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EFFECTUATION IN EMBEDDED AND ENQUIRY-BASED ENTREPRENEURSHIP EDUCATION

ESSAYS FOR RENEWING ENGINEERING EDUCATION AT KEMI-TORNIO UNIVERSITY OF APPLIED SCIENCES
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EFFECTUATION IN EMBEDDED AND ENQUIRY-BASED ENTREPRENEURSHIP EDUCATION
Essays for renewing engineering education at Kemi-Tornio University of Applied Sciences

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Abstract
Entrepreneurship education in non-business studies has not been extensively studied. The requirements and special features of engineering education of applied sciences is a fairly unaddressed research topic. Yet, there is a growing need to develop the entrepreneurial behaviour of graduates, as voiced in feedback from stakeholders and other actors in society. The competence requirements of graduates are constantly evolving; they are specified globally as well.

The aim and motivation for this study is to develop a new framework for fostering entrepreneurship in engineering education. The developed framework could be used for developing, firstly, entrepreneurial behaviour, and secondly, the entrepreneurial mind-set of the engineering graduates. The main focus of entrepreneurship education research has been on content issues and primarily from the perspective of business studies. Therefore, this study has focused on pondering the methodological challenges of entrepreneurship education in the chosen target field, engineering education.

The context for outlining the framework is constructed by first introducing the operational environment of the target organisation. Thereafter, the central concepts of entrepreneurship, entrepreneurship education and technology-based entrepreneurship are processed in a literature review in order to build the theoretical basis. In addition, research methods with ontological and epistemological choices are displayed.

Due to the multilevel structure of the research phenomenon, the study approaches the phenomenon through four essays. The first essay opens up the aspects and background in order to understand the role and expectations of stakeholders as regards entrepreneurship education. The second essay concentrates on the pedagogical issues and possibilities of action-based learning methods with respect to entrepreneurship education especially. The third essay combines effectuation and causation perspectives on opportunity recognition and offers a framework for effectuation-based entrepreneurship education. The fourth essay is an empirical study covering effectuation and causation from the point of view of local technology-based companies.

The conclusions of the study suggest that the outlined effectual entrepreneurship education, if combined with action-based learning methods like enquiry-based learning for instance, could support the development of entrepreneurial behaviour, and ensuing entrepreneurship, among engineering students. It is also suggested that adoption of the new framework requires renewal of the learning environment, and the involvement of the entire organisation in the change process.

Keywords: action-based learning, causation, effectuation, engineering education, entrepreneurship, entrepreneurship education
Mäkimurto-Koivumaa, Soili, Effektuaatio sulautetussa ja tutkivassa yrittäjyyskasvatuksessa ja -koulutuksessa. Esseltä insinöörikoulutuksen uudistamiseksi Kemi-Tornion ammattikorkeakoulussa

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**Tiivistelmä**


Tämän tutkimuksen tarkoitus ja motivaatio on kehittää uusi insinöörikoulutukseen soveltuva yrittäjyyskasvatuksen ja -koulutuksen viitekehys. Sitä voitaisiin käyttää ensinnäkin kehittämään valmistuvien insinöörien yrittäjämäistä käyttäytymistä ja toiseksi heidän yrittäjyysajattelualaa. Näyttää siltä, että yrittäjyyskasvatuksen tutkimuksen painopiste on ollut sisältöön liittyvissä kysymyksissä liiketalouden näkökulmasta tarkasteluna. Siksi tässä tutkimuksessa on keskitytty sen sijaan pohtimaan yrittäjyyskasvatuksen ja -koulutuksen pedagogisia haasteita valitun kohde- ryhmän, insinöörikoulutuksen yhteydessä.

Viitekehyksen kontekstia on hahmoteltu esittelemällä ensinnäkin kohdeorganisaation toimintatyöveroistoa. Sen jälkeen on käsitelty kirjallisuuskatsauksessa teoreettisen taustan muodostamiseksi tutkimuksen kannalta sellaisia keskeisiä käsitteitä kuten yrittäjyys, yrittäjyyskasvatus ja -koulutus sekä teknologiayrittäjyys. Lisäksi on esitetty valittujen tutkimusmenetelmien ontologisia ja epistemologisia perusteita.

Tutkimuksen johtopäätöksissä esitetään, että hahmotetun viitekehyksen yhdistettäessä aktivoivien opetusmenetelmiä, esimerkiksi tutkivaan oppimiseen, voisi kehittää valmistuvien insinöörien yrittäjämäistä käyttäytymistä ja yrittäjyysasennetta, ja lisätä myöhemmin myös yrittäjyypä to teko: edellyttää niin oppimisympäristöjen uudistamista kuin koko organisaation sitoutumista muutosprosessiin.

**Asiasanat:** aktivoivat opetusmenetelmät, effektuaatio, insinöörikoulutus, kausaatio, yrittäjyys, yrittäjyyskasvatus, yrittäjyyskoulutus
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Paakkola, Finland, June 2012

Soili Mäkimurto-Koivumaa
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1 Introduction

*Insanity: doing the same thing over and over again and expecting different results.* – Albert Einstein

Entrepreneurship education, particularly in non-business studies such as engineering education for instance, seems to be at a crossroads due to the manifold expectations of different interest groups. Researchers share the view that entrepreneurship education, in higher-education institutions as well, is interconnected with economic growth. The requirements of working life and employers’ feedback confirm that the graduates are expected to show entrepreneurial behaviour and be able to adapt themselves to changing working environments; organisations face continuous change processes, which challenge the human capacity as well. In order to ponder the foregoing issues, the goal of this study is to outline and suggest new approaches for renewing entrepreneurship education in engineering education. First, the introduction approaches the topic through conceptual definitions and thereafter describes the operational environment of the target organisation, specifies the research setting and contribution, and finally outlines the structure of the study.

1.1 Background

In the Lisbon strategy of 2006, the European Union has set a goal of creating a positive entrepreneurial mind-set in throughout the region. The statements relate as follows (Fora et al. 2008): “Universities and technical institutes should integrate entrepreneurship as an important part of the curriculum, spread across different subjects, and require or encourage students to take entrepreneurship courses. Combining entrepreneurial mind-sets and competence with excellence in scientific and technical studies should enable students and researchers to better commercialize their ideas and new technologies developed.” Entrepreneurship education and training have been considered as a means to raise entrepreneurial activity among graduates. As the Global Entrepreneurship Monitor indicated, there is a correlation between education and TEA rate (Total Entrepreneurial Activity). Thus, the duty of the actors in the field is on finding different ways to develop entrepreneurship education that meet the needs of economies in that respect. Entrepreneurship education can have an effect on an individual’s ability
to pursue opportunities and acquire skills needed in starting new ventures (cf. Levie & Autio 2008).

The definition of the word “entrepreneur” can be approached by explaining the concept of “entrepreneurship”. A priori definition of an entrepreneur can be approached by explaining the entrepreneurial process as Carton et al. (1998) have done. From an etymological point of view, the word entrepreneurship has most commonly been explained through the French “entreprendre”. “Entre” means being in between and “prendre” to take, to hold, to grasp. The same concept can be found with similar meaning in a number of other languages (e.g. in German “unternehmen”). Entrepreneurs have been seen either as creators and organisers of new business firms (as defined by Cantillon, Turgot and Say) or (as emphasized by Schumpeter) as innovators of new economical entities (Baumol 1993). Kirzner (1973, cf. Van Praag 1999), however, emphasized the entrepreneur’s ability to discover and exploit opportunities due to their alertness. Kirzner’s entrepreneur was a producer and stabilizer of the economy, whereas Schumpeter’s entrepreneur was rather a catalyser. Despite Schumpeter and Kirzner’s different points of emphasis, today they are seen more as complementary and parallel views on the phenomenon of entrepreneurship (cf. Levie & Autio 2008). However, not every individual can be an entrepreneur, due to uneven distribution of information about opportunities (Shane 2003, Venkataraman 1997). Casson (2005) highlights the entrepreneur’s role as a decision maker: “…only the entrepreneur specialises in this activity”. Wiklund (1999), for his part, has shown that the effects of entrepreneurial orientation on firm performance are positive.

There exist numerous definitions of entrepreneurship which underline the different aspects of the phenomenon (see Davidsson 2008). This, on one hand, highlights the richness of entrepreneurship as a research field, but, on the other hand, also illustrates the challenges of entrepreneurship (cf. Davidsson 2004: 1). Davidsson (2004: 16) defines entrepreneurship as follows: “I have proposed that defining entrepreneurship as the competitive behaviours that drive the market process…” He also considers that his definition includes the processes of discovery and exploitation, and links micro to macro (i.e. emphasizing that entrepreneurial activities of individual organisations have societal effects). Venkataraman (1997; cf. Shane & Venkataraman 2000) stresses that entrepreneurship requires both lucrative opportunities as well as enterprising individuals.
Entrepreneurship can be outlined as a process which consists of two elements. On the one hand, new business opportunities have to exist but so too do individuals to use or exploit them (Delmar, 2000). In the literature on entrepreneurship, opportunities are either discovered or created (see Alvarez & Barney 2007). The discovery theory is based on critical realist epistemology, according to which exogenous shocks form objective opportunities in pre-existing industries. As Alvarez and Barney (2010) define, the opportunity-discovery theory assumes entrepreneurs act on ex-ante information, trying to avoid risks. The alternate way of approaching opportunities is the creation theory, which emphasizes the fact that entrepreneurs create opportunities through enactment. “Creation opportunities do not exist until they are enacted.” (Alvarez & Barney 2010). Naturally, the two theoretical perspectives mediate to pedagogical choices, as will be pondered later in this study. The same elements and contents of entrepreneurship are expressed by Shane and Venkataraman (2000) and Shane (2003: 4): “Entrepreneurship is an activity that involves the discovery, evaluation and exploitation of opportunities to introduce new goods and services, ways of organizing, markets, process, and raw materials through organizing efforts that previously had not existed.” Bruyat and Julien (2000) emphasize that entrepreneurship also includes the creation of new value. Ardichvili et al. (2003) have concluded in their study that opportunity identification or recognition is a multistage process in which situational and individual differences of entrepreneurs are both relevant. On the basis of previous research on opportunities, Short et al. (2010) have concluded that: “An opportunity is an idea or dream that is discovered or created by an entrepreneurial entity and that is revealed though analysis over time to be potentially lucrative.”

New views for analysing the process of entrepreneurship have been voiced by Sarasvathy (2001, 2008) and Harmeling (2009). For these researchers entrepreneurship, requires entrepreneurial expertise, which consists of tacit, learnable and teachable aspects of experience that can be attained as a result of operating for years in some high-performance domain (Sarasvathy 2008: 12). Additionally, Sarasvathy combines entrepreneurial expertise with the concept of effectuation. Sarasvathy (2001, 2008) calls effectuation the logic of entrepreneurial expertise, which means that the entrepreneur aims to control the future instead of predicting it. The logic of control also includes using the entrepreneur’s awareness of available resources (skills, knowledge, and experience) in decision-making processes (Sarasvathy 2008: 17). The challenge is how and on what basis individuals can be trained for entrepreneurship. Thus the
role, as well as the contents and pedagogical solutions of entrepreneurship education are fundamental.

Harmeling (2009) underlines the importance of *contingencies* – possibilities without necessity – as an entrepreneurial resource. According to Harmeling (2009), entrepreneurs should be able to use both historical contingency (learning from the past, analysing previous actions) and personal contingency (analysing the effects of actions of the individual in different situations). Harmeling (2009) states that “...a more comprehensive view of contingency recognizes that not only does the entrepreneurial playing field change as practice evolves to solve important problems (historical contingency), but also that tomorrow’s problem-solvers are being educated with today’s truth (personal contingency)”.

There is a growing need for new entrepreneurs in Finnish society (cf. Paasio *et al.* 2005). In several reports it has been proposed that an entrepreneurial culture and procedures are best realised in co-operation with the operational environment and according to objectives set for entrepreneurship education at each level of education (cf. Nurmi & Paasio 2007, Paasio *et al.* 2005). The same view has also been expressed on the political level: “Entrepreneurship education is part of lifelong learning; in it, entrepreneurial skills are developed and supplemented at different points in life. It is a question of life management, interaction, self-guided action, a capacity for innovation and an ability to encounter change. Education and training help entrepreneurship evolve into a mode of operation in which attitude, will and a desire to take action combine with knowledge and advanced competence.” (Ministry of Education, 2009. Opetusministeriö 2009; see also the European Union Survey of Higher Education 2008). It has even been agreed that by 2015 higher education institutions will have to have incorporated entrepreneurship in their overall strategies. The higher education institutions need to adopt a mode of operation that encourages students to seek out a career in business. The education should be able to offer tools for the development of the skills and knowledge required in promoting the growth of business. Special effort has to be put on teacher education with the aim of developing the teacher’s skills in entrepreneurship education. Additionally, it is also important to note that a wider change process towards a creative economy is going on in Finland. In a creative economy, cultural competencies (products related to cultural capital, i.e. design, cultural literacy) and organisational creativity take on even more importance (Wilenius 2006). The reasons behind the transformation process towards a creative economy are numerous, e.g. the move towards an international division of labour and the fact that economic growth is predicated on service
rather than industrial production (cf. Wilenius 2006). Thus, in the future the creative economy will need new kinds of entrepreneurs and a new kind of entrepreneurship. Therefore, the importance of and call for new entrepreneurship education is well justified.

Entrepreneurship education is a way to develop the human capital needed in entrepreneurship and opportunity discovery (Marvel & Lumpkin, 2007; Shane, 2003, p. 69). Training individuals for entrepreneurship requires not only delivery of explicit knowledge related to business management but also familiarising with the tacit or experiential knowledge needed in decision making. Entrepreneurship education can be one way of opening entrepreneurial values to students (Gibb 2007). Today, entrepreneurship includes not only the behaviour of an entrepreneur as a business owner but also organisational (corporate) entrepreneurship and intrapreneurship (behaviour and actions of an employee) as well (Kyrö & Carrier, 2005). Entrepreneurship education can be seen as the framework for developing entrepreneurship in all its forms. In education institutions, the focus has to be on the individual and learning. The choices of activating pedagogical methods and learning environments can enable human development with regards to becoming creative individuals, as has been argued in one of the essays.

1.1.1 Operational environment

As part of the process of new business creation, entrepreneurship is interlinked with changes in operational environment. By opening possibilities for new business opportunities, different organisations, including educational organisations, have a central role in the process (cf. Bruyat & Julien, 2000; Shane & Venkataraman 2000, Delmar 2002). Providing an innovative milieu, an environment which enables creative co-operation in and between different organisations (cf. Camagni 1991 in Keeble et al. 1999), and a regional innovation system (cf. Etzkowitz & Leydesdorff 1995, 2000), which consists of business organisations, educational organisations and the public sector, can both aid in facilitating new business creation, also as a response to the changes of the operational environment.

The existence of different operators in an innovative milieu can enable collective learning, i.e. knowledge crossing the boundaries of firms, which may facilitate and encourage innovative behaviour in the participating firms (cf. Keeble et al. 1999, Capello 1999). Some of the preconditions of collective learning are culturally-based rules of behaviour, engagement and collaboration
and tacit codes of conduct between individuals and firms which enable development of trust needed for networking and co-operating (Keeble et al. 1999). As participants in the innovative milieu, educational organisations can play a central role in the process by educating a skilled labour pool for the operating firms – which can affect the location decisions of business organisations (cf. Keeble et al. 1999, Saari 2009). Education, and in this study engineering education, has had a vital role in building the knowledge base for regions (cf. Saari 2009, see also Lindholm Dahlstrand 2007, Keeble et al. 1999). Study contents and methods have to support the development of the entrepreneurial mind-set as well as entrepreneurship which can help lead to the establishment of new technology-based companies. The context and foundation of this study is developing entrepreneurship education in engineering education at a small university of applied sciences. Because of the author’s connections with the Kemi-Tornio region, the operational environment of KTUAS was a natural choice for collecting the research material and selecting the target organisations. To underline the importance of new entrepreneurship for the region, it was considered important to introduce the background of the operational environment in detail as well. Additionally, intensive co-operation with the surrounding operational environment and involvement in regional development is a cornerstone for the existence of each university of applied sciences. The operational environment of Kemi-Tornio University of Applied Sciences consists of process industry actors and SMEs. The region produces about 8% of Finland’s export revenue. The number of entrepreneurs in the employed labour force is about 12% (2009). The process industry has been able to guarantee the majority of the jobs since the 1980s. In the 1970s the pulp, paper and craft liner factories were the most important employers, but today the number of industrial jobs has decreased by 50%. Many tasks have been outsourced as well. Due to the decreasing number of industrial jobs, there is a growing need for local entrepreneurship.

Technician education began in Kemi in 1960, and, to serve the needs of the process industry, engineering education was initiated in 1984. Today, engineering education serves the entire industrial cluster. In the 1980s, the Digipolis technology park was founded. The aim of founding the technology park was to broaden the local economic structure to ICT and electronics, which were seen as a growing business sector. The park was located close to the Kemi Institute of Technology – later Kemi-Tornio University of Applied Sciences – to foster links with higher education.
A business incubator was established in 1992 by the University of Applied Sciences to support local entrepreneurship. 40% of the firms in the technology park have been founded with its help. Some start-ups later merged with larger firms, and some have moved to other locations in the Kemi-Tornio region or even further afield. The growth has not been very fast because of the young age of the firms. There have been two types of entrepreneurs: those living in the region and those living elsewhere but who founded their businesses in Digipolis. Most of the firms founded by locals still exist in the region, whereas many of the others have opened offices elsewhere, later closing their offices in Digipolis.

The interviews in the year 2008 (Saari 2009) revealed two cases in which a firm serving the process industry was collaborating with ICT firms: in one case the firms had a joint product-development project; while in the other a service firm had purchased tailor-made software for its in-house use. Today about 85% of the firms have customers in the Kemi-Tornio region, 70% have customers elsewhere in northern Finland, 10% abroad, and 7% within the technology park itself. The co-operation among the firms in Digipolis is fairly limited. With regard to research, applied research, and testing services, 33% of the firms co-operated with Kemi-Tornio University of Applied Sciences or the University of Oulu’s technology research unit, which was closed at the end 2009. 10% of the firms collaborated with other research centres or universities – mainly with the University of Oulu or VTT (Technical Research Centre of Finland) in Oulu.

It seems that both the incubation and attraction strategies (Ylinenpää 2001) have been followed in the Digipolis technology park. When the attracted firms or entrepreneurs have found local customers, they usually have stayed in the park. If there are no local customers and the entrepreneur lives elsewhere or the unit is run from other locations, the offices have, been later closed down in most cases. The time from start-up or merger to close-down has typically varied from two to five years. The attraction strategy with the focus on businesses without local customers has failed in the long run.

The experiences in Digipolis show the significance of local higher education with regard to the development of new businesses. The withdrawal of externally run firms and offices compared with the locally owned ones which remained, indicates the importance of local entrepreneurship and emphasises the importance of entrepreneurial studies in higher education. According to the interviews, a common feature of all the firms is that the University has been the main source of new, qualified personnel. In addition to providing an educated work pool, the University has conducted projects to train students for both the existing and new
firms. This implies that the existence and growth of the Digipolis technology park is dependent on local access to qualified labour.

During the technology park’s first years, the companies and entrepreneurs mainly came from other regions and the park grew rapidly. At that time, the goal of engineering education was on building the knowledge base of the students. The new companies came to the region due to the availability of new graduates with high expertise in the required technology fields. Even though the degree programmes did not train graduates for entrepreneurship, the growth of the region was not hindered. The focus in engineering education at that time was on traditional lecture-based education, ensuring strong expertise in technology and following the approach of causation.

Economic fluctuations coupled with a lack of local customers forced some of the technology park firms to scale down their business operations in the region. The new situation highlighted the need for new local technology-based enterprises. There was a common understanding that cultivating an innovative milieu requires intensive co-operation between different actors, including the local higher education institution. To respond to these expectations, the engineering education started to develop research environments and laboratories which opened up new training possibilities to the students. In addition, the University started to develop new pedagogical approaches and learning environments. However, despite the new efforts, there is still a need for additional local technology-based enterprises.

Measured in the rate of export revenues, the operational environment of KTUAS is economically important for the whole country. To date, growth has been built on industrial production but, due to changes related to globalization, enterprises are being forced to renew their businesses and strategies (in the process industry, for instance) – glocal (global + local) entrepreneurship has become more important as well. Due to the development of the local technology park, there are already enterprises with social networks and knowledge bases, i.e. operational preconditions, which can be utilized. As stated earlier, the expectations of the creative economy challenges enterprises to become creative organisations. Therefore, it can be argued that together with the local enterprises educational organisations have to be involved in the change process. Thus, it is important to know who we are, what we can do and with whom we can operate – and follow the process of effectuation at the organisational level as well (cf. Sarasvathy 2001).
1.1.2 Engineering education

The Finnish education system was renewed at the beginning of the 1990s. In 1991 and 1992 the first polytechnics (later called universities of applied sciences) were established on a trial basis. According to the Act of Polytechnics (351/2003): the mission of the Finnish polytechnics is to provide education in different fields, support individual personal growth, contribute to regional and economic development and conduct applied research and development (Act of Polytechnics 351/2003: §4).

Engineering education in Finland has had a central role in economic development (see Tulkki 2001). After the recession at the beginning of the 1990s the demand for a new labour force started to grow. In 1995, for instance, nine out of ten graduated engineers found immediate employment. The input in engineering education started to grow at the end of the 1990s when Finland began to invest strongly in the ICT industry. At that time, the total amount of engineering education grew as well to ensure the availability of skilled labour for international companies. New degree programmes in information technology were established in almost every university and polytechnic (see Tulkki 2001). Engineering education at Kemi-Tornio University of Applied Sciences responded to the demands of the industry in the same way by starting two new degree programmes in information technology (1995 in English and 2001 in Finnish).

It can be stated that the change from a technical institute to a unit of a university of applied sciences created a new framework for engineering education. The freedom to determine the curricula made it possible to focus on teaching technology-related subjects at the expense of other subjects. The decision was based on feedback from employers at that time. Due to the changes in technology and the business environment, companies started to need specialists or experts in a number of technical fields. On the other hand, it took time to learn to teach in the new environment – the concept “higher education” brought the need to create a more flexible learning environment for students. At the end of the 1990s, however, it became evident that the needs of working life had changed yet again. Therefore, the pedagogical approach had to be renewed towards project-based education, which has made it possible to provide the students with new skills, especially in ICT education. The training environment in research laboratories has supported the goals of education in that respect.

A recent inquiry made among SME owner-managers in Finland emphasizes the need for a renewal of engineering education. The results revealed that the
respondents underlined the importance of entrepreneurship education and action-based learning methods in engineering education. Additionally, only 46% of the respondents considered the present engineering education to meet the requirements of working life (EK 2009).

1.2 Purpose and research setting of the dissertation

The purpose of this study is to develop a new framework for training entrepreneurship in engineering education. Thus, the new framework could be used for developing, firstly, entrepreneurial behaviour and, secondly, the entrepreneurial mind-set of engineering students. The new approach includes four aspects, outlined in essays. Because of the multilevel structure of the research phenomenon, the essay structure is justified. The background and the basis for this research have been opened in the previous chapters containing an introduction to the operational environment and educational context of the target organisation. The focus of entrepreneurship education research has primarily struggled with the issue of contents from the perspective of business studies. Fairly few researches have focused on analysing the methodological challenges posed by entrepreneurship education in engineering education at a university of applied sciences operating in a small industrial region. Additionally, research on the possibilities of effectuation in training students for opportunity creation has not been very common. Due to the above-mentioned research gaps, the aim of this study has been researched through four essays offering different views on the research problem. The research setting is depicted in Fig 1.
The first essay opens the aspects and background for understanding the role and expectations of stakeholders with regards to entrepreneurship education. KTUAS is responsible for contributing to regional development through education, for instance. The operational environment of KTUAS consists of business organisations which need skilled labour. On the other hand, there is also the need to increase the number of local technology-based enterprises. Essay I is an empirical paper based on stakeholder interviews conducted in northern Scandinavian countries as part of a common project of three northern HEIs. The data of essay I, the information on Finnish stakeholder expectations, forms the basis for developing education to meet the needs of the region.

The pedagogical basis needed in developing entrepreneurial behaviour is covered conceptually in essay II. It ponders which learning methods would be the most suitable ones for entrepreneurship education. Despite the extensive experience in problem-based learning conducted in the two engineering degree programmes at KTUAS since 1999, there is a need to expand the understanding of action-based learning methods and their usability. In particular, the offerings of PBL (problem-based learning) and EBL (enquiry-based learning) require further study for realizing their role in entrepreneurship education in the future.

Studying the possibilities of effectuation with respect to entrepreneurship education and opportunity recognition validates the significance of essay III, in
which the main idea of how effectuation could be harnessed to support entrepreneurship education is introduced. The interest in effectuation led the researcher to ponder what might explain the low entrepreneurial activity among engineering graduates and how education could be renewed through effectuation. Additionally, essay IV, as an empirical paper, approaches effectuation from the point of view of local technology-based companies by analysing their establishment and decision-making processes. The paper is used to deepen the understanding of the actual actions taken in the target companies, and for strengthening the basis in renewing entrepreneurship education for training engineers.

1.3 Contribution of the study

During the last 10 to 15 years numerous research papers have been published on entrepreneurship education. To understand the research phenomenon, the researcher has utilized several databases (ABI Inform/ProQuest, Ebsco, Elsevier, Emerald Journals, for instance) and also the main international journals to locate articles in the research field. Examples of the most recent articles covering different aspects of entrepreneurship education, and those touching on the purpose of the study, have been collected in Table 1. A more detailed literature review is included in the second chapter of this study.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
<th>Journal</th>
<th>Focus</th>
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Although the above-mentioned articles cover entrepreneurship education widely, there are still some unaddressed aspects, which form the basis for the contribution of this research. The challenges and requirements of effective entrepreneurship education for training engineering students is mainly a fairly unaddressed research topic. Thus, the main contribution of this study is to outline a new holistic framework for entrepreneurship education for non-business students in the field of engineering. Additionally, the study participates in the discussion on
action-based learning methods (problem-based learning and enquiry-based learning, for instance) and especially their contribution in developing entrepreneurial behaviour. Even though the extant research includes some aspects in this field, very few of the studies have pondered why action-based learning methods are valuable for reaching the aims of entrepreneurship education. It can be argued that there is not much research on finding new pedagogical approaches to deepen the understanding of action-based learning methods from the starting point of entrepreneurship education. Therefore the pedagogical view is opened through the expansive learning theory in order to determine whether its benefits could be extended to entrepreneurship education as well. Finally, this study searches for new aspects on the process of entrepreneurial opportunity creation through effectuation: how the process of effectuation could be harnessed for training entrepreneurial individuals, in engineering education for instance. One interesting aspect explored is mapping the decision-making processes of technology-based companies and utilizing that understanding in developing entrepreneurship education, too.
1.4 Structure of the thesis

This study is composed of six chapters, as introduced in Fig. 2. Chapter 1 introduces the background and the context of the research, which consists of the operational environment of the local technology park and the educational organisation situated as the environment’s centre. Thereafter the chapter delineates the purpose of the dissertation and specifies the contribution. Chapter 2 consists of a literature review to form the theoretical basis for the study. The chapter approaches the previous research through two subchapters: entrepreneurship as a research field and entrepreneurship education. The findings of the literature review are summarized at the end of the chapter.

Chapter 3 introduces the research methodology, as well as the ontological and epistemological choices of the study. In addition, the applied research methods are described. Chapter 4 includes short descriptions of the four essays. The essay I, forming the baseline for the whole study, explores the expectations of the stakeholders. As defined earlier, understanding the stakeholders’ views is essential for developing entrepreneurship education to meet the needs of the region. The essay II follows with another important topic, concentrating on the pedagogical and methodological issues. The purpose of the essay is to open new views for comprehending the field of education, learning and teaching through learning paradigms. The essay III continues with the themes of effectuation and causation, importing new aspects for opportunity creation. In addition, it also furthers the research process by offering a new interpretation of entrepreneurship education which could be built on utilization of effectuation. The essay IV closes the process by exploring the decision-making processes of small technology-based firms. The aim is to clarify the meaning of effectuation in practice and thus model entrepreneurship education suitable for educating engineers.

Chapter 5 covers the discussion, which collects the suggestions based on the research material and introduces the framework. The dissertation is closed with chapter 6, which includes the conclusion, limitations and implications of the study.
Chapter 1
• Research context
• Objectives
• Contribution and structure

Chapter 2
• Previous research
• Theoretical basis
• Framework

Chapter 3
• Methodological choices
• Research design

Chapter 4
• Instruction of essays: stakeholders’ expectations, pedagogic view, effectuation in education (theoretical and empirical standpoints)

Chapter 5
• Description and justification of the new framework

Chapter 6
• Conclusions
• Evaluation of the study
• Suggestions for further research

Fig. 2. The structure of the thesis.
2 Literature review

The concept of entrepreneurship and its origin is traditionally combined with Richard Cantillon (1680–1734) who, as a representative of the mercantilists’ entrepreneurship school of theory, described some elements of economic activities in his publication Essai sur La Nature du Commerce en General. He clarified the activities of the merchants and entrepreneurs in the 4th chapter (Des Bourgs) by explaining the phases of changing merchandise and how entrepreneurs went to sell their products to different villages at different and uncertain prices. (Cantillon 1732/2003: 14). As Ristimäki states in his 2004 dissertation (Ristimäki 2004: 10), “Cantillon was not the first one to explain economic activities”.

Bruyat and Julien (2000) name four persons who have all brought their own economic aspects to the concept. Cantillon saw the entrepreneur as a person who is aware of the risk and may legitimately appropriate any profits. Turgot and Say separated the entrepreneur from the capitalist, because the entrepreneur organises factors of production to create value – the capitalist assumes the risk or uncertainty. Schumpeter, on the other hand, finds the entrepreneur uses innovation to force the liberal system to extend its contradictions (Bruyat & Julien 2000).

The concept and the essence of entrepreneurship can be traced back to the theories of classical economics, as has been outlined in the introduction as well. There seems to be an intense debate on the roots of entrepreneurship. However, most researchers share the view that the concept started to take its most commonly accepted form in the 17th century (Ristimäki 2004, Murphy et al. 2006, Bruyat & Julien 2000).

The literature review first approaches entrepreneurship as a field of research through describing the ways the research field has evolved. Thereafter, the first section opens the concept of entrepreneurship and moves on to a description of the process of entrepreneurship. Due to the main focus of the study (entrepreneurship and engineering education), some research in technology-based entrepreneurship is included as well. The second part of the chapter concentrates on the aspects of entrepreneurship education so as to specify the research in this field and thus form the building blocks for the essays. The chapter closes with a summarizing section combining the main contents of the whole chapter.
2.1 Entrepreneurship as a field of research

Entrepreneurship as a research field began to garner interest in the 1960s and 1970s, especially the field of in business management. Thereafter, research on entrepreneurship intensified and new researchers discovered the research field. Researches such as Davidsson, Shane, Venkataraman, Hjorth, and Gartner, for instance, have published numerous articles in which they described the research challenges posed by entrepreneurship. The researchers have approached the phenomena from different angles and theories by creating several definitions and concepts. At the same time, many researchers have expressed their frustration that the research on the field does not qualitatively progress the way they expect (cf. Davidsson 2008, Shane & Venkataraman 2000).

Davidsson has said (2008: 13) that there seems to be some kind of identity crisis among entrepreneurship researchers. He also states the literature is full of definitions which differ in the way the researchers categorise entrepreneurship as a domain. Should it be included in economic-commercial studies, small business management, and organisational theories? (Davidsson 2008: 14). An article by Tornikoski (1999) states that because of the challenges of researching entrepreneurship, the theoretical basis of the research should be grounded in psychology and sociology.

The development of entrepreneurial thought and entrepreneurship can be analysed in a number of ways. Murphy et al. (2006) have done it through a historical view by naming three bases: prehistoric bases (–1770), economic bases (1780–1980) and the multidisciplinary bases (1980–). The method used in their article the article details a link between the development of society and the phenomenon of entrepreneurship. In the prehistoric bases, only some groups with special skills were able to create innovations or have entrepreneurial activities. Ownership and social status were elements of entrepreneurship and were available for landowners and tax collectors. Later the situation started to change due to expanding trade and economic competition, and entrepreneurship became socially more acceptable. The nature of entrepreneurship changed (Murphy et al. 2006).

The economic bases started alongside the development of classical economics and economists (e.g. Cantillon, Ricardo and Smith) creating such concepts as free trade, specialization and competition. Entrepreneurs found their role in combining new factors of production – land, capital and human industry – and by taking on the economical risk. “Entrepreneurial activity came to be regarded as a
mechanism of change, as it transformed resources into unforeseen products and services.” (Murphy et al. 2006).

However, the earlier theories that described and analysed entrepreneurship had some weaknesses (e.g. assumptions of pure competition, the complexity of market-based systems). As a result, entrepreneurship research started to become multidisciplinary by expanding towards economics, sociology, psychology, marketing and management studies. Theorists attempted to use psychological theories of traits to define the typical features of entrepreneurs (see Murphy et al. 2006). It was realised that human beings have different cognition styles which can have an effect on the way entrepreneurs discover and recognise opportunities. Recent theoretical approaches have started to study entrepreneurship from the point of view of using opportunities and the ways entrepreneurs are able to use existing resources, including knowledge as a resource (Eckhardt & Shane 2003, Murphy et al. 2006).

Another way to analyse research in entrepreneurship is offered by Stevenson and Jarillo (1990). They name three research categories: what happens when entrepreneurs act; why they act; and how they act. The first can be connected to economists such as Schumpeter and Kirzner, and the second to the psychological/sociological approach. In the third category, Stevenson and Jarillo (1990) combine studies in entrepreneurial management. Burgelman (1984) has put his efforts into studying the challenges of corporate entrepreneurship, which he finds important in maintaining growth in new, maturing firms. Burgelman sees that “internal entrepreneurs” are important actors in combining separately situated pieces of technology and knowledge. Pinchot (1986), on the other hand, emphasized the concept of intrapreneurship, which means the entrepreneurial culture existing in a firm.

Shane (2003) is critical of the fact that the research on entrepreneurship has been dichotomized. On one hand, there are researchers whose main interest is in the entrepreneur as an individual. This camp, as Shane sees it, focuses on individual abilities such as tolerance for uncertainty (Kihlstrom & Laffont 1979), ambiguity (Schere 1982) or need for achievement (McClelland 1961). The aim of that approach is to show that entrepreneurs differ as individuals from the main population. Shane (2003) emphasizes that entrepreneurship is episodic and therefore the individual approach has been shown to be unsuccessful. On the other hand, some researchers study the phenomenon through external factors and have tried to determine the suitable environment for entrepreneurship. The weakness of this approach is that it neglects human agency.
The ways of doing research have also differed geographically. In the American research tradition, quantitative methods, distance and generalisability have been in the focus. On the other hand, European researchers have preferred methodological openness and the need for familiarity and awareness of context. (Johannisson 2002). According to Johannisson, researchers with small business background do not bring out or use the knowledge they have been able to create before their academic careers. Some theorists prefer to study entrepreneurship from the point of view of creativity and creative organisations. (Johannisson 2002). In those cases, the research method has been constructivism, which brings some challenges to research and also the danger of shifting the focus away from the essence – entrepreneurship means actualisation – towards refining concepts of the social world. Johannisson points this out especially in considering the process of creativity and innovative organisations.

Entrepreneurship is an interactive construction of venture and context which requires “an accepting of human willpower, belief and accountability as crucial for social change”. (Johannisson 2002). “Ideas originating in pragmatism, existentialism and phenomenology add to a proposed basic constructionist framework in making this image of the entrepreneurial phenomenon, and how to research it, intelligible” (Johannisson 2002). According to Johannisson, both pragmatism and existentialism exemplify how human beings need to be involved in society, participate (act) and not only observe. He also adds to this research approach phenomenology, which takes into account reality and personal experiencing. Therefore, entrepreneuring means continuous learning and sensemaking. Due to his emphasis on acting in entrepreneurship, Johannisson even suggested a researcher of entrepreneurship should use the method of “enactive research”, which could include that the researcher launches an entrepreneurial project, participates and uses self-reflexivity.

In Europe, research on entrepreneurship has increased since the 1980s. The research interests have been on start-ups, internationalization, innovation and technology transfer, and networks and exchange relations (Frank & Landström 1997). The field of interest differs between regions. In the UK, France and Germany, the focus has been on inward-looking or domestic themes, but in smaller countries and the Nordic countries the research interests have been more international (Welter & Lasch 2008). There has also been criticism that entrepreneurship research lacks a research paradigm and therefore that it does not have its own ontological and epistemological base. The research design in Europe is considered to be less sophisticated, concentrating on descriptive statistics.
European entrepreneurship research has focused on the environment as well as on the history of entrepreneurship (Welter & Lasch 2008). Hjorth (2008) studied Nordic entrepreneurship research and found common historical, sociocultural and disciplinary elements in the Nordic countries. The Nordic countries have been active in entrepreneurship research. A combining factor for all Nordic countries is low entrepreneurial activity coupled with a state-governed welfare system. Nordic research mainly uses qualitative methods and is conducted mainly in business administration discipline.

It can be said that the economic approach and economic theories, which earlier had a central role in concept formation, have also framed the research work. However, nowadays, entrepreneurship is interpreted to be a part of everyday life and studied from that aspect. Entrepreneurship is a multidisciplinary paradigm which can be approached from various directions, as can be seen in Table 2. The following chapter approaches the concept of entrepreneurship via different researchers in order to build the conceptual basis of this research.

Table 2. Research approaches of entrepreneurship.

<table>
<thead>
<tr>
<th>DISCIPLINES (Murphy et. al 2006)</th>
<th>DOMAIN (Davidsson 2003)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Academia (teaching methodologies, educational programmes, level of education)</td>
<td>1. Scholarly domain</td>
</tr>
<tr>
<td>2. Finance (sources of finance)</td>
<td>2. Societal phenomenon</td>
</tr>
<tr>
<td>3. Practice (high-technology firms, network marketing, franchising etc.)</td>
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2.1.1 Entrepreneurship as a concept

Schumpeter brought new views to the concept of entrepreneurship. When defining the fundamentals of economic development and the circular flow of the economy, he included the “enterprise” as the environment of new combinations for creating production (Schumpeter 1934/1968/74). He writes that “the individuals whose function is to carry them (enterprise) out we call entrepreneurs”. According to Schumpeter, entrepreneurs are not only independent businessmen but also dependent employees such as managers of a company or owners with the control of a majority in shares. He did not include in this dependent employee category the heads of firms who are solely operating with an established business (Schumpeter 1934:75).
Carton, Hofer and Meeks state that “Schumpeter defined what he meant by entrepreneurship (“enterprise”) and then concluded that those who perform the functions of entrepreneurship are entrepreneurs”. Schumpeter’s concept of entrepreneurship especially included the creation of an organisation to pursue opportunity and also included in such organisations established or existing – not only the new – ones (Carton et al. 1998). Schumpeter’s entrepreneur is an innovator who challenges the existing system (e.g. Bruyat & Julien 2000) and disturbs its equilibrium (Graig & Johnson 2006). The entrepreneur initiates change through innovation and thereby generates new opportunities. “The Schumpeterian innovator-entrepreneur is the decision-maker who is able to depart from the routine repetitive working of widely known opportunities.” (Graig & Johnson 2006).

McMullen and Shepherd (2006) interpret that Schumpeter does not consider perceived uncertainty as important in entrepreneurial action due to the identifiable and abundant existence of opportunities – which are everywhere, and available for all prospective entrepreneurs. In addition McMullen and Shepherd (2006) define Schumpeter’s opportunities as having an objective existence. Individual differences lead to a situation in which only the motivated and capable actors are able to utilize. Casson (2005) argues that Schumpeter’s entrepreneur has to have the will to succeed as well as to prove oneself superior to others and establish a dynasty. Schumpeter sees the entrepreneur as an innovator, as one who creates new opportunities, but Kirzner, another representative of the Austrian economics school, defines the entrepreneur as a seeker of new arbitrage opportunities (e.g. McMullen & Shepherd 2006, Chiles et al. 2007). Kirzner’s entrepreneur is a producer, “a type of catalyst that identifies the opportunity that sparks the market”, an alert individual (Graig & Johnson 2006, Casson 2005).

Entrepreneurship is not business-like or professional in a corporate management sense. To emphasize the extensiveness of the concept, Gibb (2005) has used the expression that entrepreneurship is a way of seeing, doing, communicating, organising and learning things. In addition Gibb (2005) has identified entrepreneurial behaviours and attributes which can be linked to entrepreneurial skills. Casson (2005) asserts that judgemental decision-making is the main attribute of an entrepreneur. However, he emphasizes, entrepreneurship is not about self-employment.

Drucker’s (1985: 20) entrepreneur is a person who owns and runs a business. However, not all new enterprises are entrepreneurial, because entrepreneurship should renew things – real entrepreneurs change or transmute values. Also, other
institutions, not just economic organisations, can be entrepreneurial in nature. Entrepreneurship is not based on personal traits. It is not linked with the individual or the institution, as Drucker has pointed out (1985: 23). He also comments on how people who desire certainty are unlikely to make good entrepreneurs. In entrepreneurship as well in other demanding positions the essence of decisions is uncertainty (Drucker 1985: 23). The entrepreneur’s role is to make sure the resources are effectively used.

New perspectives on the concept of entrepreneurship have been brought up by Kyrö (1997, 2005). According to her interpretation, entrepreneurship consists of four forms as follows:

1. Individual, self-oriented entrepreneurship,
2. Creation, management and ownership of small enterprise,
3. Corporate or organisational entrepreneurship, and
4. Intrapreneurship, which refers to the interplay between the individual and organisational entrepreneurship.

Several other researchers as well have approached entrepreneurship by emphasizing various aspects related to these forms: individual (Harmeling 2011), small business management (Casson 2005, Ikaivalko et al. 2010), corporate and intrapreneurship (Burgelman 1984, Zahra 1996, Carrier 2006, Menzel et al. 2007, Akehurst et al. 2009).

The concept of entrepreneurship has evolved from Cantillon’s context of changing merchandise into today’s views of organisational behaviour. Our understanding and interpretation of entrepreneurship has gained new layers and scopes with the development of the research field. The earliest definitions explained the phenomenon through the actor, the entrepreneur. Schumpeter emphasized that the entrepreneur is an innovator and destructor, whereas Kirzner considered the entrepreneur as a producer. The interpretation of the attributes characteristic of the entrepreneur differs as well. Some researchers emphasize the entrepreneur’s skills at risk-taking. On the other hand, some researchers prefer a view that sees entrepreneurs needing to be able to make decisions under uncertainty. In this research, entrepreneurship is a phenomenon which does not depend on an individual’s traits or features. Rather, entrepreneurship becomes visible through the behaviour of actors in different settings, not necessarily in business environments or when building new organisations. Entrepreneurship is a multidimensional phenomenon covering all the aspects of human actions.
main function of this research is to develop entrepreneurship education, and also to search for approaches that can have an impact on human learning processes.

### 2.1.2 Entrepreneurship as a process

As stated above, the concept of entrepreneurship has traditionally been explained through the person of the entrepreneur (who) and his/her operations (what he/she does). However, the main focus in defining entrepreneurship should cover the *nexus between lucrative opportunities and enterprising individuals* (Shane & Venkataraman 2000). It is important to include consideration of the variation in the quality of identified opportunities. In the case that this aspect is neglected, it leads to incomplete definitions and the whole field of research is minimised. For Alvarez and Busenitz (2001) the process of entrepreneurship consists of a) entrepreneurial recognition, and b) combining and organizing resources as resource. Shane and Venkataraman (2000) preferred to define entrepreneurship “as the scholarly examination of how, by whom, and with what effects opportunities to create future goods and services are discovered, evaluated and exploited”. Shane and Venkataraman (2000) consider that it is critical to understand the existence of opportunities, as well as their discovery and exploitation, and the actions by which opportunities are taken into use. Davidsson (2003: 75) defines the entrepreneurial process as follows:

“...is meant all cognitive and behavioural steps from the initial conception of a rough business idea, or first behaviour towards the realization of a new business activity, until the process is either terminated or has led to an up-and-running business venture with regular sales.”

The role of the environment in creating entrepreneurship is central as well. Bruyat and Julien (2000) describe entrepreneurship as a process which consists of two factors – individual (I) and new value creation (NVC). The individual (an entrepreneur or a team or organisation) learns throughout the process – the results of the learning process can be seen in the final output (NVC). The creation of new value requires creativity, innovation and a degree of change. The new value created by the entrepreneur (a new product or service) does not need to be a venture. New value can be generated by reproduction, imitation or valorisation when an individual starts to operate in a new environment.

The entrepreneurial process includes all the functions and actions of perceiving opportunities and, on their basis, of creating new organisations.
Essential is the creation of new organisations or new ventures into entrepreneurship separate from routine management. Carton et al. (1998) summarise the entrepreneurship concept by saying that “the essence of entrepreneurship is the pursuit of a discontinuous opportunity involving the creation of an organisation (or sub-organisation) with the expectation of value creation to the participants.” They also include in this definition the accumulation and deployment of resources, the building of organisational structure to utilise opportunity.

Dew et al. (2004) ponder the reason why only a small portion of all product possibilities are brought to production. One reason could be that long time span from innovation to production can lead to rejection of product ideas due to economic reasons. Another explanation, say Dew et al. (2004), could be found from dispersion of knowledge over people and time, which causes Knightian uncertainty also, when the distribution does not exist or is unknowable. Casson (2005) points out that some people have superior access to information, or information asymmetry, and therefore they are better able to exploit opportunities.

Are there differences between entrepreneurs and the way entrepreneurs discover and exploit opportunities in different countries? Baker et al. (2005) have searched for the answer from differences in division of labour. Each nation differs in the way its population (or workforce) operates in different sectors in the economy – agriculture, extraction, manufacturing, services – which affects its possibilities to discover opportunities. Participation in a certain part of the workforce is closely linked with social groups, i.e. social stratification, as well. Therefore abilities to get information differ – knowledge corridors appear as the result of the differences in getting information. As a conclusion, Baker et al. (2005) state that the more excluded the members of a group are from a nation’s most attractive economic roles, the less likely they are to discover available entrepreneurial opportunities.

Baker et al. (2005) refer to Shane and Venkataraman’s (2000) formulations which state that discovery of entrepreneurial opportunities is a form of arbitrage. Both argue that discovery of opportunities should include not only discovering new financial profit bringing means-end frameworks but also should include optimising existing means-end frameworks. In their opinion, using the classical microeconomic concept of Homo economicus, a rationally behaving individual, approaches entrepreneurial behaviour too narrowly. The taste and preference differences between nations should not be excluded when attempting to understand entrepreneurial behaviour and motivations in respect to opportunity.
discovery. According to their findings, the motivations of entrepreneurs differ by resource endowments, norms, and institutional and cultural dimensions (Baker et al. 2005).

Sarasvathy (2001) has opened a different view on the process of entrepreneurship by utilizing two approaches: causation and effectuation. Causation is a process in which the entrepreneur determines the goal beforehand and thereafter chooses the means to reach it – the process is based on the logic of prediction. The goals determine the actions, which are partly based on competitive analysis. Effectuation is the contrary of causation because in effectuation the entrepreneur operates by first analysing and collecting information regarding the means available (skills, social networks, other resources) and accordingly acts by using the logic of control. Here the actions of the entrepreneur are driven by the given means; building partnerships is a central factor in creating new markets (Sarasvathy 2001, Sarasvathy & Dew 2005, Dew et al. 2009).

The main focus in entrepreneurship theories has been on existing companies – the proceeding phases, i.e. the creation process of the company, has not been in the focus. The decisions taken on the individual-, company-, industry- and economy-level in existing companies have been often studied but tend to neglect pre-establishment actions. The continually changing operational environment challenges entrepreneurs in a way which makes it more difficult to predict events (Sarasvathy 2001). Fostering entrepreneurship in individuals and economies requires new approaches. Entrepreneurship could even be seen as a method and not as a subset of other disciplines (Sarasvathy & Venkataraman 2011). It should be studied as a science of the artificial (Sarasvathy 2004a), which means that studying entrepreneurship requires simulating and analysing the establishment and design process of particular firms from the view of the entrepreneur. Additionally, Sarasvathy (2004b) emphasizes that entrepreneurs’ psychology, history and culture are relevant elements in the design process of the artificial (a firm, for instance).

Entrepreneurship as a process is commonly expressed through three elements: individual, opportunities and output (products, services or new value). Shane and Venkataraman emphasize the role of opportunities and their exploitation, whereas Alvarez and Busenitz accentuate utilization of resources (including entrepreneurial recognition). Some researchers have pondered the reasons why some individuals are able to perceive opportunities and have offered dispersion of knowledge as an explanation. It has also been suggested that the differences in
opportunity recognition vary between nations due to the source of livelihood (division of labour) – which can hinder availability of information. In the present research, the process of entrepreneurship is seen as a combination of individuals, their manner of acting when taking advantage of their social networks and personal skills (awareness of available means and resources). Hence, Sarasvathy’s effectuation is suitable for this research purpose, from the standpoint of developing entrepreneurial behaviour and renewing entrepreneurship education. Emphasizing the process of effectuation is considered to be a typical feature of technology-based enterprises due to the continuous changes in their operational environment: today, decisions can rarely be based on predictions. Because the context of this research is engineering education, the aim is to develop educational means for technology-based entrepreneurship, which is introduced in the following chapter.

2.1.3 Aspects of technology entrepreneurship

Technology entrepreneurship is something more than just discovering pre-existing options; it means creation of new solutions by recombining and transforming the existing resources as well. Here, Schumpeter’s definition of the entrepreneur as an innovator and destructor of the existing equilibrium has been combined with technology-based entrepreneurship. As stated earlier, the process of entrepreneurship consists of opportunities and innovative individuals (cf. Shane & Venkataraman 2000). Thus, individuals need to have access to information on new opportunities in order to exploit them. On the other hand, opportunities for technology entrepreneurship can be opened endogenously through the enactment process; the value of opportunities is noticed when the entrepreneur’s actions make their value visible (Alvarez & Barney 2010, Alvarez & Barney 2008). The change processes in society (globalization, technological development, for instance) create a continuous turbulence which can complicate the decision processes. Thus, decisions concerning utilization of opportunities can rarely be built on acquiring pre-information and thereby minimizing uncertainty (cf. Sarasvathy 2001).

Technological changes are considered to be the main source of entrepreneurial opportunities because they enable the use of resources in new and more productive ways (Shane 2003: 24). It also seems that industries with closer ties to research and academics have closer ties to entrepreneurial opportunities (Shane 2003: 24, Delmar 2002). New technology-based firms have a comparably
wider impact on regional growth as well. According to Autio and Yli-Renko (1998), technology-based companies, even though they are usually micro companies, form co-operational networks with larger industries and have a positive effect on technological development in the region as a whole.

It has been argued that innovations, technological changes and entrepreneurship form a triangle, which can lead to economic growth and welfare (cf. Marvel & Lumpkin 2007, Lindholm Dahlstrand 2007, Hindle & Yencken 2004, Jones-Evans 1995). Wong, Ho and Autio (2005) have studied the general TEA (Total Entrepreneurial Activity) rate on the basis of GEM (Global Entrepreneurship Monitor) reports and found that new, high-growth potential firms were important for generating economic growth in a number of countries. The discovery of new innovations depends on the resource base of the entrepreneur. The resource base is a combination of knowledge (specialized and generalized; explicit and tacit) and capabilities (human, technical). “Firms are a bundle of commitments to technology, human resources, and processes all blanketed by knowledge that is specific to the firm.” The entrepreneur’s ability to use and expand the resource base affects a firm’s future and competitiveness as well (Alvarez & Buseniz 2001).

According to Marvel and Lumpkin (2007), the human capital that technology entrepreneurs possess can have an impact on their ability to produce radical innovations. Formal education and deep experience are both positively associated with ability to create radical innovations. On the other hand, they state that broad experience across multiple areas is not that significant. An interesting view which Marvel and Lumpkin (2004) introduce is that information about customer needs or problems is not necessary – it even seems to have a negative impact on creating frame-breaking innovations. Sanz-Velasco (2006) conducted research on the Swedish mobile internet industry and made the conclusion that prior knowledge and opportunism both influenced opportunity discovery and development. Most of the knowledge consisted of ways to serve the market rather than an understanding of customer problems. Opportunity development, on the other hand, requires resources (human and capital).

Mosey and Wright (2007) conducted research to understand the link between technology-based academic entrepreneurs, human capital and social capital. They recommend that special policies might be needed to create more specific business networks and relationships for academics representing different disciplines. Social networks seem to be broader and more effectively used among academic entrepreneurs with prior experience. In addition, they discovered that social
capital is associated with the academic discipline; additionally, it was easier to build up networks for entrepreneurs with an engineering background than for those with a background in the natural sciences.

Venkataraman (2004) states that technological entrepreneurship has a central role in regional transformation. He names seven intangibles (or sufficient conditions) of entrepreneurship which are needed for Schumpeterian entrepreneurship: 1. focal points capable of producing novel ideas (universities with R&D laboratories), 2. proper role models, 3. informal forums of entrepreneurship, 4. region-specific ideas to be created, 5. safety nets (in case entrepreneurs fail), 6. gateways to large markets, and 7. executive leadership. Lindholm Dahlstrand (2007) shares the view that technology-based entrepreneurship is a highly regional phenomenon. She considers that local large firms have a central role in the training and engendering of future entrepreneurs.

Jones-Evans (1995) has defined four categories of technical entrepreneurs to understand their occupational background. The categories are as follows: 1. research (background in academics), 2. producer (background in industry), 3. user (background in peripheral roles in the development of technology), and 4. opportunist (background in non-technical organisations). Based on the research, he concludes that entrepreneurs in most of the technology-based firms have operated either in research or as producer. In addition, the research shows that the main sample of technical entrepreneurs had only one type of occupational background. (Jones-Evans 1995).

In their article, Garud & Karnoe (2003) have used the concept of bricolage to describe the resourcefulness and improvisation of involved actors. Technology entrepreneurship requires creation and ability to use and recombine the available means (cf. Baker & Nelson 2005). It can be seen as a result of the social construction of technological system, which consists of four elements (regulation, evaluation, design and production, use). They form an embedding process by which technological artefacts can be created (Garud & Karnoe 2003). The emergence of new artefacts is the result of the involvement of different actors such as innovative entrepreneurs, various institutions, and customers. Each of these actors has a different role in the process. Garud & Karnoe point out that “technology entrepreneurship involves the creation of new opportunities by a collective”. (Garud & Karnoe 2003). They have also defined bricolage as a process which moves ahead on the basis of inputs of actors, who possess local knowledge and are able to gradually transform emerging paths to higher degrees of functionality.
It can be concluded that technology entrepreneurship has an impact on regional development especially when new technology-based enterprises are cooperating intensively with research and academic organisations, and local industries. According to a number of researches, the existence of technology entrepreneurship depends on the availability of human, capital and social resources. As it has been argued earlier, actors of technology entrepreneurship benefit if they are capable of forming and utilizing social networks; co-operation in different arena can assist in the process of opportunity creation as well. Also, the importance of resourcefulness and creativity, which can be seen through bricolage, is beneficial for technology entrepreneurship. The standpoint of this study is that technology entrepreneurship is fundamental for economic development, but it also requires that there are actors, entrepreneurs, and a suitable operational environment for enacting. As the research results show, entrepreneurship among academics is still fairly low. Thus, educational organisations need to find new approaches for creating learning environments for entrepreneurship education. As argued earlier, another prerequisite for technology entrepreneurship is human resources with specific knowledge. Therefore, it is necessary to ponder the meaning and impressiveness of entrepreneurship education, as is done in the following chapter.

2.2 Points of view on entrepreneurship education

Amongst researchers in the field, the concept and definition of entrepreneurship education is still vague and unclear. The ontological contradictions about entrepreneurship affects this discussion as well. Some researchers prefer to use the concept enterprise education (Garavan & O’Cinneide, 1994, Gibb 2002, Jones & Iredale 2010, Hytti & O’Gorman 2004) to emphasize the aim of education. Enterprise education is usually linked to developing human behaviour, creating entrepreneurial mind-set and entrepreneurial learning. Entrepreneurship education is defined more commonly as training for business management and ownership. According to Kyrö (2006a), enterprise education is usually used in UK, entrepreneurship education being the preferred concept in the USA and Canada. To clarify the distinction, Kyrö (2006a) specifies that the studied phenomenon is either ‘an enterprise’ or ‘an entrepreneurship’. Therefore it can be defined that entrepreneurship education concerns entrepreneurs/actors, enterprises and entrepreneurial/enterprising processes interconnecting them (Kyrö 2006a).
Jones and Iredale (2010) have compared the differences of entrepreneurship education and enterprise education. The main focus of entrepreneurship education is on starting a business, planning and launching a business venture, business growth, developing skills and behaviour for and in business contexts and self-employment. Enterprise education, on the other hand, aims at active-learning enterprise education pedagogy, developing knowledge needed for being an effective citizen/consumer operating in a flexible market economy, developing the student into an enterprising individual, learning to use enterprising skills throughout the life course, and understanding the small-business operations. In addition to the discussion of concepts and definitions, there has been disagreement over whether entrepreneurship and opportunity recognition can be taught at all (Fiet 2000, Henry et al. 2005a). The basis for this discussion reflects the different views and understanding of the whole phenomenon of entrepreneurship: Are entrepreneurs born or made? (Henry et al. 2005b).

As Kyrö (2008) and Carrier (2005) have concluded that the more relevant question today is how and with what methods is entrepreneurship education going to meet the expectations expressed by society. Entrepreneurship is deemed to have an important role in supporting economic growth, and entrepreneurship education is needed in reaching that objective. Globally, there is a strong pressure towards creating a society and organisations that are able to adjust operationally to change. Individuals and organisations operating in society should enhance the development of entrepreneurial skills and behaviour, and therefore entrepreneurship education is justified as well (Gibb 2005).

What then is the aim of entrepreneurship education? The researchers seem to disagree as to whether the focus should be on organisation creation, the growth of firms, innovation, and value creation or on ownership (cf. Vesper & Gartner 1997). Or as Kuratko (2005) has stated: “Entrepreneurship is more than the mere creation of business.” There are also views which emphasize that entrepreneurship education is a way to develop the human capital needed in entrepreneurship and opportunity recognition (Marvel & Lumpkin 2007, Shane, 2003: 69). To train individuals for entrepreneurship not only requires delivery of explicit knowledge related to business management but also familiarisation with the tacit or experiential knowledge needed in decision making. Entrepreneurship education can be a way to open entrepreneurial values to the students (Gibb 2007).

Today, entrepreneurship not only includes the behaviour of an entrepreneur as a business owner but also the organisational (corporate) entrepreneurship and intrapreneurship (behaviour and actions of employees) as well (Kyrö & Carrier
Entrepreneurship education can be seen as the framework for developing entrepreneurship in all these forms. In education the focus needs to be on the individual and learning. Small business management and entrepreneurship education are not synonyms even though there can be a conceptual connection between them (cf. Solomon et al. 2002).

Kyrö (2008) emphasizes the role of entrepreneurship in implementing new ideas and ways of doing things, in and proactively responding to changes in the environment. Entrepreneurship education should prepare individuals to manage change, uncertainty and complexity. Education is needed in training the students for the future – it requires development of entrepreneurial behaviour at all levels (Gibb 2005).

Harkema and Schout (2008) share Kyrö’s views (2008); entrepreneurship is a way the entrepreneur sees opportunities and transforms them into interesting propositions. Innovations, on the other hand, are the way to materialize opportunities, and renew organisations as well as their environment. Entrepreneurship education in universities has a critical role in enhancing that process. Universities and higher education institutions have struggled to find a way to organise entrepreneurship education. The first courses on entrepreneurship were arranged in the 1930s and 1940s in Japan and the USA, but their amount started to increase 30 years later, especially in business schools (Vesper & Gartner, 1997, Solomon et al. 2002, Volkman 2004). In the 1990s universities started to establish special programmes for entrepreneurship education (cf. Garavan & O’Cinneide, 1994).

The effects of entrepreneurship education have puzzled many researchers of the field. Von Graevenitz et al. (2010) have provided an analysis of learning processes in entrepreneurship education. The results of their study showed that students participating in entrepreneurship courses modified their beliefs about their entrepreneurial aptitude. As a conclusion, and suggestion on education policy, the authors conclude that entrepreneurship education is relevant for students’ future career assessments and therefore meaningful as well. Oosterbeek et al. (2010) have analysed the impact of entrepreneurship education on entrepreneurship skills and motivation. Their results show that entrepreneurship education programmes have had a negative impact on the entrepreneurial competencies and intentions of the target group. The conclusion of the researchers is that the programme the students joined was ineffective. On the other hand, they assume that the negative impact could be due to a more realistic understanding of the requirements of entrepreneurship. Packham et al. (2010) have used
comparative analysis to study the effects of entrepreneurship education on attitudes in three European countries. They found that entrepreneurship education could have a positive effect on attitudes about entrepreneurship, although some differences between gender, countries and cultures were seen.

Hytti and O’Gorman (2004) studied 50 European entrepreneurship education programmes. The most typical objectives of the programmes were creating more entrepreneurial individuals and developing a deeper understanding of the world. The studied programmes differed in learning and teaching methods as well. The researchers emphasized that the objectives of the entrepreneurship education programmes need to be specified and expanded on. Their aim should not solely be to prepare people to be entrepreneurs (Hytti & O’Gorman, 2004, Blenker et al. 2006). The contents of the entrepreneurship education programmes seem to differ in the USA as well (cf. Gorman et al. 1997, Solomon et al. 2002). Solomon (2007) sees that the growth in the number of programmes is the result of dissatisfaction with the existing offerings.

According to Kyrö (2008), Carrier (2005) and Fayolle and Gailly (2008), the challenge in entrepreneurship education is not the possibility of teaching it but rather identifying the pedagogical methods and approaches that can help lead to understanding the phenomenon. The pedagogical methods also vary depending on the focus of entrepreneurship education. If content is at the centre, the teaching is about entrepreneurship. In that case, the effort is on delivering knowledge. On the other hand, if the aim is to prepare students to act as entrepreneurs or entrepreneurial individuals, the teaching is (for) entrepreneurship education (Taatila 2008, Rae 2000, Kyrö 2006a). Gibb (2002) emphasizes that the used teaching methods should be able to instruct the students to understand and simulate “the way of life of those who live with high levels of uncertainty and complexity”, and also to become familiar with the culture and values of entrepreneurs. He stresses the need to transfer from learning about to learning for entrepreneurship. In practice, this means a holistic understanding of the suitability of pedagogical methods in different situations (Gibb 2002). A third aspect is teaching through enterprise when students are learning entrepreneurship via the venture creation process (Kirby 2007).

The most common methods in entrepreneurship education programmes are the traditional ones: lectures, business simulations and workshops, among other things (Hytti & O’Gorman 2004), but typical also are writing business plans, case studies and using guest lecturers (Solomon et al. 2002). Traditional teaching methods can be seen as a way to develop mastery of various abstract concepts
(Garavan & O’Cinnede 1994) and to support learning about entrepreneurship. Solomon et al. (2002) have criticized that entrepreneurship education lacks creativity and support for individual thinking. In addition, they claim, the teaching focuses too heavily on theory and the emergence of the personal traits of entrepreneurs (Solomon 2002).

The pedagogical challenges of entrepreneurship education have brought on criticism towards the used methods and created the need for new approaches. Heinonen and Poikkijoki (2006) have argued that the traditional lecture format is not the most effective method in entrepreneurship education. Therefore they have created an entrepreneurial-directed approach to entrepreneurship education which emphasizes the teacher’s entrepreneurial role in his/her work to support the entrepreneurial process of the students.

The need to modernize entrepreneurship education has sparked increases in activities which include experiential and activating elements. As noted earlier, focusing on traditional learning methods and teaching theory is not considered suitable for developing entrepreneurial behaviour and development of entrepreneurial skills. Therefore, various action-based methods are typically considered when searching for a new arena for learning (cf. Hytti & O’Gorman, 2004, Solomon et al., 2002, Rasmussen & Sörheim, 2006). Or, as Henry et al. (2005b) have noted, teachers need to “find innovative learning methods that coincide with the requirements of the potential entrepreneurs”. According to Carrier (2007), teaching entrepreneurship requires adoption of innovative pedagogical paradigm – transmission of knowledge is not the only goal.

Rae (2003) approaches the challenges of entrepreneurship education through a framework called opportunity centred learning, the aim of which is to focus on exploration and development of opportunities. Rae has compared opportunity-centred learning to problem-based learning and action learning methods. The main difference to the other learning methods is that opportunity recognition is in itself an act of learning. Additionally, as Rae points out, opportunity-centred learning aims at creating learning situations which motivate participants to investigate opportunities rather than solve problems.

The search to understand the learning process and, especially, models for entrepreneurial learning has led to the development of teaching models for entrepreneurship education. Bechard & Gregoire (2005) have constructed three models. The supply model studies the supply-side of education – teaching – whereas the demand model approaches the process with the learning goals and objectives as the focus. The competence model aims at finding interaction
between the first two models. In addition, Bechard & Gregoire (2005) have introduced two hybrid models based on the basic models. Kyro (2008) has criticized the framework of all the models for not being equal in and adaptable to entrepreneurship education. They neglect the different learning paradigms and the conceptual needs of entrepreneurship education as well. Fayolle & Gailly (2008) seem to share the same view with Kyrö and emphasize that each teaching model should be based on specific ontological and pedagogical hypothesis to suit different learning situations and individuals.

Lüthje and Franke (2003) have studied entrepreneurial intent amongst engineering students. Their findings support the view that the perceived contextual barriers and support factors are important for technical students considering entrepreneurship. They recommend that universities should increase their efforts in entrepreneurship education, research and related resources. Another suggestion of their study was that the activities should be assigned to students with a propensity to high risk-taking and internal locus of control. Menzies and Paradi (2002) concluded that engineering graduates are the primary group to start technology-based firms. Their findings also support the notion that entrepreneurship education is an effective way in increasing new ventures among engineering graduates.

2.3 Summary, conclusions, and applicability of the approaches

Summary

Interest in entrepreneurship as a research field has its roots in business management. Many have been critical of entrepreneurship as a topic of research because of its challenging nature and because it is linked with several other sciences/fields of sciences such as sociology and economics, for instance. In addition, it is an ambiguous phenomenon which challenges researchers. On the other hand, the extant quality of the research has generally been deemed inadequate, and, due to the newness of the domain, the concepts and definitions of the phenomenon have not yet been fully established.

The focus of entrepreneurial research and thought has followed certain stages. Initially, the focus was on analysing the activities of the individual, the entrepreneur and his/her behaviour. Later, when classical economics evolved along with e.g. Cantillon, the input and importance of entrepreneurs in society
was viewed in a different light. The result was that entrepreneurship was seen as a way to organise the production of goods and services. Entrepreneurship was considered to be a dynamic in society. However, later researchers argued that entrepreneurship should not solely concentrate on studying the individual nor should it focus merely on the environment where the entrepreneurs operate; but rather it should also include situational or episodic elements. Thus, it can be argued that today entrepreneurship is increasingly seen as a multidisciplinary research field.

Concerning the research, there are also geographical and methodological differences between America and Europe. The American research tradition has put more value on quantitative methods, whereas the European research has embraced study methods more openly. In Europe the focus of research has been on start-ups, internationalization and innovation, for instance. Additionally, in some European regions the phenomenon has followed domestic themes, but in the Nordic countries, which have been active in the research field, especially during the last 15 years, the interest has been on international aspects. It has been argued that this trend can be explained by low entrepreneurial activity and the state-governed welfare system.

Defining the concept of entrepreneurship has created new forms and contents. First, the definition was based on describing the economic activities of the person, i.e. the entrepreneur, the owner or the risk-taker, and later the entrepreneur was depicted with such expressions as innovator and destructor of economic equilibrium (Schumpeter) or alert seeker of opportunities (Kirzner). Some researchers, Drucker for instance, emphasize that entrepreneurship includes a renewal of things, and is not limited only to economic organisations. In the 1980s and 1990s the concept was further expanded. Entrepreneurship could be seen in all human activities throughout society. Thus, the connotation of entrepreneurship was not merely economic. Additionally, a new scope was added when the concept intrapreneurship was introduced.

At the beginning of the 21st century, the concept of entrepreneurship became more comprehensive as it began to be analysed as a process involving individuals and opportunities. The existence of entrepreneurship requires recognition and exploitation of opportunities. The operational environment creates the framework for the process. An additional challenge for entrepreneurship, which may possibly even prevent it, is the availability of information or dispersion of knowledge over time and people. Those individuals who have access to information have better possibilities for recognizing opportunities. Another view in this discussion has
been raised by Sarasvathy’s analyses of entrepreneurs’ decision-making processes. Earlier it was assumed that entrepreneurs prefer to predict future events before making decisions, i.e. by using causation in their operations. Sarasvathy argues that in most cases entrepreneurs instead use effectuation: they approach different situations through controlling and utilizing the means they possess. The reason for this behaviour is that the continuously changing operational environment hinders prediction of the future.

Knowledge is an essential resource for technology-based entrepreneurship. In addition, awareness of the available means and options such as creativity, bricolage or effectuation forms a part of the mental resources of the entrepreneur. On one hand, it can be argued that economic growth requires entrepreneurship, and on the other hand, technological changes are the sources of innovation and entrepreneurship. The existence of technology-based entrepreneurship is dependent on the availability of knowledge and social networks as well. According to a Swedish research study, recognition and exploitation of technology-based entrepreneurship even presumes opportunism. Some researchers claim that academic environments offering a setting for social networks and contacts with reference groups are at a centre stage in the process of entrepreneurship.

As argued earlier, the existence and realization of the phenomenon of entrepreneurship requires information and knowledge, and thus entrepreneurship education is needed. It can be perceived that the same vagueness in defining entrepreneurship has existed in entrepreneurship education also. The most common expressions are enterprise education, entrepreneurial education and entrepreneurship education. The differences between these concepts can be explained through etymology and the goals of the activities. Enterprise education has been targeted to train entrepreneurial mind-set, for example, and entrepreneurship education similarly to train for business management. Today, the latter concept is becoming more common and can include both aspects. In addition, there have been other concerns in entrepreneurship education at the end of the 1990s – some researchers even pondered whether entrepreneurship can be taught at all. Fortunately, the discussion has later moved on to pedagogical and methodological issues.

It has become clear that entrepreneurship education has several objectives and scopes. On one hand, entrepreneurship education is needed for delivering explicit knowledge about entrepreneurship. On the other hand, its objective should be training for, through and in entrepreneurship so as to effect a profound
comprehension of the phenomenon. Thus, entrepreneurship education requires delivery of tacit or experiential knowledge as well. Additionally, the view that entrepreneurship education is fundamentally different than small business management has been emphasized in recent years.

Special courses in entrepreneurship education became more common in the 1980s. Thereafter some universities and business schools started programmes in entrepreneurship education as well. Research on these special programmes, both in Europe and in the USA, has revealed that the study methods are mainly traditional, such as lectures, business plans and case studies, but also that the main objective is still on training students to become entrepreneurs. The effectiveness of entrepreneurship education courses has also been researched recently. The conclusion of one such study found that the major function of entrepreneurship education has been to assist students’ career prospects, and therefore it has filled the expectations as well. But then again, another study showed that an entrepreneurship education programme had had negative impact on participants’ entrepreneurial competencies and intentions. Thus, the researchers concluded that the programme had been ineffective. However, both of the studies showed that the studied entrepreneurship education course and programme had been able to increase students’ awareness of the requirements of the entrepreneur and entrepreneurship, which was considered a positive result.

As a summation of the earlier research, it can be stated that entrepreneurship education is in need of renewal and mutual consensus amongst researchers. It is evident that there is still a need for common definitions and consensus regarding the objectives of entrepreneurship education. The effectiveness and productivity of entrepreneurship education presumes that diverse pedagogical methods are used in response to different learning situations, learning environments and target groups.

**Conclusions: strengths and weaknesses of the approaches from the viewpoint of the study**

Over the years, research on entrepreneurship has evolved and changed, which shows that researchers’ understanding of the phenomenon is mutable. As a result of new researchers in the field, entrepreneurship has become a multidisciplinary discipline, which emphasizes the importance of the research field as a whole. Researchers of entrepreneurship are not possessed solely by the business field or economics. The emerging circle of researchers has been able to bring to light new
views as well. This development is, on one hand, a positive implication of the significance of the field as a whole. But on the other hand, these new approaches lead to new challenges due to the different backgrounds of the researchers.

As stated earlier, the growing interest in the research field has not been able to resolve the conceptual differences. Ontological differences still exist and vary according to the researcher’s subject and personal interest. A positive development in that sense, however, is that entrepreneurship is no longer explained through the traits or characteristics of the actor. The most recent views offered by Alvarez and Barney (2010) as well as their consideration of opportunity creation theory can be considered particularly valuable, for this study also. The view can be justified because enactment and the behaviour of the entrepreneur in the entrepreneurship process provide new aspects on entrepreneurship education as well. Sarasvathy’s (2001) views on effectuation and causation have also been able to renew the comprehension of the entrepreneurial decision processes. Especially, the inclusion of elements such as personal skills and capabilities (or resources) and social networks is relevant and worth studying when seeking a path for renewing entrepreneurship education. Therefore, this approach has been included in the study with the assumption that it can open a new perspective on the practical applications.

Alongside interest in the field of entrepreneurship has grown a similar interest in entrepreneurship education. The same conceptual variety and diversity in that sector causes misunderstandings and interpretation differences likewise. There seems to be some kind of “language barrier” between researchers from different geographical regions (continental vs. Anglo-American). Therefore, it would be important to reach a conceptual consensus if possible. (Some such suggestions have been outlined in Fig. 3.) The research on entrepreneurship education has struggled especially earlier, with structural issues (e.g. the effectiveness of entrepreneurship programmes vs. special courses). One weakness, which can be interpreted as being caused by the researchers’ background, is that entrepreneurship education has typically been the domain of business studies. Therefore, studying and pondering the requirements of entrepreneurship education in other majors, such as engineering for instance, has been relegated to the background. Also, until recently, methodological issues have not been in the focus. Kyrö (cf. 2008), Fayolle and Gailly (2008), for instance, have raised interest in pedagogical views. A few studies about the benefits of action-based methods in entrepreneurship education have been published, but they rarely include in depth analysis of the actual reasons underlying such conclusions.
Therefore, it would be important to study through practical cases the actual effects of action-based learning in the context of entrepreneurship education.

**Applicability of the approaches to the research on entrepreneurship education**

A theoretical context based on the literature review is illustrated in Fig. 3. It emphasizes that entrepreneurship education is a multidisciplinary field which has intersections with psychology, education, economics and even sociology. In addition, in entrepreneurship education the main questions concern the content (what), target group (for whom) and pedagogic methods (how). As a result of a balanced process, entrepreneurship at different levels can be realized.

![Fig. 3. Theoretical context for entrepreneurship education.](image)

The most central approaches for this study, introduced earlier in this chapter, are the theories of opportunity creation and causation/effectuation. In addition, the view that entrepreneurship is a developing process consisting of the operations and relationships of different actors is relevant when considering the context depicted in Fig. 3. The applicability of the views of Alvarez and Barney on opportunity creation could be considered challenging due to the earlier research on entrepreneurship in which the possibility to teach opportunity creation, or
discovery, has been questioned. It seems that such scepticism is no longer that visible; and several researchers of entrepreneurship education have been able to overrule those suppositions. It is argued here that especially the development of the pedagogical aspects of entrepreneurship education has enabled an expansion of the understanding of entrepreneurial learning and its possibilities for training opportunity creation. Combining Sarasvathy’s theory of causation and effectuation with entrepreneurship education is considered so as to allow new approaches in that respect as well. Again, referring to Fig. 3, in entrepreneurship education it is necessary to be able to create a learning environment which permits adopting an entrepreneurial learning process that can be adjusted to the needs of different target groups.
3 Research methodology

The previous chapter contained the literature review to introduce the academic discussion on entrepreneurship and entrepreneurship education. The aim of this chapter is to outline the philosophical choices and approaches followed in this research. The challenge for each researcher is to comprehend the meaning of the academic discussion in the research field. The process of understanding requires that certain central concepts are defined and selected. Additionally, clarifying the theoretical basis of the research leads the whole research process towards choosing a research methodology suitable for the purposes of the researcher. The first part of this chapter describes the elements of the philosophy of science used throughout the research process. Thereafter, the focus is on specifying the philosophical and methodological choices in the field of entrepreneurship research to clarify the choice of the research method.

3.1 Research process and philosophical bases

The research process consists primarily of the choices the researcher has to make. The selection process starts with defining the phenomena and narrowing the research focus until the final phases of evaluation and publication of the research report. Philosophical decisions are essential and outline the entire research process, even though they are sometimes unconsciously made (see Hirsjärvi et al. 2009, Kyrö 2006b).

Entrepreneurship as a field of research can be categorized in the applied sciences and social sciences. It has links with several basic sciences such as mathematics, biology, psychology and sociology (see e.g. Bygrave 2007). Paradigm is a concept which gathers the philosophical bases for the phenomenon. The concept, first introduced by Kuhn to denote conceptual world-views, consists of an agreement on formal theories, classic experiments and trusted methods (Kuhn 1970, Kyrö 2005, Kyrö 2006b). Paradigms, on one hand, stand for the beliefs, values and techniques a community of researchers share. On the other hand, a community of researchers share the same paradigm, or what is legitimate as a research topic (cf. Neergaard & Ulhoi 2007).

The philosophical bases of the social sciences can be approached through four concepts: ontology, epistemology, human nature and methodology (see Burrell and Morgan 1979: 1–2). Researchers make implicit or explicit assumptions of ontology, the essence and nature of the phenomena.
Epistemological assumptions construct the grounds of knowledge of the phenomena – how to find and form an understanding of the phenomena so as to communicate it forward. Epistemology consists of three elements, or true beliefs, which can be defined as follows:

1. truth as a correspondence between proposition and actual situation
2. truth as coherence between proposition and a specified system of propositions
3. truth as a pragmatic cognitive value, meaning that knowledge is created through action (Kyrö 2003: 62, 2006b).

Additionally, the researcher makes assumptions concerning human nature and especially the relationship between human beings and their environment. All the assumptions have an impact on the methodological decisions of the research process (see Burrell and Morgan 1979: 1–2). Kyrö (2006b), on the other hand, defines that the philosophical bases consist of ontology, epistemology and axiology. The latter relates to value theories related to ontology as well as epistemology. Kyrö (2006b) also defines ontology as answering “what”, epistemology “how” and axiology “why” we learn entrepreneurship.

The objectives of research are interlinked with paradigm, cognitive interests and methodological choices. The cognitive interest of the research describes the way the individual expects to acquire the knowledge needed. Habermas (1974, Kyrö 2006b) has defined three categories of cognitive interest: technical, practical or hermeneutic, and emancipatory or critical. In addition, the researcher has to connect the arguments to the philosophical stance and logical reasoning. The stages of the research process and the research methodology assumptions of this research are illustrated in Figure 4.
Fig. 4. Research process.

In this research, entrepreneurship is ontologically seen as a processual phenomenon, which includes the view that entrepreneurship exists, changes and develops over time in the human being’s life-world. The paradigm is based on constructivism, which emphasizes the lived experiences of social actors (see Schwandt 1994). Thus, it can be challenging to follow the steps of Kuhn when he emphasizes the importance of trusted methods and classic experiments in doing research in normative sciences (Kuhn 1970, see also Kyrö 2005). Knowledge and truth are created, not discovered. As Cuba and Lincoln (1994) relate about ontology in constructivism: “Realities are apprehendable in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature…” The view of the researcher is that the human being’s life-world creates the framework for the actor to co-operate with others to renew the environment through his/her actions. Thus the approach is close to social constructivism, which emphasizes the role of social relationships in building knowledge and understanding; knowledge is socially constructed (see Schwandt 1994).

Epistemology, as said earlier, pertains to the grounds of knowledge, and how information can be acquired. According to Cuba and Lincoln (1994), epistemology in constructivism is transactional and subjectivist. “The investigator and the object of investigation are assumed to be interactively linked so that the ‘findings’ are literally created as the investigation proceeds.”

The ontological and epistemological bases lead to the philosophical and methodological decisions. Phenomenology is a philosophical approach whose
“...goal is to study the meanings of phenomena and human experiences in specific situations, and to try to capture and communicate these meanings in empathetic and lucid ways”. (Berglund 2007). Phenomenology can be seen as a way which allows researchers to approach entrepreneurship through the everyday experiences of entrepreneurs, a way in which situations are opened to interpretation: it is “…in our capacity to understand and find meaning in other people’s stories and experiences”. (Berglund 2007). Moustakas (1994: 41) has outlined phenomenology as “the first method of knowledge because it begins with ‘things themselves’; it is also the final court of appeal.” Thus, Moustakas, when referring to the transcendental phenomenology of Husserl, emphasizes the need to set aside prejudgments and presuppositions to reach a transcendental state of freshness and openness. The aim of philosophers scientists such as Dilthey, later also Husserl and Heidegger who presented phenomenology was to underline the differences between the natural sciences and human sciences (see Van Manen 1990: 3, Berglund 2007). “We explain nature, but human life we must understand, said Dilthey (1976).” (Van Manen 1990:4). Phenomenology offers an approach which can (and interpret; cf. Van Manen 1990: 26) the different aspects of entrepreneurship experienced by entrepreneurs (or students, for instance) and can utilize them in developing new views for entrepreneurship education.

The chosen phenomenological approach is supported by cognitive interest, which in this research is hermeneutics – the aim is to understand and interpret the phenomena. The aim in hermeneutics is not to avoid misunderstanding the unknown phenomena, but understanding and lived experiences are needed to make the unknown (or alien, cf. Gadamer 1976) familiar and enrich our life-world. Additionally, the goal is to find consensus between the research material, the researcher and the theoretical framework, as described in Fig. 5 (hermeneutic circle). Hermeneutic phenomenology is interested in the human world as it is found and experienced, and in situations also (see Van Manen 1990:18). “To do hermeneutic phenomenology is to attempt to accomplish the impossible: to construct a full interpretative description of some aspect of the life-world, and yet to explicate that the lived life is always more complex than any explication of meaning can reveal.” (Van Manen 1990:18). In researching entrepreneurship and education, the focus is on the human being or the actor: how he/she experiences and interprets the phenomena in different situations. From a theoretical point of view, the interpretation of the researcher is in focus when translating lived experiences into pedagogical theory, concepts and methods.
The logical reasoning in this research adheres to the concept of abduction, which should be used throughout the entire research process (see Van Maanen et al. 2007). Abduction, or abductive reasoning, has been linked with the logic of discovery (Kyrö 2003: 74). The researcher can use abduction when he/she is observing a surprising event and to clarify the causes behind the event. Abduction can also be seen as a process of working back from an observed event to a probable antecedent (Teddlie & Tashakkori 2009: 89). Abductive reasoning combines practical thinking and operations with the processes of logical reasoning (Kyrö 2003: 74). In this research, inductive reasoning is utilized with logical reasoning when analysing the status quo of entrepreneurship education in the regional context of this research. Thereafter, the phenomenon is researched through deduction by intensifying the understanding of the general theories of entrepreneurship and education. In the concluding part of the research, the circle is closed by creating a practical-oriented framework for entrepreneurship education which might be adopted in regional engineering education.

### 3.2 Research strategy and data collection

As defined in the first part of this chapter, the hermeneutic phenomenological is the philosophical approach chosen for this research. This choice leads to the research being conducting as qualitative research, which allows studying the
phenomena in its natural settings. Qualitative research also enables the use of various data collection methods such as case study, interviews, and personal experience, for instance. In addition, research in entrepreneurship requires and benefits from rich empirical material (Denzin & Lincoln 1994, Neergaard & Ulhoi 2007). Choosing case study as a method in this research is predicated on two reasons. Firstly, case study method is suitable when studying a phenomenon in its real life setting, as is the case in essays I and IV. Secondly, the case study method assists the researcher in finding the common and special features of a phenomenon via experiential knowledge of the case, which in this research is the engineering education at KTUAS.

This research comprises of four essays; two of them are conceptual and two empirical. The research strategy of the empirical essays is based on the case study method. Case study is an empirical inquiry which studies a contemporary phenomenon within its real-life context and in which the boundaries between the phenomenon and the context are not clearly evident (Yin 2003: 13). Yin (2003: 15) categorizes the case study as useful for a number of purposes:

- to explain presumed causal links to real-life interventions
- to describe an intervention and its real-life context
- to illustrate certain topics within an evaluation
- to explore an intervention which has no clear outcomes
- to make an meta-evaluation (a study of an evaluation study)

Yin points out that the case study should be seen as a research strategy which necessitates that the researcher follows the research protocol systematically. He also sees that the motives for using a case study can be manifold, ranging from presentation of a single case to arriving at broad generalizations about various cases. Similarly, Stake (1995, 2005) views the case study as rather like a research method and emphasizes studying a single case: “By whatever methods, we choose to study the case.” When using the case study as a method, the researcher’s aim is to find what is common as well as what is particular about the case – generalizations can be difficult according to Stake (1995). The reason for using a case study is that it enables the building up a theory based on rich empirical descriptions; especially when using multiple cases, replication is also possible (Eisenhardt and Graebner 2007). The case study “... allows [the researcher] to study complexity, context, ambiguity and chaos”, as Gummeson (2007) has described it. Eisenhardt (1989) states that the focus of the case study is on understanding the dynamics present within single settings. A case study enables
utilization of different data collection methods such as interview, archives and questionnaires (Eisenhardt 1989; see also Yin 2005, Stake 1995). The number of cases, or sampling, varies from a single case to multiple case studies. Miles and Huberman (1994: 28) recommend using a maximum variation strategy, which means looking for outlier cases to recognize the main patterns, to exemplify the findings. Entrepreneurship is a complex phenomenon, as can be seen from the literature review in Chapter 2. It is assumed the using the case study research strategy will benefit understanding and developing the phenomenon for the purposes of entrepreneurship education.

Various data collection methods have been used as part of the research strategy as well. For the first essay, representatives of different stakeholders have been interviewed. The interviews form a primary source of information. These semi-structured interviews were carried out in three Nordic countries and the data was analysed and cross-analysed before making conclusions. The Finnish material consists of 14 interviews, conducted in January and February 2009. The stakeholder interviewees represented six target groups, which were chosen on the basis of a decision made among the project partners. In each partner organisation the interviews were conducted according to the same protocol. The Finnish target groups represented stakeholders of engineering education. Each interview took 1.5 to 2 hours. The interviewer posed the semi-structured questions, and thereafter, the interviewees were allowed to reply and, if needed, ask additional questions. The answers were immediately documented using a template. After the interviews, all the documents were written down for analysis according to the same protocol. Thereafter, all the answers were collated in a common document following the themes of the interview template. Finally, the common document was used for comparing the replies of each interviewee to determine similarities and differences between stakeholder views. Appendices 1 and 2 of the essay I include a listing of the interviewed organisations and the template used in the interviews. In addition, official documents, curricula and web-pages have been used as a secondary source of information. That information was used for defining the objectives and strategic goals of the studied stakeholder organisations.

For the fourth essay, the case study analysis is based on company interviews and diaries kept by the company representatives. The four target companies were chosen to use the replication logic typical for multiple case studies, to find confirmation for analysing and extending the theory. The main principle in choosing the cases was that they are in close co-operation (either through development projects and/or employing graduates, for instance) with engineering
education. At the time of research, there were four companies meeting the prerequisites, and all of them were chosen as cases. Thus, triangulation is used on the basis of multiple data collection methods for creating the fourth essay. Triangulation is commonly understood as the use of differing methods (quantitative and qualitative; cf. Bryman 2008) for cross-validation of research data. In addition, triangulation can mean usage of different data sources, and different investigators or theories as well (cf. Jick 1983, Janesick 1994). For collecting material about the establishment process of the interviewed companies, one or two representatives (owners and/or shareholders) were interviewed using the same template (model included in essay IV). The interviews were simultaneously documented and later all the interview material was written down for analysis. Each interview document covered the themes of the interview. As part of the case analysis and cross-case analysis, each document was read several times for the purpose of making conclusions based on the material as well as for comparing each process with the framework described in essay IV. Additionally, the interview material was analysed for to determine features linked with features of causation and effectuation (see essay IV). Additional material about the decision processes in the target companies was collected via diaries. The owner-representative of the company kept a diary for one month in the spring of 2009. The diaries were written down for analysis using the same template. Thereafter, the documents were analysed by comparing their contents with the features of causation and effectuation specified in essay IV.

When using the case study method, the reliability of the study (i.e. evaluating the data collection procedures) requires that the study is repeatable with the same results (Yin 2003: 34). Data collection can be evidenced through the case study protocol or by developing a case study database. In this study, the reliability is based on using a case study protocol, meaning that all the stakeholder interviews (essay I) followed the same procedure in the later analysing process as well. A database has been created of all the material, that is, the case study notes. Triangulation is used to validate the credibility of the conclusions described in essay IV. Thus, the case study data base consists of interviews notes and diary material.
4 Summary of essays

4.1 Essay I: Sources of inspiration for continued improvements in entrepreneurship education: A case from Norway, Sweden and Finland

The purpose of the first essay is to compare the ways entrepreneurship education are interpreted and conducted in three northern Scandinavian HEIs (Bodø Business College – HHB, Luleå Technical University – LTU and Kemi-Tornio University of Applied Sciences – KTUAS). Additionally, the essay studies how the existing education is responding to the stakeholders’ expectations regarding specifying the need for improvements. On the basis of the study the essay is aims to ponder what the participating HEIs could learn from each other as well as transferable knowledge in entrepreneurship education.

The universities involved are all multidisciplinary and have studied the issue via different fields of education. The Norwegian HEI included its business school in the study, the Swedish HEI included its teacher education, and the Finnish HEI studied stakeholder expectations regarding engineering education. The research material consists of case studies representing different stakeholder groups in the target countries. The chosen stakeholder groups represented government, municipality, industrial organisations, development agencies, teachers and students. All the semi-structured interviews were conducted in spring 2009. The interview template consisted of several themes, a few of which are analysed in the essay (see Appendix 1 of the essay I).

For determining the sources of insight, two examples of each university’s offerings in entrepreneurship education have been introduced. HHB offers a 30 ECTS course in its BSc programme in business administration, with the aim that the students learn how to establish their own company. In addition, the HEI offers a specialization MSc programme in entrepreneurship (120 ECTS). LTU offers two courses. The first one is a 7.5 ECTS course which is open to students in all disciplines and education programmes. The second course (7.5 ECTS) is offered to all students interested in entrepreneurship as a phenomenon, particularly those interested in entrepreneurial learning and education. KTUAS annually arranges a 3 ECTS InnoMaraton which is open for all the students at the HEI. The aim of the course is to enable students to participate in a co-operational project operating on a real assignment. The second course is a 12 ECTS project which aims at training
students for project-based working life, entrepreneurial behaviour and designing actual technical products.

The interviews showed that on one hand some of the stakeholders share similar views and expectations. The government in each country has a broader definition for entrepreneurship than other stakeholders, one which emphasizes the importance of new enterprises but also the need for supporting entrepreneurial behaviour and skills in society in general. This view is reflected also in their expectations of entrepreneurship education. On a municipality-level, the expectations are more on the short-term effects of education, this is new companies. In each country on one hand industry values intrapreneurship but on the other small business organisations have more practice-oriented expectations. Additionally, industry seems to expect “Learning by doing” education in projects, for instance, to prepare students for risk taking. In particular, contacts with business life in various forms are expected of engineering education.

Teachers and students both defined that the role of entrepreneurship education is to train students for working life. Teachers interpret entrepreneurship education as aiming to develop entrepreneurial behaviour and skills but also as expanding the student’s understanding of the importance of entrepreneurship in general. Students, especially in engineering education, expected that entrepreneurship education trains students to be an entrepreneur.

As a conclusion, it can be said that HHB mainly concentrates on educating about entrepreneurship in economic terms, whereas LTU emphasizes entrepreneurship education’s role in training for entrepreneurship and offering students the tools for shaping their future. KTUAS, on the other hand, trains – on the basis of the two examples – mainly for and partly through entrepreneurship. It can be concluded that the three HEIs can learn from each other regarding entrepreneurship education. Additionally, there is still a need to specify the concepts and definitions in the studied field. Also, due to the differences in stakeholder expectations, each HEI needs to select which expectations can be met and develop its offerings accordingly.

4.2 Essay II: The role of action-based learning methods in entrepreneurship education

The second essay is a conceptual paper aimed at searching for new pedagogical aspects on entrepreneurship education. The research effort and interest in entrepreneurship education has been growing continuously during the last two
decades. Regardless of this trend, the number of new enterprises and graduates’ entrepreneurial activity has been fairly low. Therefore, there seems to be a need for new offerings in the field. Thus, the paper approaches these challenges through pondering whether the possibilities of action-based learning methods have been effectively exploited yet. The concept action-based learning methods covers various learning methods such as problem-based learning (PBL), project-based learning and enquiry-based learning (EBL), for instance. The paper offers new views on entrepreneurship education and action-based learning by means of the expansive learning theory, which was originally developed for studying organisations.

Entrepreneurship education as a field of research is engaged with two fields of science: entrepreneurship and education. Learning can be seen as a co-operational process which includes the operations of teachers and learners/students. On the other hand, building the basis for analysing the benefits of action-based learning methods can be assisted by familiarization with the development of learning paradigms. It can be argued that action-based learning methods are grounded on constructivism and socio-constructivism, which emphasize the role of the active learner. But, as mentioned earlier, learning is a co-operational process with (at least) two participants. A productive and successful learning process requires supporting and facilitating tutoring and teaching as well. The same also concerns entrepreneurship education.

Learning can be considered a chaotic event with situational factors forcing the participants to co-operate, communicate and reflect during the process. Engestöm’s expansive learning theory, even though constructed for understanding human actions in organisations, can open new views for recognizing the features, requirements and potential of action-based learning as well. Therefore, the paper develops an expansive entrepreneurship education model. In addition, the expansive learning theory has been compared with Kolb’s commonly referenced theory of experiential learning.

During the 20-year-history of action-based learning methods, their variety has expanded with the advent of new concepts and views. PBL was the first action-based method which was systematically developed and adapted for various learning environments varying from medical education to engineering education. Project-based learning, on the other hand, has also been considered useful in training graduates for team- and project-based working life. The most recent example is EBL, which aims to utilize all other action-based methods in order to create and maintain learners’ innate curiosity for learning.
As stated in the essay, action-based learning methods, using PBL as an example, can bring about various effects which assist entrepreneurial behaviour as well. PBL can train learners to adapt themselves to different situations, such as simulating decision-making processes, and learning risk taking and creativity, for instance. In addition, by including continuous reflection in the learning activities, in accordance with the methods of PBL, the learner is forced to continuously evaluate both the explicit and, especially, the implicit knowledge. Hence, the aims of entrepreneurship education are targeted as well.

### 4.3 Essay III: Effectuation and causation in entrepreneurship education

The aim of essay III is on one hand to approach entrepreneurship education through proposing effectuation as a tool for possible futures. On the other hand, causation is interpreted as an approach for delivering relevant knowledge needed in the creation of entrepreneurial opportunities. In addition, effectuation in entrepreneurship education has been introduced as a new pedagogic view and as an advocator of creativity required for opportunity creation. As a result, a model in which effectuation could be systematically used together with causation in entrepreneurship education is proposed.

Entrepreneurship education has a history of about two decades and its importance is widely recognized nowadays. Despite this fact, it poses some challenges. Firstly, the level of entrepreneurial activity and interest in entrepreneurship education among higher education students is rather low. In practice, students can be educated towards entrepreneurship – information about entrepreneurship is available – but they are not motivated to use it for building their career. Secondly, the business environment is very turbulent today, and therefore it is increasingly difficult to predict future events. As a result, the general causation-based approach in entrepreneurship education is not sufficient to meet the competence requirements entailed by the prevailing circumstances.

It is argued in the essay that entrepreneurship education is not only a pedagogical issue but also an ontological and epistemological issue about how to approach the creative and constructive behaviour of human beings in truly uncertain business environments. It seems to be typical to approach entrepreneurship as a linear phenomenon consisting of causal relationships. On the other hand, despite the effort put into researching entrepreneurship, it is difficult still to deliver an understanding of why, where and how entrepreneurship
emerges. Therefore, because entrepreneurship is considered to be a multi-layered phenomenon consisting of transformable events, learning and understanding, the subject requires processual pedagogical methods.

Ontologically, entrepreneurship can be defined as the creation of business opportunities – it is a process in which the entrepreneur combines ideas and actions to reach the goals that emerge through the process. However, entrepreneurship is related not only to small business and business ownership but also to other sectors of society as well; actually, it is context free. Thus, entrepreneurship, as emphasized in this essay, is present in all organisations despite their field of operations or line of business. Hence, it appears in companies, development projects, and in public sector organisations.

Traditionally, especially in management theories, entrepreneurship has been viewed as a causation-based process using logic of prediction. The latest research has shown, however, that entrepreneurship is also an event-based phenomenon, especially with respect to available resources. Entrepreneurs are continually adjusting their actions on the basis of their available means and ability to take affordable risks. Therefore, entrepreneurs’ future actions depend on their ability to build up networks and create confidence with stakeholders. Thus, they rather aim to control their future than to predict it. As is argued in the essay, entrepreneurship education should be renewed to better respond to present, genuine entrepreneurship. The change could also open new possibilities for developing students’ entrepreneurial behaviour and mind-set.

As the essay proposes, a new effectuation-based entrepreneurship education framework is needed. Supported by different processual pedagogical methods, the framework can prepare the students to act entrepreneurially in different environments, events and circumstances. With the assistance of such a framework, the student is better able to envision the composition of the means needed in genuine entrepreneurship: social networks, cognitive abilities and entrepreneurial activities.

4.4 Essay IV: Effectuation or causation: understanding entrepreneurial processes in small companies – A case study in technology-based firms

Essay 4 is an empirical paper whose aim is to analyse entrepreneurial decision-making processes in technology-based companies. In addition, the focus is on determining how the studied companies operate with respect to causation and
effectuation. Furthermore, the paper studies entrepreneurial opportunity recognition from a similar angle in order to compose a framework for entrepreneurship education, especially with regards to engineering education. The need for the study, on one hand, comes from the low entrepreneurial activity of engineering graduates, and, on the other hand, from the decreasing number of technology-based companies in the target region.

The theoretical framework of the paper consists of analysing Sarasvathy’s theories of causation and effectuation. Causation is defined as depending on the logic of prediction, when the entrepreneur’s decisions are based on collecting information. Effectuation, on the other hand, uses the logic of control, which means that the entrepreneur attempts to increase his/her awareness of the available means before making decisions. In addition, the paper emphasizes the processual nature of entrepreneurship, which entails not only innovative individuals but also a supportive environment for creating new value.

The research strategy of the paper is based on the case study method due to the aim of comprehending the target companies in their real-life contexts. The case companies are situated in the Digipolis technology park. They were selected on two grounds. Firstly, all of the companies are actively co-operating – either in research projects and/or employing engineering graduates – with the engineering education of Kemi-Tornio University of Applied Sciences. Secondly, the line of business of all the companies is based on utilizing different fields of technology. All companies meeting the selection requirements, four companies in total, were studied by interviewing company representatives and by analysing weekly diaries.

The collected data was analysed and cross-analysed. The data revealed both types of the decision-making processes (causation and effectuation) were used in the studied companies. The results showed that most of the companies used effectuation in their establishment processes. This could be the result of the previous entrepreneurial experiences of the founders; some level of entrepreneurial expertise existed and supported the awareness and utility of available means needed in the establishment process. Furthermore, during the business operations, most of the case companies used both decision-making approaches. Another interesting result was that most of the case companies emphasized the role of the operational environment in their development. The co-operation with the local engineering education was considered relevant for their existence. It is also worth noting that all the companies are either premised on utilizing information technology or rely on employing engineering graduates who have joined co-operative projects during their education.
The conclusions of the paper argue that there is a demand for renewing entrepreneurship education in engineering education. The argument can be justified on the findings of the case companies. All of the companies seemed to primarily use effectuation in their establishing activities and daily operations. The sample case companies, which formed the entire available research group at the time the research material was collected, confirmed that entrepreneurial activities cannot be based only on causation and the logic of prediction. It can be claimed that using causation methods is more common in entrepreneurship education and in engineering education as well. Therefore, the paper calls for a wider renewal process towards actual pedagogical solutions in the curriculum development of engineering education.
5 Discussion

In the previous chapter, all the essays forming the basis of this research work have been summarized. On the grounds of the essays, a new model and framework for entrepreneurship education will be outlined in this chapter. During this study, the notion that entrepreneurship education should enhance the abilities of opportunity creation is “the missing link”. Hence, it is necessary to describe the need for the renewal process and the underlying elements. This discussion section concentrates first on opening the general framework of engineering education. Thereafter, the suggested model is outlined to specify the direction of development work.

The Finnish engineering education at the Bachelor’s level has faced many changes during its existence. The most recent changes were the establishment of polytechnics (today universities of applied sciences) in the 1990s when the former technical institutes were integrated into the higher education system, a move which the Bologna Process furthered and finalized in 2005. As a result of the process, the Finnish higher education system continues as a dual system with universities and universities of applied sciences. The Finnish Bologna Process was a continuation of the renewal of the European higher education system started in 1999 in Bologna (cf. Arene 2007). Together with the international change factors, the national context of education was renewed as well. In practice, this enabled universities of applied sciences and fields of education to define the contents and focus of their curricula quite freely.

There have also been other general change trends which have affected engineering education. Examples of these trends are globalization and increasing competition amongst graduates, multidisciplinarity between technologies, increasing importance of networking between people and business, and the appreciation of expertise (cf. Korhonen-Yrjänheikki et al. 2007, Uhomoibhi 2009). The requirements of lifelong learning and student-centred learning are challenges to the renewal of education and pedagogy (cf. Leuven Communiqué 2009, Commission of the European Communities 2006). It can also be stated that the competence requirements have changed – or expanded – as a consequence of these changes. All polytechnic graduates should attain generic competencies such as learning competence, ethical competence, communicative and social competence, development competence, organisational and societal competence, and internationalization competence (cf. Arene 2007). These generic competencies form only a part of the competencies and skills needed in
engineering. Representatives of Finnish business world (see EK 2009) expect that future engineers have, in addition to strong knowledge in engineering and natural sciences, better competencies in entrepreneurship as well. Korhonen-Yrjänheikki (2009) has noted that the status of the 20th-century engineer was that of a formal profession based on information power, but the 21st century engineer’s status is founded on individual profession and learning power. In this study, attaining such learning power is defined as an important part of the suggested framework.

Several attempts at reining engineering education have been made worldwide since the 1990s when the development network CDIO for engineering education (CDIO, an abbreviation of conceive, design, implement, and operate) was established. The network was established to address the general trend of decreasing interest in engineering education but also with the aim of enhancing the competencies of engineering graduates (see Crawley et al. 2007). The CDIO network has stated that its initiative is to train students to be able to: “1. Master a deeper working knowledge of technical fundamentals, 2. Lead in the creation and operation of new products, processes, and systems, and 3. Understand the importance and strategic impact of research and technological development on society.” (Crawley et al. 2007; see also www.cdio.org). The underlying goal is to renew the content and context of education with an aim towards activating learning methods. One of the main aims is to develop students’ CDIO skills, which include such elements as personal and professional skills and attitudes (creativity, critical thinking, for instance) and interpersonal skills (teamwork and communication). It can be interpreted that the goals of the development process are congruent with the development of entrepreneurial behaviour (cf. Kirby 2007, Kyrö & Carrier 2005), and thus are relevant for this research as well. Teaching theories through lectures has been found to be an ineffective way of developing entrepreneurial behaviour, as Heinonen and Poikkijoki (2006) have concluded.

The above paragraphs have outlined the requirements and needs for the new approach from the global standpoints. In order to strengthen the foundation of the new educational model, it is important to comprehend local views as well. Therefore, for this study a number of local stakeholders have been interviewed, as described earlier. On the basis of the interviews summarized in essay I, the engineering graduates should have an entrepreneurial mind-set, behaviour and skills, but should also understand the importance of entrepreneurship with regards to society. On the other hand, the region in particular expects that the education is able to have a positive impact on entrepreneurial activity, verifiable by such things as a higher number of start-ups. In entrepreneurship education, from the
student’s point of view, understanding the phenomena of entrepreneurship depends on one hand on knowledge but even more on situational elements: how, when and where the phenomena is to be studied. Hence, the challenge for entrepreneurship education is how to create a framework which supports entrepreneurial opportunity creation and recognition (see also Rae 2003, Marvel & Lumpkin 2007, and Shane 2003, who all share the same concern).

Entrepreneurship education in non-business studies can still be very fragmented and distributed. The main focus is on delivering explicit knowledge from the perspectives of the different disciplines which study the phenomenon. Therefore, it can be argued that the main focus invariably seems to be on delivering information and talking about entrepreneurship. Several researchers, such as Gibb (2002), Kuratko (2005), Rae (2000), Solomon et al. (2002) and Kyrö (2008), have expressed the need to renew entrepreneurship education and make it more creative. Additionally, education in the field of entrepreneurship is usually conducted in small units, courses, and supplementary, with only a part of the curriculum being dedicated to the subject, as can be seen from the curricula of engineering degree programmes. Students in engineering education are usually trained to operate in industrial organisations, e.g. for middle management, as can be interpreted from the curricula. Therefore, the arranged courses concentrate mainly on covering skills needed in business management; only a few of them support the aims of genuine entrepreneurship. On the other hand, some special courses or projects can be arranged as occasional events to emphasize the importance of the subject. Unfortunately, alone they are not able to evoke good and long-lasting effects. These conclusions are based on the research material collected for essay I. Thus, it can be claimed that long-term entrepreneurship education is not realized, and therefore that there is need to outline a new, creative framework for training entrepreneurship in engineering education.

The framework should be constructed on three concepts dimensions: embedded education, effectuation and enquiry-based learning. Part of the suggested entrepreneurship education framework for engineering education is outlined in the model introduced in essay III, i.e. holistic effectuation-based entrepreneurship education. The aim of the framework is to operate on three levels of entrepreneurship education: for, in/through and about entrepreneurship. It is important to note that the main focus is not merely concentrating on explicit knowledge about entrepreneurship but rather offering a systematic approach for educating students for opportunity creation as well. Thus, the learning process and environment includes not only students and teachers but also other actors.
Learning entrepreneurship is understood as a process in which transferring tacit knowledge in a social network is focal.

Some trials tracks towards embedding entrepreneurship or enterprise in science and technology studies have been conducted in the UK. In such experiments, enterprise was embedded in the existing subject-specific modules of the degree. The aim was to make students develop their skills continuously and see enterprise as a relevant field for their studies. The findings concluded that enterprise learning has assisted students in developing self-efficacy, confidence and taking responsibility for their future (see Handscomb et al. 2008). There have been other studies examining how to embed entrepreneurship and enterprise in curricula at research-led universities as well (see Smith 2008). In these studies, embedded entrepreneurship education is present throughout the entire degree programme. This means that entrepreneurship education is built into all the subjects and modules in the curriculum of the degree programme. Embedding, in this case, not only means contentual solutions but also pedagogic methods as well. The new approach entails planning the whole education from the aspects of working and business life and not only from the perspective of technology. In designing the curriculum, study modules and course contents, the objectives of entrepreneurship education are present continuously. On a practical level, the embedded entrepreneurship education leads to a curriculum in which entrepreneurship is approached from all different angles: for, in/through and about. Thus, curriculum development is a central part of the process, and therefore different expertise is needed.

The second dimension is based on effectuation. In practice, this means increasing students’ awareness of their available means, which include personal capabilities, social network, hobbies, and work experience, for instance. Awareness of personal capabilities is a way of thinking that needs to be sparked and supported by way of including such study methods in the first semester of the engineering education. Skills at building social networks are enabled through collaborative learning methods, such as teamwork in study projects. In addition, instruction about opening and forming networks needs to be included in the study arrangements. Again, practical co-operation with the operational environment of a university of applied sciences can be of assistance. The possibilities of the learning environment, the research laboratories for instance, need to be utilized effectively. Additionally, effectuation includes the idea that students should understand how to use their means (personal skills and abilities, social networks,
for instance) with which they can control the expected result. The challenge for teachers is in organizing learning events which can enable effectuation. On the other hand, the entire organisation has to accept and support education predicated on effectuation. Therefore, it is necessary to realize that the concept “learning environment” includes the surroundings of the educational organisation, and even society as a whole. As essay III shows, entrepreneurship is about change and creation of opportunities in fluctuating circumstances. Sarasvathy’s views on effectuation (cf. 2001, 2008) highlight the entrepreneur’s need to be able to manage unknown elements and results, and to use available means flexibly. Respectively, it is argued in essay III that effectuation-based entrepreneurship education using processual pedagogical methods could enable the same results: training the students for managing change throughout their education, as well as utilizing available means and creating social networks (cf. Sarasvathy 2003). Additionally, the empirical essay IV emphasizes the importance of effectuation in entrepreneurship education. As the research material shows, technology-based firms mainly use effectuation in their establishment and decision processes, and daily operations. The activities of expert entrepreneurs supported the findings of Sarasvathy (2008), and the importance of effectuation in the training of engineering students.

The third dimension of the framework is the enquiry-based learning method. As described in essay II, the enquiry-based learning method (EBL) is an action-based learning method emphasizing student participation in the learning process (and enactment; see also Johannisson 2002). EBL, as well as other action-based learning methods, is founded on constructivist learning theory, and even on socio-constructivist theories. On the other hand, EBL can be described as an umbrella term for several action-based learning methods. Therefore, it provides utilization of several different methods (later called learning tools) such as project-based learning, case studies, learning camps and even elements of problem-based learning. Additionally, the benefit of EBL is that it includes the important aspect of maintaining student interest throughout the learning process by enabling usage of varying learning tools in different learning situations (or subjects) and thus nourishing students’ innate curiosity. Besides, including reflection in the learning events in order to evaluate their success challenges the students to participate and take responsibility as well. It can be argued that EBL contains several benefits of action-based learning methods which can positively affect the students’ entrepreneurial behaviour and mind-set (cf. Solomon et al. 2002, Hytti & O’Gorman 2004, Rasmussen & Sörheim 2006, Fayolle & Gailly 2008, Kyrö
Action-based learning methods commonly exploit teamwork, communication and collaboration. Therefore, students learn both horizontally from other student teams, for instance, and vertically from other team members. This view is supported by the expansive learning theory of Engeström, which is introduced in essay II. Impulses from the different aspects can expand the students’ way of thinking and understanding – learning from each other is relevant as well. Continuous reflection in and on action strengthens the learning event. The whole framework is outlined in Fig. 6.

Fig. 6. Framework for effectual entrepreneurship education in engineering.

The aim of the framework is, on one hand, to have a general effect on students’ entrepreneurial behaviour and mind-set. On a practical level, it is assumed that this can be attained through entrepreneurial learning with pedagogical solutions based on EBL, and by using effectuation in education. On the other hand, increasing students’ awareness of entrepreneurial opportunities, or their abilities to create and exploit them, is targeted through effectuation by using EBL and allocated entrepreneurship education. Both aspects of entrepreneurship education can be promoted by embedding entrepreneurship throughout the education. The proposed education renewals would entail several other actions. Firstly, the
curriculum of each degree programme needs to be reformed structurally and contentually. Secondly, the learning environment should be renewed as depicted in Fig. 7. Thirdly, the educational arrangements need to be re-organised as well, as suggested in Fig. 8.

Fig. 7. Learning environment organisation.

Fig. 8. Learning team participants.
In Fig. 7, the two main functions of the organisation operate in a matrix. The aim is to create learning environments on the basis of the laboratories and the chosen strategic competence fields of the HEI. Due to the matrix structure, different fields of research and degree programmes operate together to form natural co-operational networks for the students. The combination of the participants varies according to the different situations. Intensive co-operation through common premises enables the building of more intensive contact between the different operators. Hence, activities in research and education are continuously collaborating – the project and laboratory environment creates a natural setting for using EBL as a teaching method. The main purpose of the organisational structure is to create an operational environment which supports action and enactment throughout the organisation. All the parties need to be involved in supporting the learning process – “territorial thinking” is replaced by joint responsibility.

To enable a student- and learning-centred way of working, it is necessary to operate in teams which consist of different actors, as depicted in Fig. 8. The focus of this structure is to create a system for expanding the network of individual teachers. By involving external business representatives and project managers and engineers who are primarily active external research projects, it is possible to approach the different study themes in a more comprehensive way. Additionally, this structure creates a natural path for intensifying co-operation with external stakeholders. The business representative could be replaced with a representative from a public organisation, for instance. The main purpose of this structure is to create a comprehensive, multi-skilled team of experts to support the entrepreneurial learning process. The different team members are equally able to contribute to the final result, a learning event for instance.

It is obvious that establishing a new educational framework is a demanding change process. The general setting for the education is specified in the curriculum, the renewing of which can be a challenging process as well. However, changing the attitudes and approaches to teaching and learning is even more challenging. Thus, all the involved participants need to be committed to the change process from the very outset. Teachers and other staff members need to be made aware of the benefits of the new framework, and be allowed to participate genuinely. In addition, the change process can be assisted by effective training and education, too. On an organisational level, it is essential to note that the participants have to be authorized to operate both financially and strategically. It
is probable that the change process requires re-evaluation of the strategies and the established ways of action.

Including studies on entrepreneurship, being and becoming an entrepreneur, can be arranged through pre-incubation processes. The purpose of the pre-incubation process is to operate as general incubators: to form a system for supporting the development and commercializing of a (business) idea (see Kirby 2004). The success of the pre-incubation process depends on timing. The first two years of studies in the degree programme are critical for developing a knowledge base in the subject substance field. The methods of entrepreneurial learning assist this process. It might be assumed that the student could join the pre-incubation process in the third year of studies. However, it is fundamental to the whole model that the development of entrepreneurial skills and behaviour is activated from the first study year. Pre-incubation will be an optional step for some of the students – the aim is not to force all the students to go through the same “format”. Recognizing individual goals and abilities is necessary for maintaining motivation and interest in learning; the main tenet of effectuation is thus followed as well.

Adopting the new framework could be the first step towards an entrepreneurial educational organisation – or university of applied sciences. An entrepreneurial university could be seen as a continuation of the Triple-Helix model, which emphasizes the interconnectedness and collaboration of education, technology and research, and region (see Etzkowitz 2002, Horvat 2009). The role and main function of an HEI is to support regional development through its operations. By adopting and embedding entrepreneurship in the entire education process, the HEI is able to activate regional development comprehensively.

The main advantages of the outlined effectual entrepreneurship education framework are manifold. The possibilities of comprehensively utilizing effectuation in entrepreneurship education have opened up a positive prospect for developing entrepreneurial behaviour, and later, entrepreneurship among engineering students. Additionally, earlier research and experiences on the benefits of action-based learning methods have brought about the practical tools for that purpose. On the other hand, the frustration caused by the present state and narrowness of entrepreneurship education has spurned a search for new approaches. It has become evident that entrepreneurship is an extremely demanding subject which requires the involvement of the entire organisation.
6 Conclusions and implications

This study has approached entrepreneurship education from three different angles in order to find a framework or model to be adopted in engineering education. The first angle is based on studying stakeholder expectations for forming the basis for curriculum renewal. The second angle has been searching for pedagogical methods suitable for supporting entrepreneurial behaviour. The third angle has concentrated on finding and developing a new approach grounded on effectuation. The need for the study is, on one hand, the low entrepreneurial activity among engineering graduates. On the other hand, there is demand for new technology-based companies in the region; economic fluctuations, for instance, have hindered the formation of new enterprises. It has become clear that the present education does not support graduates’ opportunity creation abilities. The purpose of this chapter is to summarize the contribution of this study, as well as to evaluate its limitations and collect implications for future research.

6.1 General conclusions

Entrepreneurship education is considered to have a vital role in economic growth and regional development. The European and national government as well as the regional administration emphasize its significance. It can be said that the function of entrepreneurship education is to develop human capital, enabling opportunity creation, recognition and exploitation, i.e. entrepreneurship. Learning entrepreneurship is a lifelong process; it can be seen as a competence which each individual needs. In spite of the consensus on the importance of the research field and the practical activities developed in different contexts, there is still demand for new ideas with respect to pedagogical methods and approaches.

The concept of entrepreneurship is vague and varies according to geographical regions and language districts. In addition, different languages offer a rich variety of expressions for defining the content and meaning of entrepreneurship. During the last twenty years, growing interest in entrepreneurship has given rise to new aspects on entrepreneurship, on the individual, economical and organisational level. The development of the research field has projected onto the research of entrepreneurship education as well. The role of HEIs has been found crucial in encouraging graduates towards opportunity creation. This view has been emphasized both on the governmental and European Union level. Thus, it can be interpreted that there is demand for new approaches.
Due to the conceptual variety, and to avoid misunderstandings, following the Finnish tradition, this research has interpreted entrepreneurship education as including on one hand education and training for developing entrepreneurial behaviour and mind-set. Thus, the focus is on developing individuals and their cognitive abilities to operate in different organisations and situations. On the other hand, entrepreneurship education also includes training students to act as a business-owner, i.e. as an entrepreneur. Operating as an entrepreneur does not, as some researchers have emphasized, require establishment of a new organisation. It can take place in existing organisations throughout society. From the standpoint of education, the challenge is in finding methods which suit training entrepreneurial individuals capable of operating in evolving environments. According to various researchers, it can be argued that the operational environment in general expects that graduates can collaborate, communicate and enact. Therefore, there is demand for utilizing the benefits of action-based learning methods.

An operational environment such as Digipolis technology park allows actual co-operation and establishment of collective learning between actors. It has been stated that an innovative milieu already exists there – the challenge is to intensify utilization of its potential and connect it more closely with the engineering education of the institution itself. The recent changes in the operational environment, the closing down of companies as an example, underline the need for a renewal of entrepreneurship education and engineering education as well. The findings of other studies confirm that only companies with local customers and commitments stay in the region.

Entrepreneurship is a processual and episodic phenomenon which changes over time. The development of the definition as such shows that entrepreneurship cannot be understood only by defining personal characteristics or features, using the individual perspective. Hence, the existence of entrepreneurship, creation of artefacts, requires active individuals and a supportive environment. This is also a challenge for entrepreneurship education. Fortunately, most modern researchers agree that entrepreneurship can be taught – questioning this was a part of a transition phase in researching entrepreneurship, i.e. from teaching about entrepreneurship to teaching for, in and through entrepreneurship. Thus, a new understanding of entrepreneurial learning and development of pedagogic methods has made it possible to include entrepreneurship as a general societal competence.
6.2 Evaluation of contribution

The contribution of this study is grounded on three elements. The first element consists of opening the role of action-based learning methods with respect to entrepreneurship education. Despite the long history of action-based learning methods, PBL for instance, their applicability in entrepreneurship education has not been studied extensively. Action-based learning methods emphasizing the participation of the student in the learning process and construction of his/her own knowledge and understanding are in line with the objectives of entrepreneurship education. Learning by doing and enactment are pertinent to the success as well. In addition, the study suggests that the expansive learning theory of Engeström (2001, 2004), by emphasizing the role of continuous reflection and collaborative learning, confirms the benefits of action-based learning methods.

The second element is based on uncovering the benefits effectuation can represent for entrepreneurship education by preparing graduates for episodic and uncertain futures. Due to the changing operational environment, it is difficult to predict future events by following the decision process of causation. Companies as well as individuals have to adopt new ways of operating, and build up social networks for successfully managing different situations. Thus, there is a need for effectuation-based entrepreneurship education, which has been outlined as a holistic framework. Even though new methods and approaches – the opportunity-centred learning of Rae (2003) and entrepreneurial-directed approach of Heinonen (2007), for instance – have already been developed, combining effectuation comprehensively with entrepreneurship education is a not very common solution.

The third contributing element is related to utilizing the two previous elements. Thus, a new framework for entrepreneurship education in engineering education is outlined on their grounds. The model is constituted of three concepts: embedded education, effectuation and EBL. The benefit of this model is that its background is in researching the expectations of the stakeholders – the purpose has been to meet the demands of the region. Secondly, the model has been created for non-business studies and engineering studies especially. During the research (and long work experience as a teacher), it has become evident that learning entrepreneurship calls for long-term, comprehensive renewal of the learning and teaching processes in engineering education. The new model, which is based on embedding entrepreneurship throughout the education and on using effectuation as a learning approach and EBL as one action-based learning method, argues that
by adopting these principles it is possible to establish an entrepreneurship education which also lowers the threshold for becoming an entrepreneur. Additionally, the model outlines an extensive organisational renewal process which, if carried out, could serve as a pathway to an entrepreneurial university of applied sciences.

6.3 Limitations

The limitations of this study are approached by assessing on one hand the used study methods and research design, and on the other hand the contents and results. The study methods and research design are contrasted on the basis of the trustworthiness of using constructivist paradigm and qualitative study methods.

The trustworthiness of constructivist, and interpretative, paradigms can be evaluated by four criteria: credibility, transferability, dependability and confirmability (cf. Teddlie & Tashakkori 2009: 296, Cuba and Lincoln 1994: 13, Wigren 2007). Credibility depends on the correspondence between the participants’ views and the researcher’s ability to delineate them. Transferability exists when the results can be transferred to another research setting to make generalizations. Dependability includes evaluation of the dependability between the researcher and the research process, i.e. showing that the research process is logical, traceable and well documented. Confirmability links the reached results with the findings of previous research and confirms that they are not based on the researcher’s imagination. In traditional and quantitative research, the evaluation criteria are categorized differently (see Yin 2003: 34, Wigren 2007, Teddlie & Tashakkori 2009).

Firstly, internal validity, which is not suitable criteria for descriptive or exploratory studies, evaluates causal relationships between certain conditions and other conditions. Secondly, external validity evaluates the generalizability of the results. Thirdly, reliability (or construct validity, Yin 2003) describes the repeatability of the study operations or evaluates whether the correct operational measures for the studied concepts have been used. Fourthly, objectivity shows how well the research is able to represent the reality.

The empirical essays are composed of interview materials (essay I and IV) and diaries (essay IV). Thus, to strengthen the credibility of the results, triangulation of data collection methods has been used as well. To support the credibility of the results, the semi-structured interviews were based on a common template. The interviews were documented and transcribed according to the same format. Despite carefully conducting the interviews and documenting the answers,
it is always possible the inquirer and the interviewees have different meanings on the conceptual level. However, this limitation is not significant in this case.

Interpretation of the diary material can be biased and misinterpretations are possible, but in order to eliminate such possibilities the researcher was allowed to ask for clarification from the contact persons of the companies, when needed. In addition, the results were analysed by using the same categorization which was developed on the basis of previous research in the same field. The diaries were based on the same template, instructions and timeline as described in essay IV.

The results of this research can be transferred and repeated in other research settings. By using multiple cases in essay IV, the aim was to strengthen that aspect as well. Through triangulation (essay IV) and describing the research process in detail, the researcher aimed to increase the confirmability of this research.

The contents and results of this research can be utilized for developing similar HEIs and operational environments. However, it is important to note that the context of this research is a small technology park, with specific characteristics and member organisations. For instance, the studied companies all are representatives of information technology or its applications. The development of that field has enabled creation of new companies during the last 15 years – the field of technology has opened up new business opportunities to be exploited, which has been possible for the studied companies due partly to cooperation with KTUAS.

One limitation which can be mentioned is that all the studied companies mainly operate in the same field, as said earlier. Entrepreneurial expertise in the studied cases seemed to be related to information technology. A second limitation concerns the developed framework for entrepreneurship education. Due to the contexts of this research, it is based on renewing the existing engineering education in a small educational organisation. Utilization of the framework in a different operational environment might require some adjustment.

6.4 Implications

The developed framework could be the starting point for a comprehensive change in the organisation. The change process extends both to the strategic and operational levels of the organisation. Therefore the change process, if conducted as suggested, requires that the different operators be involved in the process through effective education, discussions and delivery of information. The
involvement concerns internal stakeholders, such as students and staff, as well as external stakeholders.

To determine the implications, some individual examples need to be pointed out. Firstly, studying the decision-making process of other business fields related to technology, for instance, is important. The interviewed companies represented information technology, and as concluded, their entrepreneurial expertise seemed to incline the entrepreneurs to using mainly effectuation in the studied situations.

Secondly, the framework is built on utilizing action-based learning methods, EBL especially. A profile study in engineering education would be necessary for determining the effectiveness of action-based learning methods in entrepreneurship education. The scope of the research should also cover the employers and their experiences regarding the skills of the graduates. Thirdly, the utilization and suitability of the framework would have to be adopted and extensively analysed in practice. Additionally, utilizing the approach of effectuation would entail further development of the concept. Several study methods already exist, but new ones presumably would be needed. It can be expected that as soon as the renewal process is initiated, new doors would need to be opened.

6.5 Future research

As stated above, the main concern and focus of researchers in entrepreneurship education has been on business studies and economics. Due to economic and structural changes in society, it is clear that entrepreneurship is a phenomenon which exists, or will soon exist, also in health care, the social sciences, and engineering. Therefore, it is important to more intensively study entrepreneurship in those fields of education as well. A comparative study of entrepreneurship education in different fields could be beneficial in developing the field as a whole. Universities of applied sciences have existed for about twenty years. Most of them have a strategy that defines that their aim is to promote entrepreneurship in the region. Therefore, studying their operations and actions in comparison to universities would be important for understanding the challenges and possibilities of educational organisations in that respect. Another view could be studying how HEIs have succeeded in developing their pathways toward an entrepreneurial university: how has this concept been interpreted and changed into actions.

This study has approached the subject from the point of view of a university of applied sciences operating in a small technology park, suggesting a model for
increasing both the entrepreneurial behaviour and mind-set of engineering graduates. Thus, it would be important to research whether the model has been successful in contributing in the expected manner (that is, in developing the entrepreneurial behaviour and mind-set of the graduates), and to study the phenomenon in a different operational environment. One interesting aspect could be to study how the entrepreneurial behaviour of engineering graduates is being exploited by their employers, and the by region in which they operate. In addition, there is a need to study the type of education or model needed for increasing the TEA rate of engineering graduates: what other actions can be taken to increase the number of entrepreneurs with engineering backgrounds. The suggested effectuation-based entrepreneurship education model also offers other views which could be studied, such as students’ ability to create and utilize their social networks in personal decision processes and opportunity creation.

Creating a learning environment for supporting entrepreneurship education is a main concern of teachers, also of HEIs. Therefore, it would be important to study how teachers’ different education, practical experience and personal attitude with regards to entrepreneurship affect their operations and activities in that respect, including pedagogic views also (learning paradigms vs. teaching methods). Such a study could be conducted either nationally in a country or geographically including different countries or continents. Additionally, using entrepreneurship as a method (as suggested by Sarasvathy & Venkataraman 2011) in education could be a rewarding subject.

To conclude, it can be argued that especially because entrepreneurship is an ambiguous research field it should be approached by focusing on different aspects. Understanding entrepreneurship can be considered the prerequisite for developing entrepreneurship education. Entrepreneurship can have different manifestations, depending on the operational environment – where it can exist: social entrepreneurship, business context (company size and business field), the public sector, educational organisations (school level, academic). The second aspect could be the actor – who is operating entrepreneurially. Additionally, the third aspect of research could be on finding an answer to the question how is the actor operating entrepreneurially. Analysing the behaviour of the actor (individual, entrepreneur, student, teacher, for instance) together with the other aspects could assist us in coming to a consensus on the definitions needed in developing the field.
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EFFECTUATION IN EMBEDDED AND ENQUIRY-BASED ENTREPRENEURSHIP EDUCATION

ESSAYS FOR RENEWING ENGINEERING EDUCATION AT KEMI-TORNIO UNIVERSITY OF APPLIED SCIENCES