and as few of the risks as possible. The smaller the company, and the less financially robust, the more pronounced this sentiment seems to be.

The answer would seem to lie in the manner with which we undertake and manage innovation processes rather than within the processes themselves. Since a common theme is the ability to be reactive to various circumstances, it stands to reason that maintaining a fundamental awareness of these circumstances is a natural first step in doing this. However, deciding on specifically where and how to create this awareness quickly moves us into the domain of abductive reasoning. Likewise, creating an environment which allows for the nurture and cultivation of ideas, technologies, or whatever else comes out of this awareness, also seems to be a straight forward initiative. Unfortunately, when it comes to the practical matter of formalising these ideas, selecting which ones to incubate and later, which to act upon and how to do so the decision-making process once again becomes blurred with no clear-cut inductive precedent on which to base it.

In this way, framing innovation processes in a way that allows some control over them seems simple at first glance, but does not present a practical method for reducing the risks inherent to them on closer scrutiny. This does not mean it is impossible to do so, but rather presents us with the incentive to delve deeper into the components necessary to frame these processes in a way that allows at least some way of assessing their potential value against the costs and uncertainties involved in pursuing them; in effect achieving what is essentially the purpose of strategic planning.

6.1.2 On Strategy

Concerning strategy there are two main components that seem apparent throughout the evolution of the concept: The first is that of *capabilities*, the second being *goals*. Quite simply this is an expression of a beginning and an end framing what needs to be achieved to reach that end, through some sets of actions.

As we have seen in the previous chapter, the specific names for these beginnings and ends have changed along with the introduction of sub-types and specific definitions for each (see pages 60, 65 & 70). However, the main dynamic remains the same throughout the various paradigmatic shifts.

Moreover, any form of plan, strategic or otherwise, must embody some form of *assessableness*. It must be possible to assess actual progress made and evaluate it against the original plan allowing for qualified revisions to be made to either the goals themselves, the actions to reach them, or both. This affects the fundamental way we think about goals and actions early on in the process. If they are not formulated with evaluation in mind it may well turn out to be difficult, if not impossible to gauge feasibility, manage progress or even determine success or failure in a realistic manner.

These aspects of strategic planning also represent concepts that can seem at odds with the fundamentally abductive nature of innovation stated previously (see pages 39 & 78).

Having a clear idea of what one's capabilities are at any given point in time usually relates to what one wishes to achieve. In other words, it is usually necessary to have a relatively specific idea of what you are trying to do or achieve before you can begin listing relevant capabilities that your company possesses. Without the necessary focus, the question of capabilities is simply too broad and abstract. On the other hand, setting one or more specific goals that are both assessable and realistic would similarly require an astute evaluation of one's capabilities, or lack of them. Moreover, the term *goal* implies, that you have a well-defined idea of what you are trying to achieve so you may deduce which actions to take to reach them. This is in direct contrast to what we refer to as the abductive nature of innovation where we specifically state that we do not, and often cannot know what the outcome of an innovation process is (see section 3.3). Rather, inference is directed towards selecting which circumstances to be aware of, and within them, which opportunities to act on (and how to do so) in order to create a situation that is most likely (based on what we currently know) to result in new value for the company. If we knew the precise outcome in advance, it would quite simply not be innovation. Finally, being concise enough to allow for useful evaluation, and progress reports suggest a linear path from start to finish, which would seem to counter the creativity and free-thinking process that innovation appears to require.

Nonetheless, the ability to do all three things as part of an interconnected and continuous process is key to the strategic mind set and the advantages it brings with it. Thus, the challenge is to overcome the apparent paradoxical nature of innovation processes and strategic planning so a compromise can be reached and they may be combined in a useful manner.

6.2 Framing Strategic Innovation

A generic way of representing the overall shape of the strategic process is shown in the following model:

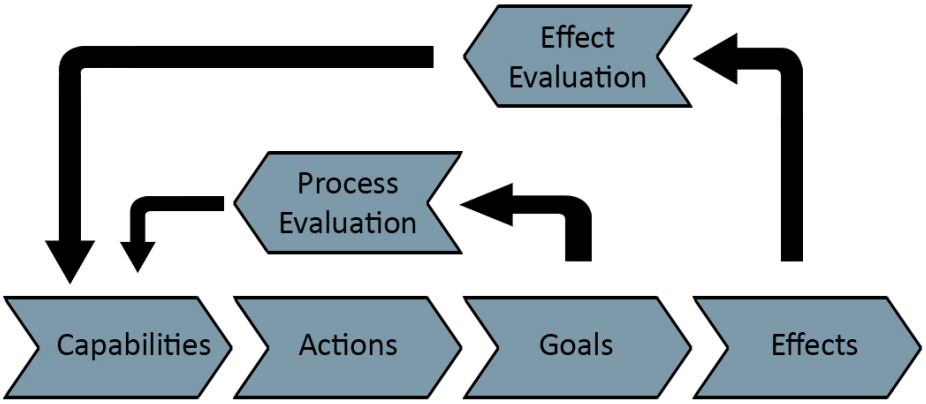


Figure 23: Generic representation of strategic innovation processes. Model developed by the authors.

There exist many variants on this theme in just about any field of literature that concerns itself in some way with processes and management. However, we have chosen to illustrate it in this way, to represent a simple two-order iterative or cyclic, reflective process using the terminology with which we are concerned.

In the above model two orders of iteration are shown. An inner cycle representing the four elements from the field of strategic planning mentioned above, and an outer cycle representing the actual, effects of the strategic process. In this way, the outer cycle represents reflection on the chosen strategic goals, whereas, the inner cycle reflects on the specific actions taken (or more precisely their *actualisation, see section 6.2.3*) to achieve these goals.

As mentioned, this model could be used to describe any generic process. However, in this case we use the term *actions* to represent the specific innovation processes set in motion to move the company in the direction of the specified goals. This places more focus on the type of goals specified, the regular evaluation and the virtual size of each inner iteration (i.e. the time each cycle takes). Since the relation between capabilities and actions, and actions and goals are no longer inductive and deductive respectively, the way in which we determine and define these elements is also changed. Thus, the overall form of the process is unchanged (in this simple depiction) compared to any other strategic process. However, the ways in which the aspects of each element are determined and evaluated can change, as a result of the shift towards an abductive, non-deterministic, relation between each element.

For this reason, it becomes necessary to re-visit each element in the process and evaluate what each means and must contain in the light of this new context, and to allow for a compromise between the two approaches.

6.2.1 Determining Capability

The first logical step when setting goals and planning how to achieve these goals, is to determine one's capabilities regarding the goals themselves. In this context, the term *capabilities* is used as a general term encompassing both *resources* and *capabilities* from a resource-based perspective on strategy (see page 67).

First and foremost, it makes sense to set goals which can be achieved within the realm of existing capabilities, or at least without being reliant on the acquisition of too many new ones. Secondly, the ability to compare what we *can do* with what we *want to achieve* allows us to identify what we *need*, and by extension (and analysis) a spectrum of possibilities representing what we *could do* to achieve this. In other words, knowing which capabilities we possess becomes relevant, not only in terms of evaluating possibilities and planning our actions, but also in relation to determining which goals to pursue.

Similarly, an awareness of what we are capable of allows us to evaluate our capabilities alongside external factors such as those of our competitors, market demand etc.

The fundamental problem with determining capabilities is limiting the area of interest. In principle a company could be said to possess an unlimited array of capabilities; attempting to list them all from beginning to end would be a meaningless exercise. To overcome this, we normally consider capabilities in relation to the specific goal we intend to pursue. However, this presents us with a chicken and egg type problem since we have also established that setting realistic goals requires insight into ones´ capabilities.

In practice this need not pose a problem. Recognising that there is a dependency between components of the inner cycle shown in Figure 16 is one of the main reasons that the process is so highly iterative.

If we think of capabilities as the potential or pre-requisite for actions, and the actions themselves as the actualisation of this potential, the goals can be seen as both the premise and the consequence (or at least a contributing factor towards it [see page 86]); comprising both head and tail of a metaphorical Ouroboros moving in an endless cycle.

In other words, capabilities cannot be seen as static or constant. They exist in a context defined by external forces, ever changing goals and shifting opportunities, all of which affect their value in the given situation. While their role has not changed in a strategic perspective, the innovation perspective, and its fundamental nature have turned this into a much more dynamic element in the overall process; requiring much more frequent attention to be paid to it on every iteration of the inner cycle. The close dependency on the inner process goals

(which are also highly dynamic), increases the need for these goals to be well-defined in order to properly assess capabilities along with their strengths and weaknesses. Through this perspective, the increased focus on innovation processes, could be said to drive the strategic outlook of a business to become shorter, and require more frequent iteration.

6.2.2 Setting clear goals

The inter-dependant relationship between the elements in the inner cycle of figure 13 appear highly reliant on the ability to identify and define clear and relevant goals to pursue. This not only requires an awareness of one's capabilities as mentioned above, but also an ability to detect and convert changes in circumstances surrounding and influencing the company into goals that allow for the exploration of these changes with as little risk as possible, and minimal restriction to the exploration process.

This can be broken down into several unique aspects. The first draws on elements from the strategic perspective of Porter (see page 60); specifically, the differentiation between the Five Forces, and the idea of Competitive Strategy.

The Second, on the ability to consider evaluation from the moment the goal begins to be defined. In the field of software development, which in many cases is also categorised by being a form of highly iterative design, this process is called Test-Driven Development (Beck, 2016), and is often used in conjunction with agile (Cadle & Yeates, 2008, pp. 78–82; Schwaber, 2004) development processes. The basic idea is, that during the design process it is advantageous to design the test used to determine whether a specific module of code works as intended *before* the actual module is written. This forces the designer to consider what actually constitutes successful operation, and how to go about testing it. The purpose is to ensure that there is a way of determining successful operation: If, initially you are unable to design a test for the module this is taken as an indicator of poor design. Normally, this would lead to the team re-visiting the drawing board for that particular module. When the test is written it can be executed each time a change is made to the actual module. As long as the test fails after each change, the module is not complete. However, as soon as the module passes the test it is considered to be a working part of the larger system. Tests, of course, can also be re-run regularly to aid debugging and working out larger design issues, but this is where the example becomes less useful as a metaphor in this context, so we will not elaborate further on the intricacies of software design. The point here is to think about goals in terms, not only of *what we want to achieve*, but also *how we will know if and when we do achieve them*.

The third is the elasticity of these goals. This is not much different from how the management literature works with goals (see section 5). Goals should not be static, they should be evaluated and revised so they are always synchronised with current circumstances, capabilities and so on. However, the frequency with which this revision process takes place is ever changing. In some areas of business strategic goals would be revised every few years. In most businesses today it is probably more useful to do so two or more times a year. This all depends on the type of business, and the type of goals, but a general observation is that

the speed with which we need to iterate over the strategic process is gradually increasing, as also was the theoretical point made by (McGrath, 2013). When we consider innovation processes, and particularly in MSME's, this is even more apparent. With the high risk of failure that goes hand in hand with innovation processes, long returns on investment are not a good idea. It is generally much better to be able to experiment quickly with several ideas and then begin a process of evaluating, adapting, changing and discarding these ideas while continuously initiating new ones as circumstances present suitable opportunities.

In practice this means balancing iteration frequencies so that they present just-enough time for an idea to incubate and develop but not so much time that they stagnate and become an 'expensive investment' and a risk. The main difference is that innovation processes generally require faster iteration times due to their abductive nature. Similarly, the more risk-sensitive a company is, due to size, capital or whichever other factors may be at play, the more acute is the need for higher frequency iteration.

6.2.3 Courses of action

It is important to recognise, that actions do not exist in a vacuum. They represent *the process of actualising opportunity through one's capabilities*.

The concept of actualisation refers to the underlying premise that every action is influenced by circumstances that make up the context of the action. This could be in the form of motivations and practices by actors engaged in the process, external forces, internal forces or otherwise. The point is, that the actualisation is unique, and that simply replicating the actions themselves will not necessarily lead to the same actualisation or its effects.

In other words, we cannot utilise an empiricist approach when viewing the relations between capabilities, actions and goals but are more inclined towards the perspective of critical realism as described briefly in the following section.

6.2.4 Evaluation types and measuring effect

Moving from action to evaluation, the processes illustrated in Figure 16 describe two distinct feedback loops that serve this purpose. As mentioned earlier (see page 83), the inner loop is concerned with the process of determining capabilities, setting goals and acting to achieve these goals, which makes it interesting to evaluate every stage of the process rather than simply to what extent the goals have been achieved. Particularly since the relationship between the three stages of the process are often dynamic and interdependent due to the abductive nature (see page 39) of innovation processes. Since the parameters of the process are dynamic, thereby making it difficult to gain a meaningful measure of how close we are to achieving the current goals, it becomes more relevant to review the process itself against principles behind the decision to act. Similarly, the goals themselves may not be the most interesting things to evaluate since setting, and working towards a goal may simply be a means to uncover a new set of goals; thus, beginning a new cycle. In other words, at this level we are more interested in evaluating *what we are doing*, and *how this relates to our current*

beliefs about the situation than we are concerned with *how close we are to an arbitrary current goal*.

The outer loop, on the other hand, is concerned with assessing the effect of what would often be multiple, on-going, iterations of the inner loop. Since we are concerned with continuous innovation, we must assume that these processes are on-going, and never truly end; rather the specific capabilities, goals and actions morph and change throughout. In that scenario, the outer loop can be likened to stopping and taking stock once in a while; attempting to see the bigger picture and making sure we are still travelling in the right direction.

Unfortunately, measuring or in some way gauging effect relies on a fairly straight forward causal relation between cause and effect. In this case, the cause is an iterative cycle of ever changing goals and actions taking place in a complex business environment potentially affected by a myriad of variables. Even more problematic is the potentially extended temporal relation between cause and effect. Effects of an innovation process are not necessarily immediately apparent. For example, launching a new radically innovative product may well have a disruptive effect on the existing market. However, while we can say that the product represents something radically new simply by comparing it to existing products, we cannot determine how successful it will be in the market until enough time has passed for it to have had an effect. How much time will this take? We do not know. We only know when we either see it, or so much time has passed that it has been surpassed by other initiatives and is no longer relevant. Even when we do see the disruptive effect, determining the precise set of factors that caused it would usually be mere speculation at best.

So what precisely do we mean by effect? To maintain a strategic perspective, it is clearly relevant to be able to evaluate at this level, however, the potential temporal separation between the inner cycle and its seeming effect, together with the general complexity and blurred nature of the entire process seems to make this impractical, if not impossible. The answer to this problem lies in the reasoning behind the evaluation, and its expectations. This is founded on the principle of causality; that there exists a direct relation between cause and effect, and that uncovering this relation allows us to assess the effectiveness of a given cause (Krogstrup & Dahler-Larsen, 2003). This problem is not with the concept of causality, but with the tendency to take a rather reductionist view of what constitutes the actual causes and effects.

In many cases we would like to be able to reduce the causal relation to a simple and direct link between a single, well defined cause and an equally well defined effect. However, there exist many examples of more complex initiatives where this type of ideal simply does not apply, but where the base need for evaluation of some type persists. One way of approaching this is by constructing methods that can supposedly uncover the underlying simple relation indirectly, based on a set of axiomatic rules and logical deduction (Krogstrup & Dahler-Larsen, 2003).

Another method of approaching the problem of evaluating complex initiatives is the concept of theory-based evaluation (Chen & Rossi, 1983; Krogstrup & Dahler-Larsen, 2003; Pawson & Tilley, 1997; Weiss, 1997). The central idea behind this is, the realisation that a certain action does not necessarily cause an effect in itself; it may simply contribute to a set of circumstances that have led to the observed effects. This perspective raises several interesting questions. Who is observing these effects, and are they the same for all observers? To what extent has the action with which we are concerned contributed? What other circumstances are at play, and how or what have they contributed?

The approach acknowledges this complexity by viewing the initiative or cause as something that exists in the context of a background; a set of expectations which may differ among those involved, together with a range of other variables that in some way influence (both positively and negatively) the meaning we ascribe to the effect. Rather than reducing cause and effect to an observable static empirical state to which we can ascribe meaning. This perspective does not see the actions we perform as causes alone. They are actualised in a context which, in turn influences the action in various ways. The causal relation still exists, however, it is now the entire actualised cause, and not the isolated action which contributes to the effect.

In practice, this is both a blessing and a curse; on one hand, it complicates the evaluation process immensely since performing the same action repeatedly can, from this perspective, lead to a multitude of different actualisations and by extension, different effects. On the other hand, it also allows for evaluation of more complex processes, permitting us to take into account things like extended temporal displacement, multiple sub-processes and multiple actors. In theory, allowing for this added complexity can also lead to a more nuanced evaluation. The process of embracing this complexity rather than attempting to reduce it is also touted by its proponents, as to what makes it a *realistic* approach to evaluation while playing on its foundation in critical realism in the process.

These aspects of theory-based evaluation make it well suited for working with innovation processes. First and foremost, the approach requires that goals are well defined, and that they are assessable, which also applies to the inner cycle process described above (see page 85). This is normally achieved by describing the *programme theory* which contextualises the actions performed in order to understand how they become actualised (Pawson & Tilley, 1997). While the programme theory is normally a formal aspect of the evaluations foundation it is quite possible to adapt the principles to more loosely structured, designerly innovation processes. It is still necessary to be aware of the underlying programme theory in order to evaluate. But this may remain largely the same across a series of changing goals since conceivably they all serve the same overall purpose, and can be understood within the same rationale; i.e. underlying governing theories. Likewise, although formalising the programme theories at the beginning of a process is always a good idea with regard to evaluation it is not always necessary to do so. Theory-based evaluation is often used in relation to large-scale policy implementations and where formal and highly structured evaluations play an important role. In the context of small businesses' continuous evaluation of their innovation initiatives there is much less need for this level of formality and documentation. Moreover,

it could be argued, that spending the necessary amount of time on these types of formalities could actually hinder the innovation processes.

Capabilities, goals and underlying programme theories still need to be well defined and understood which is why they should always be considered and revised when working with strategic innovation. However, the level of formality and documentation should be adapted to the situation. Often some simple notes, just enough to jog one's memory, would be enough; particularly in MSME’s where the need for communication between several employees or departments is limited.

7 Conclusions and perspectives

The main purpose of this book, has been to develop a perspective on innovation which lives up to the following four goals: A) It should allow for the many different innovation types from the literature, without discriminating against of favouring any in particular. B) It should be useful, not only from an analytical perspective, but also a strategic one. C) It should be just as useable for micro-enterprises, as for small-, medium- or even large-enterprises, and, D) it should incorporate a method of evaluation that is useful in a strategic context.

In the following, we summarise the main points made throughout this text which relate to these goals and reflect upon them. For clarity, they are addressed sequentially.

On different innovation types:

Since innovation is used in so many ways, many different types and definitions have been put forward in various contexts. As mentioned before, this either enriches or depreciates the term depending on your perspective. From an analytical perspective, these many definitions equate to precision which is useful when describing or analysing specific cases. However, from a strategic perspective these many definitions seem to create more confusion than clarity within the companies wishing to make use of them.

In an attempt to maintain the best of both worlds, we suggest an understanding of innovation that rests on a single, generic definition, which can be adapted to describe more precise variations through the use of common parameters. In a sense, these parameters can be used to decorate the base definition. This definition lends itself more to the classical understanding of innovation suggested by Schumpeter than from the many different specialised variants that have evolved in recent years. This idea is illustrated in Figure 5 and described in section 3.2.3.

Rather than re-defining innovation or introducing new types or methods, we have chosen to emphasise thinking about competitiveness through positioning, and gaining a clear picture of the company's resources and capabilities. The purpose being to create an informed point of departure, from which to create an innovation strategy.

On analytical and strategic use:

A fundamental property of innovation processes, however they are defined, is that they are abductive by nature. As with design, we cannot know whether what we have achieved is good before we have achieved it. During the process, you cannot be certain that your design will be good. Similarly, while you can certainly plan and execute processes with some form of innovation as the desired outcome, you will not know what that outcome is, or if it is indeed an innovation until after the fact.

This leads to conclusions about innovation processes similar to those found in Design Thinking and Strategic Design; iteration and reflection are key. Linear, deductive approaches do not work, or rather, have an unacceptable level of uncertainty, and thereby risk, about

them. Instead, it is useful to adopt an abductive approach combined with an appropriate degree of iteration, reflection, evaluation and adjustment. What constitutes an appropriate scope and frequency of iteration depends on the process. However, it is often advantageous to attempt to *fail fast* in the sense that we wish to discover a process's failings as quickly as possible to reduce loss on investment.

An advantage of the above perspective on innovation is, that it allows for both analytical and strategic use. Analytical in the sense that the model prompts us to pose a set of fundamental questions about the innovation in order to describe it in terms of our common parameters. Strategic in the sense that these same questions can be phrased to help us describe opportunity, resources, actors and challenges in a way that helps us make that first educated guess on an abductive road of iterations. This duality is also what makes the model a useful tool for companies to draw up their innovation strategy.

On scalability regarding organisational size and complexity:
Since the scope and frequency of iteration cycles can be adapted to different organisations and purposes our understanding of innovation becomes scalable. It can be used to describe and evaluate simple, sequential initiatives or complex constructions spanning multiple parallel and even asynchronous processes.

This allows the model to become useful for different sizes and types of enterprise. Micro-enterprises can use it to prompt simple strategic questions and prioritise opportunities or ideas. Similarly, larger enterprises can do the same with more complex scenarios. The base principles are unchanged by size or complexity.

On evaluation:
To allow for constant reflection and evaluation it is necessary to adopt a different perspective on the nature of causality and evaluation. Innovation processes take us, by definition, toward outcomes that we do not fully expect. Therefore, adopting an empiricist view of causality as the foundation for evaluating such processes makes little sense.

Instead we propose a theory-based perspective that allows us to focus on what we wish to achieve rather than the specific innovation that helps us achieve it. The key difference being that evaluation is part of the strategic process constantly reminding us of the reason behind our actions so we can actively reflect on whether they are bringing us closer to them.

Every specific initiative requires a specific evaluation to be designed for it, and gradually adapted and evolved along with the initiative itself.

7.1 Perspectives

A further development on this perspective would be to attempt to convert these findings into a useful strategic tool for micro-enterprises. Primarily because its potential use as a strategic innovation tool for, among others, micro-enterprises is one of the original reasons for our interest in the subject.

However, where this text mainly explores the theoretical foundations for such a tool, converting its findings into a more tangible toolset would most certainly benefit from a period of further empirical study.

Thus, the next step towards such a tool is to engage with micro, small and medium sized enterprises and begin a process of experimentation based on the models and ideas presented in this book. While such a process will certainly further the development of our perspective on innovation it will also, more importantly perhaps, add an operational dimension aiding businesses to plan, implement and evaluate innovation processes more easily.

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SUMMARY

Since the Danish Governments national innovation strategy was published in 2012, there has been increased focus on promoting and supporting various innovation initiatives in the interest of boosting our competitiveness as a nation. The aim of this thesis is to understand what this could mean from the broad perspective of vocational education. When the government suggests that students should become an innovation capacity, accumulated through education and utilised to create real competitive advantage in a wide range of enterprises, what does this imply for education, and particularly for vocational colleges?

This idea of student-driven innovation is explored through the study of interdisciplinary problem-based workshops designed to promote collaboration, not only between disciplines, but also educational and professional practices. Specifically, within vocational programmes taught across two different vocational colleges and with special attention towards engaging micro-enterprises which not only make up a large part of the national corporate landscape, but also employ many of the students attending vocational colleges.

During this study, several elements relevant to the practical aspects of working with student-driven innovation are presented; including a dynamic understanding of innovation, a framework for evaluating innovation capacity and identification of a series of didactic and organisational dynamics for consideration.

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