Innovative High-Tech Firm Development within Business Incubators

By

Terrence Benjamin Ogenio

UNDERSTANDING HOW ENTREPRENEURIAL HIGH-TECH FIRMS EXPLOIT RESOURCES TO MANAGE DEVELOPMENTAL PROBLEMS WITHIN BUSINESS INCUBATORS.

Master of Science in Business Administration with specialization in

Innovative Entrepreneurship & Business Development

School of Management and Governance

UNIVERSITY OF TWENTE.

Research conducted in collaboration with

NIKOS

Netherlands Institute for Knowledge Intensive Entrepreneurship

Author:

Terrence Benjamin Ogenio

Supervisors:

Dr. Tiago Ratinho

Netherlands Institute for Knowledge Intensive Entrepreneurship

University of Twente

Dr. Rainer Harms

Netherlands Institute for Knowledge Intensive Entrepreneurship

University of Twente

Netherlands, Enschede

January 2013

This master's thesis is submitted to the faculty of Management and Governance of the University of Twente, in partial fulfillment of the requirements for the degree of Master of Science in Business Administration, specialization Innovative Entrepreneurship and Business Development.

The thesis will be publicly defended on 29 January 2013 at 13:45 hrs

By

Terrence Benjamin Ogenio

Born on December 29, 1985 in Willemstad, Curaçao

Student number: s0183768

Location: Ravelijn Building, Room 2231

University of Twente Campus

Enschede, the Netherlands

Supervisory committee:

First Supervisor: Dr. T. Ratinho, NIKOS, SMG, University of Twente (Tel. 3248)

Second Supervisor: Dr. R. Harms, NIKOS, SMG, University of Twente (Tel. 3907)

Please cite this thesis as: Ogenio, T. B. (2013). *Understanding How Nascent High-Tech Firms Exploit Resources To Manage Developmental Problems Within Business Incubators.* University of Twente, Enschede.

Abstract

This study is about new high-tech firm development within business incubators (BIs). BIs have been developing all around the world as a means to facilitate the development of new firms by providing support in the early stages of their development. Research has suggested that this can be achieved by: i) providing incubatees with the appropriate resources lowering their liability of newness; ii) helping to create capabilities within the new firm to promote sustainability and growth. Yet few studies have discussed the dynamics of resource provision and the potential role of business incubation in creating capabilities within nascent firms. This study therefore seeks to understand how BIs contribute to new firm development by investigating how BIs help firms solve developmental problems. First, a BI framework is derived and applied to understand the characteristics of the BI programme within the research context. Second, a conceptual framework is constructed based on the resource-based view and the problems solving perspective of the entrepreneurial firm.

The research strategy employed is a multiply-case study with five cases. The case study strategy allows for a deep understanding of the events that occurred during the incubation phase in an attempt to uncover the problems the firms experienced and the resources that are utilized to manage each problem. Primary data is collected right after the incubated firms exit the incubation programme through face-to-face interviews using a questionnaire across all cases. Data triangulation is achieved by collecting secondary data from various sources (e.g. business plans, meeting notes, reports, and media publications). Data are collected from both the BI and the incubated firms. The data is collection took place at the University of Twente's BI programme located in Enschede, the Netherlands.

The findings show that firms do not have to completely solve developmental problems in order to progress, as initially expected. First, it takes a lot of time and resources to search for solutions to highly complex engineering problems. Second, firms have to deal with unexpected problems they are unable to predict. In addition, firms sometimes deliberately choose to ignore these problems in order to prioritize other problems. Finally, while all problems can be managed, not all problems can be solved within the capabilities of the firm since the control firms have over the problem is sometimes limited.

Regarding the resources, firms use a mix of firm resources, non-BI resources and BI resources. In several instances using BI resources alone has shown not to be sufficient to manage problems effectively. BI resources are used primarily to manage engineering problems, such as product development. BI resources are valuable as they consist of about the half of the total amount of resources firms use to manage problems. In addition, resources mediating through initial clients have shown to be necessary to manage important components of all types of problems. It can be concluded that firms must combine resources from initial clients as it is considered both a necessary and sufficient resource to manage problems more effectively.

Perhaps the most significant finding of this study is the realization that *how* firms utilize resources is in essence a methodological problem. The problem deals with the methods firms apply when using resources in the effort to manage developmental problems. This observation leads to the notion that the success of a start-up might have more to do with the methodology firms apply when managing problems, than with the resources being used. The two typologies identified sequential and parallel problem-solving, shows two distinctive approaches firms employ during the start-up of a firm. The main difference is that some firms manage various problem types simultaneously, while other firms choose to manage each problem type in an isolated sequential fashion.

The first method is characterized by a focus on solving engineering problems first, such as product or service development. The various types of problems are managed in a linear, sequential fashion. The tendency is to focus a lot on one problem, manage it, and then move to the next problem. In addition, these firms conduct product development in isolation, without interacting with initial clients. Validation is sought by solving engineering problems, by convincing BI managers, investors, partners, without involving initial clients. The underlying assumption is that the chances of succeeding rely on building great products and establishing partnerships with key players to penetrate markets. Finally, there is a lot of resource accumulation, both in terms of financial and human resources, but with limited revenues.

In contrast, the second method focuses on solving entrepreneurial problems first, such as developing the initial customer base. The various types of problems are managed simultaneously, in parallel. Initial clients are approached very early on, without firms having a complete finished product, this results in a more open product development approach. Moreover, these firms progress by offering services first, and expand their offerings to physical products later on. Services facilitate interaction with initial clients. A relationship with initial clients allows for resources gathering that will help to solve other problem types. Surprisingly, most of these firms do not have access to significant amount of financial resources when founded. Finally, firms place more emphasis on customer validation, instead of technical validation.

It can be concluded that BI resources alone are not sufficient for the effective development of nascent firms. The bottom line is that firms need to combine resources that are outside of the BI to increase the effectiveness of problem solving. In this sense, the BI's value proposition is limited. In addition, the problem itself is not necessarily related to the use of resources, but to the method of how problems are being managed. If BIs manage to address the methodological aspects involved in a start-up, failure can be prevented without the need of additional resources.

Keywords
Business Incubation; Entrepreneurship; Innovation; University Technology Incubator; Incubatee Development; High-Tech Ventures; Problem Solving Perspective; Start-up Methodology; Resources; Capabilities.

Acknowledgements

While writing these words, one of the first persons that come to mind is that of my first supervisor, Tiago Ratinho. First of all I would like to thank him for the opportunity he gave me to do my master thesis project under his supervision. His passion and enthusiasm for his work—best described as a contagious energetic spirit—inspired and motivated me throughout this research. I would also like to express my appreciation for all of his honest and insightful comments, especially his patience and assistance during the project. His efforts taken to guide me and his knowledge invested in me are greatly valued.

I would like to thank all the staff of the department of NIKOS that somehow contributed to this master thesis project. I would also like to thank the office manager, Hèla Klaczynski for her administrative support. To the TOP-coordinators, Patrick Bliek and Jann van Benthem, also Dick van Barneveld and Jaap van Tilburg for their interest to share their insight and experiences. To my second supervisor Rainer Harms, some of his comments made during meetings had a great impact on the research design and data analysis. To all entrepreneurs that participated in the interviews, their availability and willingness to openly share their experiences with me made the great majority of this research possible.

I would also like to show my gratitude to the attendees of the High Technology Small Firms Conference, especially those that were present during my presentation. My guest attendance during the 11th PhD researchers in Business Economics and Management (PREBEM) conference resulted in meaningful contributions to this research. Key note speeches, presentations, and comments made during conversations I participated in (with for example, Professor Michael Hitt) also contributed during the shaping of the vision I had for this research. The information shared during the conference and the interests shown by other participants into my research topic are highly valued.

Finally, I would like to thank the most important people in my life, my family and close friends that supported, encouraged and believed in me throughout the years. Without them, I could have not accomplished everything I have accomplished up until now, so thank you for your support. Zinah, Lisa, Vania, Sandra, Erwin, Hendrey, Zahira, Nupur, Cindy, Tamara, I thank you all!

Terrence Benjamin Ogenio

Enschede, January 2013.

Table of Contents

Abstract i
Acknowledgements iii
Table of Contents iv
List of Tables vi
List of Figures vii
Abbreviations viii
Chapter 1 – Introduction 1

1.1 The Big Bang of Organizations 1
1.2 Business Incubation Concept and Assumptions 4
1.3 Research Gaps in the BI Literature 6
1.4 Research Questions 9
1.5 Research Strategy 10
1.6 Report Structure 12

Chapter 2 – Business Incubator Framework 13

2.1 Definitions 13
2.2 Incubator Services 15
2.3 Incubator Types 18
2.4 Incubator Strategies 19
2.5 Business Incubator Framework 21

Chapter 3 – Problem Co-Solving Framework 23

3.1 Findings of Incubatee Development Studies 23
3.2 Resource-Based View in the BI Literature 27
3.3 Problem-Solving Perspective 29
3.4 Problem Co-Solving Model 31

Chapter 4 – Methodology 36

4.1 Research Design 36
4.2 Case Sample 37
4.3 Data Collection 40
4.4 Data Analysis 45
4.5 Operationalization 47

Chapter 5 – Findings & Analysis 49

5.1 (RQ1) – Business Incubation Programme 49
5.2 (RQ2) – Developmental Problems 52
5.3 (RQ3) – Utilization of Resources 63
5.4 (RQ4) – Development Progress 65

5.5 (Central RQ) – Exploring Problem Solving Dynamics 70
Chapter 6 – Discussion 80
6.1 Findings and Extant Literature 80
6.2 Contribution of Theories and Frameworks 82
6.3 Rebuilding the Problem Co-Solving Model 83
Chapter 7 – Conclusion 89
7.1 Conclusion 89
7.2 Contribution and Recommendations 92
7.3 Limitations and Future Research 94
7.4 Self-Reflection and Learning Objectives 95
References 97
List of Software & Tools 105
APPENDIX A: Interview Questionnaires 106
A1 – Questionnaire 1: Incubator Managers & Experts 106
A2 – Questionnaire 2: Entrepreneurs 108
APPENDIX B: E-Mail Introduction 112
APPENDIX C: Business Incubator Case Study 113
APPENDIX D: Descriptive Case Studies 113
APPENDIX E: Interview Transcripts 113
APPENDIX F: Time-Ordered Displays 113
APPENDIX G: Data Network Views 113
APPENDIX H: Transcription Guide 114

List of Tables

Table 1 - Research Gaps and Challenges 8
Table 2 - Various Definitions of Business Incubator 14
Table 3 - Various Definitions of Business Incubatees 15
Table 4 - Business Incubator Support Services and Resources 16
Table 5 - Various Types of Business Incubators 19
Table 6 - Previous Studies on Incubated Firms 24
Table 7 - Components of the Problem Co-Solving Framework 34
Table 8 - Batch of Preliminary Cases 39
Table 9 - Description of Case Data 44
Table 10 - Developmental Problems & Resources 53
Table 11 - Cost Structure and Pricing Mechanism 57
Table 12 - Development Progress 66
Table 13 - Differences between Parallel and Sequential Problem Solving 84
Table 14 - Software and Tools 105

List of Figures

Figure 1 - Research Focus 4
Figure 2 - Basic Business Incubation Concept 5
Figure 3 - Five Business Incubator-Incubation Research Streams 7
Figure 4 - Research Strategy, Design, and Methods 11
Figure 5 - Selection Strategies 21
Figure 6 - BI Assessment Framework 22
Figure 7 - Development Phases, Critical Junctures and Resources 26
Figure 8 - Graphical Representation of the Problem Solving Perspective 30
Figure 9 - Problem Co-Solving Model 31
Figure 10 - High-Tech University Spin-Off 38
Figure 11 - TOP Incubation Programme Assessment 49
Figure 12 - Problem Complexity across Cases 60
Figure 13 - Complexity and Types 61
Figure 14 - Problem Awareness across Cases 61
Figure 15 - Problem Awareness and Problem Complexity 62
Figure 16 - Problem Type across Cases 63
Figure 17 - Problem Type and Problem Awareness 63
Figure 18 - Amount of Resources Used to Manage Problems 64
Figure 19 - Types and Amount of Resources used across Cases 64
Figure 20 - Complexity and Resources 65
Figure 21 - Amount of Problems Solved across Cases 68
Figure 22 - Resources Used in Search for Solutions 68
Figure 23 - Problem Types Solved 69
Figure 24 - Solution Efficiency across Firms 69
Figure 25 - Vertical Focus: Problems are Isolated 72
Figure 26 - Horizontal Focus: Problems are Interdependent 74
Figure 27 - All Resource Types across Cases 79

Abbreviations

BI	-	Business Incubator
PSP	-	Problem Solving Perspective
TOP	-	Temporary Entrepreneurial Placements
HTBF	-	High Technology Business Firm
NTBF	-	New Technology-Based Firm
USO	-	University Spin-out Company
NBIA	-	National Business Incubation Association
USI	-	University Science Park Incubator
UTBI	-	University Technology Business Incubators
UKBI	-	United Kingdom Business Incubation
TKT	-	Technology Kring Twente (Technology Circle Twente)
STW	-	Stichting voor de Technische Wetenschappen (Technology Foundation)
M2i	-	Materials Innovation Institute
RBV	-	Resource-Based View
RQ	-	Research Question
B2B	-	Business to Business
B2C	-	Business to Consumer

Chapter 1 – Introduction

1.1 The Big Bang of Organizations

For more than four decades, business incubators (BIs) have been developing all around the world as means to facilitate the development of new firms by providing support in the early stages of their development. Research has suggested that this can be achieved by: i) providing start-up firms with the appropriate resources lowering their liability of newness; ii) helping to create capabilities within the new firm to promote sustainability and growth. Yet few studies have discussed the dynamics of resource provision and the potential role of BI in creating capabilities within nascent firms. This study therefore seeks to explore how BIs contribute to firm development by helping them solve developmental problems. The perspective taken is that of the individual entrepreneurial firm within a business incubation (BI) context. The introduction explores relevant topics related to entrepreneurship, firm development and BI.

1.1.1 Entrepreneurship, Innovation and Economic Growth

In the field of Theoretical Physics and Cosmology, scientists study the early development of the universe. According to the Big Bang model, the universe was once in an extremely hot and dense state that expanded rapidly, hence the term 'Big Bang'. In the field of organizational science, the study of entrepreneurship focuses on the early development of rapid expanding organizations. The study of entrepreneurship focuses on various aspects of the 'Big Bang' of these new expanding organizations.

There are dozens of entrepreneurship definitions found in the literature (Audretsch, Falck, & Heblich, 2011), most of the definitions address entrepreneurship on the individual level (Baum & Locke, 2004; Bruyat & Julien, 2001). For example, Schumpeter (1934) defines entrepreneurs as individuals who carry out innovation processes. A working definition of entrepreneurship is borrowed to narrow down the focus of the phenomenon for this study. Entrepreneurship means the creation of new economic activities and organizations as well as the transformation of existing ones (Audretsch, et al., 2011). Here, the entrepreneurship is seen as the self-employed individual who introduces new economic activity that leads to change in the marketplace. This means that non-innovate self-employment falls outside the scope of this definition, since innovation is considered an important aspect of entrepreneurship here. Innovation is strongly associated with economic growth; the nature of innovation is that it is fundamentally about entrepreneurship (Bessant & Tidd, 2011; Schumpeter, 1934; Stam, 2008). Innovation generally refers to the creation of new knowledge that are accepted by the market (Stam, 2008). Innovation can be manifested in a new product design, a new technology, a new production process, a new marketing approach, or a new of conducting training (Porter, 1990).

Innovation is often driven by entrepreneurs (Schumpeter, 1934), but also by established firms, mainly through the process of research & development (Bessant & Tidd, 2011; Schumpeter, 1942). Achieving innovation through entrepreneurship is said to be difficult

(Bessant & Tidd, 2011). For example, Schumpeter (1934) argues that unlike managers, entrepreneurs must overcome the resistance to change present on the individual, group and social level. In addition, innovative entrepreneurial firms often have to cope with the inexistence of artifacts such as economies, markets, industries and firms (S. G. Blank, 2006; Ries, 2011; Sarasvathy, 2001), leaving them exposed to true uncertainty and risk (Sarasvathy, Dew, Velamuri, & Venkataraman, 2005). This is especially true when compared to already established industries where such artifacts are presumed to already exist (Porter, 2008). However, there are key differences between entrepreneurial firms and established firms. For example, the probability that an entrepreneurial firm experiences—what Christensen (1997) refers to as—the innovator's dilemma, is much lower. The innovator's dilemma emerges when an established firm has difficulties making trade-offs to address a new emerged market. This is often the case because established firms are path dependent (Dosi, Nelson, & Winter, 2001), meaning that the allocation of resources made in the past affects current decision making. As a newcomer, an entrepreneurial firm is less path dependent, which makes it more flexible to develop the necessary activities in order to address new opportunities without having to make huge strategic trade-offs (Porter, 1996). Successful innovative entrepreneurial firms often become a monopoly and benefit from early economic rents until competitors enter the market, resulting in economic growth.

1.1.2 Business Supportive Environments

Business supportive environment is an environment where a new firm has accesses to a pool of resources which is strategically allocated by a resource provider to facilitate the development and growth of the new firm. For example, when a large software company acquires a nascent company developing a promising new technology, this young company is turned into a subsidiary company (resource consumer) of the parent company (resource provider). The resource provider allocates its resources to strategically develop the subsidiary company and its technology in the attempt to produce successful products (value). Business supportive environments are also present when a franchisee starts up a company to address opportunities in a specific (international) geographic region. The franchisor (resource provider) allocates different resources (e.g. brand, supplier, training, R&D, marketing, technology, etc.) to facilitate the start-up of the "new" business. Thus, business supportive environment is broadly defined here to capture the interplay between the resource provider and the resource consumer.

In light of the proposed working definition of business supportive environments, BIs are a specific type of resource provider within the business supportive environment. Firms that are incubated within an incubator environment do not work for the service provider in the sense of the traditional business supportive environment described above. Rather than working for the success of the principal's firm and shareholders, the incubated firms work to attain their own firm's success (Hackett & Dilts, 2004a). BIs often have different goals than the incubated firms they support. Since the establishment of the first BI, most incubators have been created as publicly funded vehicles for job creation, urban economic revitalization, commercialization of university innovations, and as instruments to promote entrepreneurship and innovation (Aerts,

Matthyssens, & Vandenbempt, 2007; Campbell & Allen, 1987; Hackett & Dilts, 2004b; Tamásy, 2007).

The role of technology-oriented incubators is to provide a supportive environment needed by new businesses to transform knowledge and technology into commercially viable innovations (Tamásy, 2007). They encourage the formation and growth of knowledge-based businesses and other organizations. Furthermore, university incubators are a specific type of incubators run by universities or higher educational institutions. BIs merge the concept of fostering new businesses with growth potential (entrepreneurship) with concepts of the commercialization and transfer of technology from an incubator to the regional business community (Phillips, 2002; Tamásy, 2007).

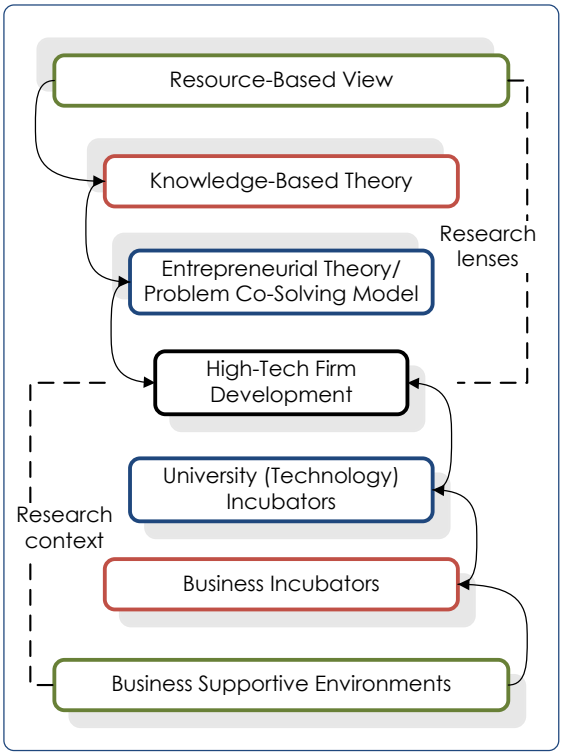
For purposes of scientific observation, business incubation is an interesting phenomenon to observe how innovative entrepreneurial firms come into existence, by studying the formation of new firm development within these supportive environments.

1.1.3 Theories and Perspectives

In order to survive and grow, firms must achieve and maintain competitive advantage through acts of innovation (Bessant & Tidd, 2011). Firms often approach innovation in its broadest sense, including both new technologies and new ways of doing things (Porter, 1990). Managing innovation can be approached as a process and managing this process (over time) is considered to be a (dynamic) capability of a firm (Bessant & Tidd, 2011; Teece, Pisano, & Shuen, 1997). Success in innovation appears to depend upon two key ingredients—resources (people, knowledge, technology, money, etc.) and the capability in the organization to manage these resources (Bessant & Tidd, 2011). In order to explore the nature of firms, it is necessary to understand what resources and capabilities are and how these contribute to firm sustainability.

A theory that originated from the Strategic Management field seeks to explain how firms achieve and sustain competitive advantage from a resource-based perspective. This 'resource-based view (RBV) of the firm' suggests that firm resources and capabilities are heterogonous across firms. A firm survives and grows based on its capability to manage these resources in order to expand and sustain competitive advantage over time (Jay Barney, 1991; J. Barney, Wright, & Ketchen, 2001). In order for a firm to achieve competitive advantage, the resources have to contain valuable and rare properties, and they should also be difficult to imitate and substitute by other firms. The knowledge-based theory of the firm, as the name implies, focuses on one specific area of resource: a firm's ability to generate novel valuable knowledge and capability (J. A. Nickerson & Zenger, 2004). The knowledge-based theory conceptualizes the ability of a firm to find opportunities and solve problems related to these opportunities as a capability of the firm to create new valuable knowledge. The theory of the entrepreneurial firm positions the knowledge-based theory in an entrepreneurial context, where the entrepreneur's task is to discover and exploit opportunities and solve problems related to these opportunities in order to create value (Hsieh, Nickerson, & Zenger, 2007). The entrepreneur can be regarded as the individual responsible to create new value in this process (Bruyat & Julien, 2001). These theories form the layers of the research lenses that are applied in this study (Figure 1).

Figure 1 - Research Focus



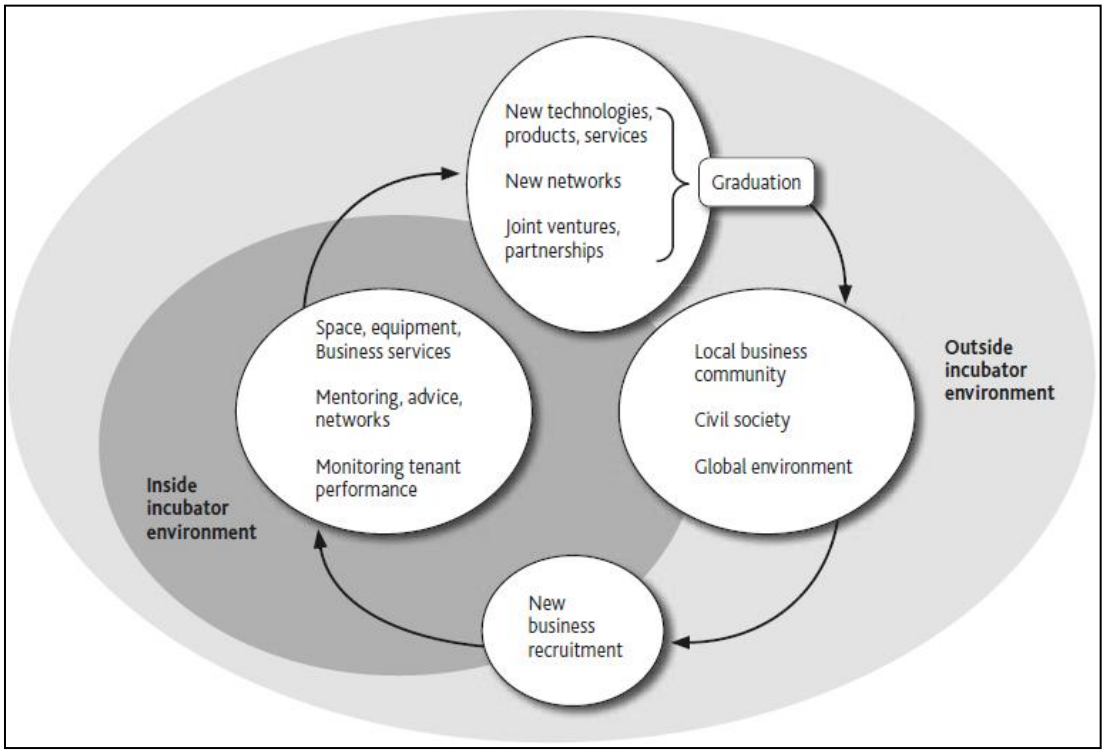
1.2 Business Incubation Concept and Assumptions

In their study, Burnett and McMurray (2008) conceptualized the BI as being a catalyst for business growth that functions as a bridge between the internal 'protected' incubation environment and the external 'exposed' business environment (Figure 2). The basic business incubation concept suggests that BIs constitute an environment especially designed to hatch enterprises. Furthermore, business incubators provide their incubated companies with several facilities, from office space and capital to management support and knowledge. It is assumed that this allows the start-up to concentrate on its business planning and therefore raises the changes of success (Aerts, et al., 2007).

Hackett and Dilts (2004a) conceptualized the incubator as an entrepreneurial firm that performs a bridging function by sourcing and ''macro-managing'' the innovation process within emerging, weak-but-promising intermediate potential organizations, infusing them with resources at various developmental stage-gates while containing the cost of their potential failure. Macro-management occurs through the value-adding processes of monitoring and assistance and resource infusion, and in extreme cases, through expulsion from the incubator (Hackett & Dilts, 2004a).

The different business incubation concepts found in the literature are analyzed and compared to reveal how different authors and practitioners view the concept of business incubation. Distilling this information reveals a pattern of business incubation concepts that is constructed in two parts.

Figure 2 - Basic Business Incubation Concept
Source: Burnett & McMurray (2008, p. 61).



First, the concept embodied in business incubation seeks to supply different support services and resources to the incubated firms. These resources are shared not only among the incubated firms, but in some instances also between departments found in the BIs (e.g. universities, research institutes, faculties, etc.). The support available is often based on subsidized, and thus inexpensive, office spaces and office services, which eases the difficult start-up phase of businesses by reducing fixed costs (Tamásy, 2007).

Second, the resources are provided with the assumption that they are effectively used by the incubated firms in order to "accelerate development" (Grimaldi & Grandi, 2005; Mian, 1996; NBIA), "ensure entrepreneurial stability and long term survival" (Schwartz & Hornych, 2008), "exploit innovations made at the incubator [university]" (Aaboen, 2009; Löfsten & Lindelöf, 2002) and "help business grow fast" . Since most BIs only invest in the shared resources (macro-management) and not in the incubated firms, they do not have to carry the risk associated with the new start-up. This allows for greater flexibility when accepting weak-but-promising firms that would otherwise not be able to establish themselves. As Hisrich and Smilor (1988) write, "the expectation is that this [incubation] system will result in viable tenant companies that develop and transfer technology; contribute to the local economy; create jobs, profits, and successful products; and confidently leave the incubator nest within a reasonable time". Furthermore, the authors developed a categorization of the benefits that incubators extend to their incubatees through their services along four dimensions: i) develop credibility; ii)

shortening of the entrepreneurial learning curve; iii) find quicker solution to problems; and iv) increase the access to an entrepreneurial network.

The business incubation concept seems to put a lot of emphasis on the supply side of the resource provider, and less emphasis on the actual diffusion and effective use of the resources by the incubated firms. This is reflected in the assumptions of business incubation concept. A question that arises is whether the incubated firms actually make effective use of the resources provided, and if these resources help the incubated firms to develop faster by solving problems quicker. It can be argued that in order for the business incubation concept to provide any real significant value to the incubated firms, the resources that are offered should be used to make a meaningful contribution to the development of the firms. If this is not the case, the value proposition the business incubation concept is promoting is not being transferred effectively. In light of this argument, attention is turned to the current state of the business incubation literature in search for research gaps and possible challenges that need to be addressed.

1.3 Research Gaps in the BI Literature

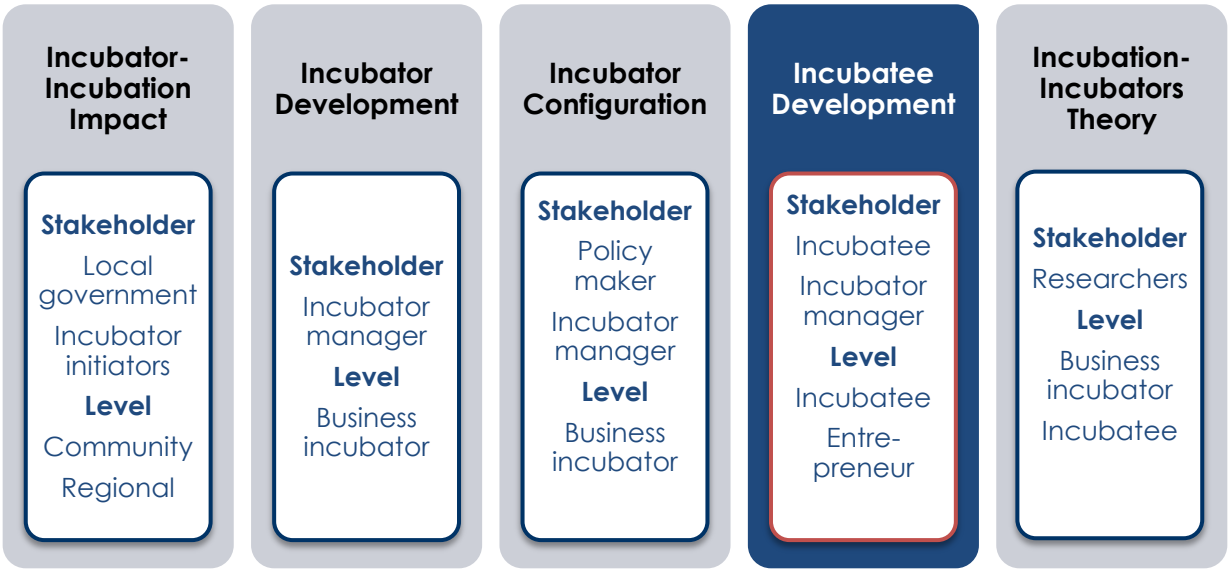
The effectiveness of the business incubation as a strategy to promote new firm development received a lot of attention in the business incubation literature (Anderson, Daim, & Lavoie, 2007; Ateljevic & Dawson, 2010; Bergek & Norrman, 2008; Chan & Lau, 2005; Colombo & Delmastro, 2002; Hackett & Dilts, 2004b; Mian, 1994, 1997; Rothaermel & Thursby, 2005a, 2005b; Scillitoe & Chakrabarti, 2010; Tamásy, 2007; Udell, 1990). However, business incubation research started just to scratch the surface of the incubator-incubation phenomena and there are some areas of research that are still underdeveloped (Hackett & Dilts, 2004b).

1.3.1 Business Incubation Research Streams

In their paper, Hackett & Dilts (2004b) systematically reviewed 38 studies on BIs and business incubation that were published between 1984 and 2002. The authors segmented the studies into five research streams (Figure 3).

First, incubator-incubation impact studies investigate whether the incubation concept influences incubatee (and incubator) success. Second, incubator development studies describe incubators. Third, incubator configuration studies analyze the components of the incubator system and their mutual coherence. Fourth, incubatee development studies seek to clarify how incubatees develop within incubators. The fifth orientation comprises studies theorizing about incubators-incubation. Based on this classification, the authors conclude that incubatee development studies are rather underdeveloped and thus present fertile ground for future research. In addition, while knowledge produced in incubators have been studied extensively and its impact on the industry little is known about knowledge flows at the firm level. In part, it is because the firm has not been a common unit of analysis (Rothaermel & Thursby, 2005b). A possible reason for this is due to the fact that it is difficult for obtaining data from early stage ventures regardless of whether the venture is located within an incubator (Hackett & Dilts, 2004b).

Figure 3 - Five Business Incubator-Incubation Research Streams



In addition, after examining the effectiveness of the knowledge acquisition and exploitation by high-tech entrepreneurial firms from interaction with incubator management, Studdard (2006) suggests that future research should examine whether the knowledge obtained by the firm from the incubator manager is actually utilized in combination with its level of usage. The underdeveloped research stream of incubatee development is identified as the first research gap.

1.3.2 Incubatee Development Studies

Although the business incubation concept seeks to improve the effectiveness of new firms and accelerate their development, there are not many studies that have focused exclusively on the dynamics of resource utilization within BIs.

Vohora et al. (2004) investigated the development stages of university spinout companies by indentifying the stages that the incubated spinouts go through during their development. In addition, the authors also identified the critical junctures they must overcome in order to continue developing. However, the authors do not elaborate on how effective (non-)BI resources are used in order to overcome each critical juncture. McAdam and McAdam (2008) explored how lifecycle development within incubatees can affect how they use the unique resources and opportunities of the incubator. However, the study does not discriminate between incubator and non-incubator resources and does not elaborate on the uniqueness of the incubator resources. Furthermore, the study focuses on the management team and entrepreneurial level (social support) within the firm. Rice (2002) investigated the relationship between the incubator and incubatee to find out what factors impact the provision and consumption of resources, the author refers to this as the co-production dyad. The scope of the research is limited to the resource provision and consumption of business assistance and counseling. Studdard (2006) explored how the entrepreneurial firm's acquisition of business processes' knowledge from interaction with incubator management positively impacts on new product development, increased technical

competence, enhanced reputation and lower costs of sales to customers. The research scope is limited to the acquisition of knowledge as the main resource from the incubator. Mian (1996) assessed the incubator resources that are perceived to be the most valuable to incubated firms. The author defines "value-adding" in incubators as those specific ways that an incubator program enhances the ability of its incubatees to survive and grow in business. The research does not answer (and nor attempts to answer) the question of how incubatees use these "valuable resources" to increase the chances of survival or growth.

A commonality found in these studies is that the analysis of resource utilization is restricted to only between the incubator and the incubatee, mainly in the form of knowledge flows (Rothaermel & Thursby, 2005b; Studdard, 2006), business assistance (Rice, 2002) or social support (McAdam & McAdam, 2008). Other non-incubator resources that incubatees might also be using are mostly left unexplored. Furthermore, these studies are not specifically aimed at understanding how incubatees strategically use (non-)incubator resources and their effectiveness when it comes to managing problems. Thus, an opportunity arises to address this research gap.

Table 1 - Research Gaps and Challenges

Area	**Research Gaps / Challenges**	**Strategy**
Research stream (Chapter 1)	Incubatee development studies are understudied; There is still little known about the utilization of resources within BIs.	Analyze BIs from the standpoint of the firm (make incubatee unit of analysis); Integrate previous findings and build upon them.
BI Framework (Chapter 2)	Frameworks to study BIs from the point of view of the incubatee are limited.	Build a framework to analyze incubators from the standpoint of the firm.
Theory, Conceptual Framework (Chapter 3)	RBV is commonly applied to study incubatee development.	Integrate relevant theories of the (entrepreneurial) firm; Build a conceptual framework to guide the analysis of data.
Methodology (Chapter 4)	Data are hard to collect, and rely mostly on subjective reporting (e.g. perceived value of resources).	Focus on triangulation of factual (qualitative) evidence combined with primary data.

1.3.4 Research Objective

The research gaps and challenges serve as input for the formulation of the research objective.

Research Objective *The objective is to understand how nascent high-tech firms develop within business incubators by investigating what (non-)incubator resources the incubated firms use to manage developmental problems.*

1.4 Research Questions

The research goal leads to the central research question followed by definitions of the key concepts it contains.

Central Research Question	*How do nascent high-tech firms utilize resources to manage developmental problems within business incubators?*
Nascent firms	Nascent firms are firms that are coming into existence (< 3 years) who are not yet fully developed but show signs of future potential.
High-Tech firms	The core business of a technology firm revolves around the development of a (new) technology. Technology firms employ what Kline refers to as "sociotechnical system of manufacture". Based on the definitions of technology provided by Kline, it is argued that high-tech firms develop both types of technologies; tangible (products) and intangible (services), see (Kline, 1985). High-tech refers to the industry a firm is operating in, e.g. computers, communication technology, semiconductors and lasers.[1]
Resources	Firm resources are firm-specific assets that are difficult if not impossible to imitate (Dosi, et al., 2001). Firm or BI resources include all assets, capabilities, organizational processes, attributes, information, knowledge, etc. controlled by a firm [or incubator] that enable the firm to conceive of and implement strategies that improve the efficiency and effectiveness of the [incubated] firm (Jay Barney, 1991; Daft, 2009; Hackett & Dilts, 2004a).
Problem	A developmental problem is a problem that yields desirable knowledge and capability that improves the efficiency and effectiveness of the firm's development, if successfully solved (Hsieh, et al., 2007; Jackson A. Nickerson, Silverman, & Zenger, 2007; J. A. Nickerson & Zenger, 2004).
Firm efficiency	Firm efficiency pertains to the internal workings of the firm. Firm efficiency is the amount of resources used to produce unit of output. If one firm can achieve a given production level with fewer resources than another firm, it would be described as more efficient (Daft, 2009).
Firm effectiveness	Effectiveness is defined as the degree to which a firm achieves its goals (Daft, 2009). A common goal of for-profit organizations is to maximize profits, this is the assumed goal described here.
Managing problems	Managing problems include organizing, planning, controlling, deploying and exploiting resources in an effort to strategically solve parts of the problem or the problem in its entirety.

[1] For the full definitions of high-tech industries see http://epp.eurostat.ec.europa.eu.

1.4.1 Sub-Questions

Four research questions are derived from the central research question.

Research Q1 *What are the characteristics of the business incubator; what are the support resources and how are these resources being provided?*
Since the firms are located within the BI, understanding this environment is necessary for the implications it might have on the way firms use incubator resources to manage problems.

Research Q2 *What are the developmental problems experienced by the incubated firms and what are their characteristics?*
In order to understand how firms manage problems, each problem is isolated and analyzed. Problem dimensions are introduced to better understand the properties of each problem.

Research Q3 *What are the resources being used during problem solving and what is the BI's contribution?*
This question combines the findings from the first and second research question in an attempt to better understand how incubatees use various necessary and sufficient (BI) resources. The answer will shed some light on the effectiveness of the business incubation concept and its value proposition.

Research Q4 *How do firms progress based on the problems solved?*
Finally, the last question is related to firm progression and the success of the firm's development.

1.5 Research Strategy

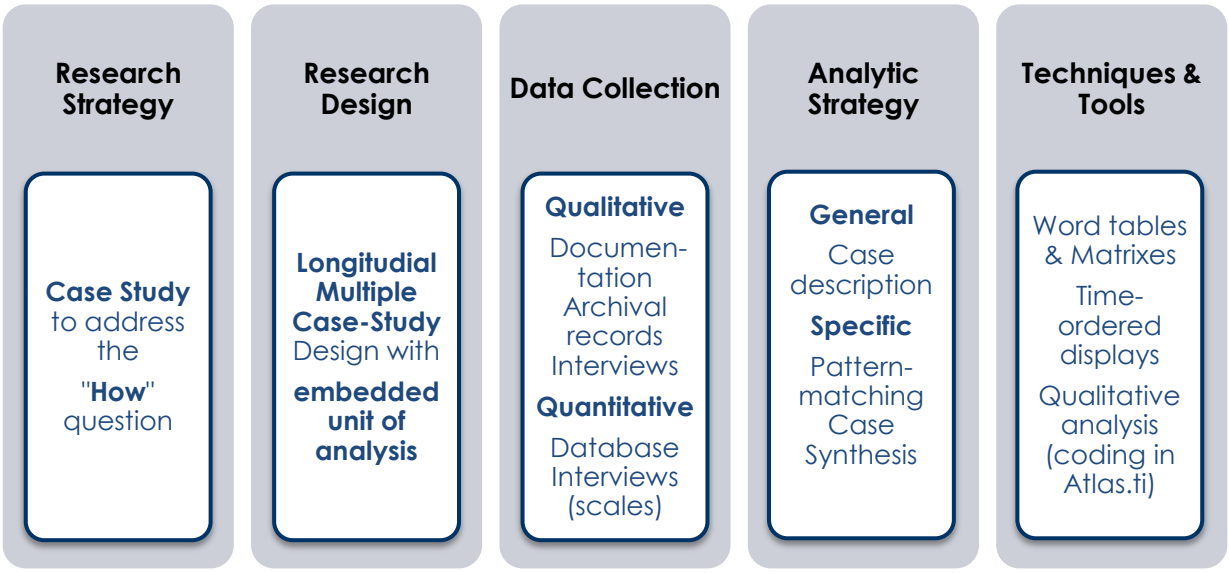
1.5.1 Strategy

The research strategy employed is a case study to best accommodate the qualitative nature of the research questions. The reason why this strategy is chosen is because case studies are the preferred strategy when "how" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context (Yin, 2009). Furthermore, the essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions, why they were taken, how they were implemented, and with what result (Yin, 2009). The case study strategy will allow for a deep understanding of the events that occurred during the incubation phase in an attempt to uncover the problems the firms experienced and the resources that are utilized to manage each problem.

1.5.2 Research Design

The research follows a longitudinal multiple-case study design featuring five cases. The two main units of analysis include the BI, the incubated firms and one embedded unit of analysis: developmental problem. Multiple case design permits replication logic (Yin 2009), allowing the case analyses to be treated as a series of independent experiments or observations (Eisenhardt, 1989). By adding multiple-cases into a case study strategy increases the analytic power of the findings; analyses from multiple cases typically yields more robust, generalizable, and testable findings than single-case research (Eisenhardt & Graebner, 2007).

Figure 4 - Research Strategy, Design, and Methods



1.5.3 Data Collection

Primary data is collected right after the incubated firms exit the incubation programme through face-to-face interviews using a questionnaire across all cases. BI experts and managers are also interviewed. Data triangulation is achieved by collecting secondary data from various sources, such as business plans, meeting notes, intermediate reports, e-mails, annual reports, videos and other publications. For firms that stayed longer than the average 1-2 years, secondary data is collected over a period of six months after primary data is collected. While the collected data is mostly qualitative in nature, quantitative data are also collected.

Collecting data from incubatees is considered a challenge. In order to overcome this challenge, the researcher became intimately familiar with the available sources and databases during the initial stages of the research. This experience made it possible to assess what type of data can be collected beforehand, which helped to shape the research design accordingly. The research is commissioned by a department at the same university where the incubation programme is active. This permits sensitive information to be shared and collected more easily, and since secondary confidential data is not threatened by researcher bias, it increases the credibility of the data.

1.5.4 Data Analysis

Data are analyzed using different analytic methods to establish analytic triangulation (Figure 4). All collected data are systematically prepared and the recorded interviews are transcribed. Descriptive and explanatory displays are used when conducting both within-case analysis and cross-case synthesis (B. M. Miles & Huberman, 1994). Qualitative data analysis is performed using the qualitative software package Atlas.ti. The data are coded using an indexing list across all cases. The within-case findings are reported in the form of case studies consisting of narrative interspersed with quotations from key informants and other supporting evidence. The case studies are built through reconstruction of the events that occurred during incubation in a chronological fashion to improve interpretation and analysis. Cross-case findings are summarized in word tables, matrixes and network views to facilitate cross-case comparison and pattern matching (B. M. Miles & Huberman, 1994; Yin, 2009). Conclusions are drawn and analyzed through various analytical lenses to preserve and establish dependability of the procedure and credibility of the findings.

1.5.5 Research Setting

The data is collected at the University of Twente in Enschede, the Netherlands, which is considered to be the birthplace of more than fifteen new firms each year. The TOP (Temporary Entrepreneurial Placements) incubation programme, established in 1984, is an initiative of the university to provide support to new start-up firms (Broekstra, Karnebeek, & Sijde, 2002; Tilburg & Hogendoorn, 1997). The programme provides a supportive environment which seeks to promote entrepreneurship and business start-ups (Tilburg & Hogendoorn, 1997). It also serves as a purpose to commercialize research conducted at the university through university spinout companies. The case sample analyzed in the study consists of five spin-off firms that participated in the TOP incubation programme.

1.6 Report Structure

In Chapter 1, research gaps within the business incubation literature are identified and research questions are formulated. Chapter 2 presents a framework which is used to analyze BIs from the standpoint of the firm. Chapter 3 starts by discussing findings of previous studies. The RBV and the entrepreneurial theory of the firm are then discussed. The last section of the chapter discusses the Problem Co-Solving framework. Chapter 4 covers the steps taken regarding the methodology applied during data collection and analysis. Chapter 5 presents the analysis and findings of the BI and the five in-depth case studies. Chapter 6 discusses the findings, makes comparison with extant literature and provides a reworked model. Chapter 7 concludes by summarizing the findings, answering the research questions and highlighting the contribution of the research.

Chapter 2 – Business Incubator Framework

2.1 Definitions

2.1.1 Business Incubator

A BI's basic value proposition lies in the assumption that incubators produce more start-ups with fewer business failures compared to start-ups that are not incubated. But despite this shared baseline assumption, the terms 'business incubator' and 'business incubation' still raise some confusion in business incubation literature (Hackett & Dilts, 2004b). According to Zedtwitz and Grimaldi (2006), the term 'incubator' is neither legally nor academically defined. However, Hackett and Dilts (2004a, 2004b) did propose a comprehensive definition of BI: "*A business incubator is a shared office space facility that seeks to provide its incubatees with a strategic, value-adding intervention system of monitoring and business assistance. This system controls and links resources with the objective of facilitating the successful new venture development of the incubatees while simultaneously containing the cost of their potential failure."* The National Business Incubation Association (NBIA) proposed three characteristics that define a BI. First, it must have a mission to provide business assistance to early-stage companies. Second, it must have staff that deliver and coordinate business assistance to client companies. Third, it must be designed to lead its companies to self-sufficiency (Adkins, 2002; NBIA).

Table 2 presents an overview of more definitions found in the business incubation literature. When analyzing these definitions, it becomes clear that there is a distinction between a broad definition of BIs, and a specific definition of technological BIs. A closer look at the difference between two types of definition should be beneficial to gain a better understanding of the term "business incubator". The broad definition of BI can be condensed into the following sentence: A BI is a provider of shared physical facilities, business assistance and resources through a development process coordinated by a management team strategically designed to accelerate development and increase the chances of survival of a new business in the start-up phase. In addition, technological BIs, support a property based venture with a core technological innovation that originated from the BI.

Most definitions of the BI in the literature appear to be consistent with the broader definition of BIs. However, the main difference between these definitions lies on the focus of technology and the origin of the technology; whether it is developed by the incubator or not.

Table 2 - Various Definitions of Business Incubator

Sources	Definitions of Business Incubator
(Hisrich & Smilor, 1988)	A new-business incubator is a system designed to assist entrepreneurs, particularly in high-technology, by providing a variety of services and support to startup and emerging companies. It also seeks to give structure and credibility to fledgling business ventures by maintaining controlled conditions for their cultivation.
(Mian, 1996, 1997)	The university technology business incubator is a modern enterprise development tool employed by some entrepreneurial universities to provide support for nurturing new technology based firms. University technology business incubators are multi-tenant buildings, in and around university campuses, which provide affordable, flexible space and a variety of typical incubator and university related services for a select group of technology based tenant firms.
(OECD, 1997)	Technology incubators are a specific type of business incubator - a property-based venture which provides tangible and intangible services to new technology-based firms, entrepreneurs, and spin-offs of universities and large firms, all with the aim of helping them increase their chances of survival and generate wealth and jobs and diffuse technology.
(Rice, 2002)	A business incubator—in collaboration with the community in which it operates—is a producer of business assistance programs.
(Bergek & Norrman, 2008)	Generally an incubator can be viewed as ‘‘… a support environment for start-up and fledgling companies’’. The incubator is reserved for organizations that supply joint location, services, business support and networks to early stage ventures.
(Tamásy, 2007)	Technology-oriented business incubators can be defined as a property-based initiative assisting technology-oriented businesses to become established and profitable during the start-up phase.
(Aaboen, 2009)	An incubator provides resources like space, goals, marketing, management, structure and financing to knowledge- and technology-intensive new technology-based firms. In other words, an incubator is an environment for initiation and growth of these firms.

2.1.2 Business Incubatee

The distinction between the definitions of BI appears to translate into two types of incubatees. Rice (2002) defines business incubatees as the entrepreneurial ventures located within an incubator that consume business assistance outputs that are co-produced with the incubator. Lockett and Wright (2005), and Vohora et al. (2004) define incubatees located within university BIs as new ventures based around a core technology of the university. Table 3 displays more definitions of business incubatees found in the literature.

Table 3 - Various Definitions of Business Incubatees

Sources	Definitions of Business Incubatee
(Corsten, 1987)	[Universities are the technology providers and] small and medium-sized enterprises the technology recipients.
(Rice, 2002)	The entrepreneurial ventures located in an incubator, as "consumer" of those [business assistance] outputs, operate in an interdependent co-production relationship with the incubator.
(Broekstra, et al., 2002)	A spin-off of a knowledge institution is a new venture that uses recently developed knowledge of that knowledge institute as a substantial contribution for the start-up.
(Vohora, et al., 2004)	We define the university spin-outs as a venture founded by employees of the university around a core technological innovation which had initially been developed at the university. The university spin-out is created solely to overcome technical and market uncertainties inherent in the perceived commercial opportunity.
(Lockett & Wright, 2005)	We narrowly define university spin-outs as new ventures that are dependent upon licensing or assignment of the institution's intellectual property for initiation.

After analyzing these incubatee definitions, two types of incubatees emerge: spin-offs and spin-ins. Spin-offs are defined as incubatees that use a core developed knowledge of the incubator as a substantial contribution for the start-up. The developed knowledge can be either technological or nontechnological depending on the focus of the incubator. On the other hand, spin-ins are incubatees that start-up a company that is not based around core knowledge developed by the incubator but consume resources provided by the incubator. Now that the definitions of BIs and incubatees are addressed, attention is shifted towards the support services offered by BIs.

2.2 Incubator Services

BIs provide support services and resources, but what do these services and resources consist of, and how does the literature define these offerings? In their study, Aerts et al. (2007), identified 23 different services provided by 107 incubators in Europe. The services are ranked based on the amount of incubators that offer these services. According to these numbers, more than 90 BIs offer conference facilities or meeting rooms, services related to networking, business planning and forming a company. There are a lot of incubator services mentioned in literature (Table 4). However, it can be concluded that these BIs services are overall consistent across studies based on the frequency of their mentioning. When comparing these services, a pattern emerges that can accommodate a categorization of BI resources.

Table 4 - Business Incubator Support Services and Resources

Sources	Incubator Services
(Hisrich & Smilor, 1988)	Secretarial support; administrative assistance; business expertise (e.g., management, marketing, accounting, and finance); facilities support; and access to networks.
(Mian, 1996)	Shared office services; business assistance; access to capital; business networks; rent breaks.
(Lalkaka, 1996)	Finance service, marketing and legal support; counseling and training services; business information services; shared office facilities & equipment services; affordable modular rented space on flexible terms.
(Hansen, Chesbrough, Nohria, & Sull, 2000)	Office space; coaching; funding; information technology; public relations; recruiting; legal; accounting; pooled buying programs (e.g. media); organized networking.
(Phillips, 2002)	Access to labs, lab equipment, and sophisticated computer equipment; help in obtaining equity financing; clerical and receptionist services; and office equipment and furniture.
(Hackett & Dilts, 2004b)	Secretarial support, administrative support, facilities support, and business assistance.
(Grimaldi & Grandi, 2005)	Assistance in developing business and marketing plans; building management teams; obtaining capital; access to a range of other more specialized professional services; flexible space; shared equipment; and administrative services.
(Zedtwitz & Grimaldi, 2006)	Physical infrastructure; office support; access to capital; process support; and networking.
(Schwartz & Hornych, 2008)	Flexible below market rental space (office, manufacturing space, laboratories); collectively shared facilities and services (conference rooms, secretarial support, IT and presentation infrastructure, etc); managerial services and business assistance in fields such as marketing, accounting, human resources or legal matters.
(Aaboen, 2009)	Space; goals; marketing; management; structure; and financing.

By developing a categorization of BI services a distinction can be achieved that can be integrated into the BI framework. For example, Bergek and Norrman (2008) identified four components of BI services that received particular attention in the literature. The authors grouped the components into three main categories: i) shared office space; ii) a pool of shared support services and business support; iii) network provision of internal and external resources. Bruneel et al. (2012) proposed a similar segmentation to capture the evolution of the business incubation value proposition across generations. The authors make a distinction between: i) infrastructure; ii) business support, and; iii) networks. Todorovic and Moenter (2010) also used a similar

segmentation. Using this grouping of components as inspiration, a categorization of BI resources is developed along three dimensions: i) infrastructure; ii) business assistance, and; iii) access to networks and clusters.

2.2.1 Infrastructure

Infrastructure as presented here, is similar to what Rice (2002) refers to as passive environmental intervention; the concept that captures the various ways the incubator assists the incubatees that do not involve the incubator manager directly (e.g. office space, laboratories, equipments, software, conference rooms, computers, administrative services, secretarial support, etc). Most services provided through the infrastructure are services that are available for every incubatee; they do not differ significantly from incubatee to incubatee. These services are usually provided against relatively low prices since they belong to a pool of shared support services and resources which results in a reduction of overhead costs.

2.2.2 Business assistance

Business assistance includes coaching, training, financing, intellectual property protection, business and product development, etc. Business assistance is related to the business development activities of the incubatees and is provided by the incubator manager directly to the incubated firm. Technical assistance includes access to incubator research activity and assistance through the transfer of technological know-how skills and adoption of incubator technologies (Phillips, 2002; Scillitoe & Chakrabarti, 2010).

Counseling Method

Counseling is a form of business assistance that received particular attention by Rice (2002). Counseling refers to the actual diffusion of knowledge and advice to entrepreneurs in the domain of business start-ups and has been emphasized as a critical part of business assistance in the literature (Rice, 2002). The author identified three different approaches to counseling. The first is ‘‘reactive and episodic’’. In this mode, the entrepreneur requests help dealing with a crisis or problem. The second type of counseling is ‘‘proactive and episodic.’’ Because of co-location, the incubator manager can be proactive in engaging entrepreneurs in counseling on an episodic basis. The third type of counseling is ‘‘continual and proactive.’’ The counseling efforts are focused on the ongoing developmental needs of the entrepreneur and the incubator. Bergek and Norrman (2008) call one extreme of counseling ‘strong intervention’, this is when the incubatees are guided by a steady hand of incubator managers. At the other extreme, which the authors call, ‘laissez-faire’, is when incubatees are left entirely to themselves and are provided with very little assistance unless they take the initiative.

Thus, the different approaches to counseling seem to impact the diffusion of business assistance when it is transferred to the incubatee. It is therefore necessary to study the type of counseling to understand how business assistance is being transferred and consumed by business incubatees when managing problems.

2.2.3 Access to Networks

The last dimension is access to networks. When the incubator is unable to contribute knowledge directly, the incubator still possesses the ability to link the firm with other actors in and outside the social structure of the incubator (Hansen, et al., 2000). Linking the firm to other actors, inside and outside the BI, facilitates the entrepreneurial firm's acquisition of knowledge (Rice, 1992; Studdard, 2006). When incubatees have access to incubator networks, the incubator acts as a mediator by providing the available resources and contacts in its network to the incubatees (Rice, 2002).

Clusters

According to Porter (1998), clusters are geographic concentrations of interconnected companies and institutions in a particular field. Clusters are relevant to firm development because it is believed that they offer benefits such as; better access to employees and suppliers, access to specialized information and access to institutions and public goods (Porter, 1998). For example, science or research parks are considered to be clusters, because they provide clustering effects (Chan & Lau, 2005; Löfsten & Lindelöf, 2002). Chan & Lau (2005) define a science park as a property based initiative which has a formal link with a university, which encourages formation and growth of businesses on site, and which has a management function engaged in the transfer of technology and business skills. By taking incubator networks and clusters into account, indirect contribution of the BI to the incubatee can be observed. The benefits of clusters such as Science Park are regarded as incubator resources when it mediates through the networks of the incubator.

2.3 Incubator Types

There are various BI types identified in business incubation literature (Table 5). For example, Grimaldi and Grandi (2005) identified four main types of BIs; business innovation centers, university BIs, independent private incubators, and corporate private incubators. Perhaps more importantly are the characteristics that researchers use to differentiate each incubator type from one another. Zedtwitz and Grimaldi (2006) based similarities and differences on incubator variables, such as their strategy, profit-orientation, competitive scope and services offered. Grimaldi and Grandi (2005) took a slightly different approach by looking at the industrial sector, services offered, and management teams. For example, according to the author's typology of BIs, the university BIs are set up by universities willing to adopt a directly entrepreneurial role in generating and spreading scientific and technological knowledge (Grimaldi & Grandi, 2005).

BI types are generated based on the characteristics that shape the segmentation of incubators. The typologies are used mainly to describe incubators. However, one specific characteristic of BIs—incubator strategies, received relatively more attention in the literature. Incubator strategies are used not only to develop a typology of BIs, they are also used to analyze and assess BIs.

Table 5 - Various Types of Business Incubators

Sources	Incubator Types	Segmentation
(Adkins, 2002; NBIA)	Nonprofit: stand-alone incubators; incubators that are part of larger tax-exempted entities; incubators that work closely with other organizations.	Tax status; organizational structure.
	Profit: real estate and leases; equity holders; spinning out/in companies.	Tax status; return on investment.
(Phillips, 2002)	University (technology) Incubators; Private Incubators; Hybrid Incubators.	Incubator objectives; sponsors.
(Grimaldi & Grandi, 2005)	Business Innovation Centers; University Business Incubators; Independent Private Incubators; and Corporate Private Incubators.	Mission; incubation period; industrial sector; services; and management teams.
(Carayannis & von Zedtwitz, 2005; Zedtwitz & Grimaldi, 2006)	Regional business incubators; University incubators; Independent commercial incubators; Company-internal incubators; Virtual incubators.	Incubator strategy; profit-orientation; competitive scope; and services offered.

Below, two incubator strategies are discussed, the generic strategy and the selection strategy. These strategies have implications for both the resource pool of BIs and the criteria for selecting incubatees.

2.4 Incubator Strategies

2.4.1 Generic Strategy

Clarysse et al. (2005) found three main incubation models based on the activities and resources offered by research institutions: i) the low selective model; ii) the supportive model, and; iii) the incubator model. The authors arrived at the different models by analyzing the BIs in terms of the resources utilized and activities undertaken to achieve the goal of creating new spinout ventures. The resources are related to financial resources, organizational resources, human resources, technological resources and physical resources. The low selective model and the incubator model represent the extremes of the spectrum. The low selective model needs the lowest number of resources in terms of quantity, and the incubator model needs the highest number of resources.

The low selective models need only a few managers, and no organizational structure has to be created separate from the institution. The financial resources are limited to a small amount of (public) money and the infrastructure is shared with that of the research institute. Finally, the entrepreneurial climate within the research institute is considered important.

In the incubator model, incubatees are seen as an option where the technology is really cutting edge, and a financial participation might generate more revenues for the research institute than future contract research. Institutes employing an incubator model hire experienced professional staff and focus on in-house specialists. The technology is narrowly focused on

specialism, the internal physical space and infrastructure is offered for free. Financial resources consist of (large amount of) money invested by private venture capitalists or the research institute itself. Finally, the entrepreneurial network is considered very important.

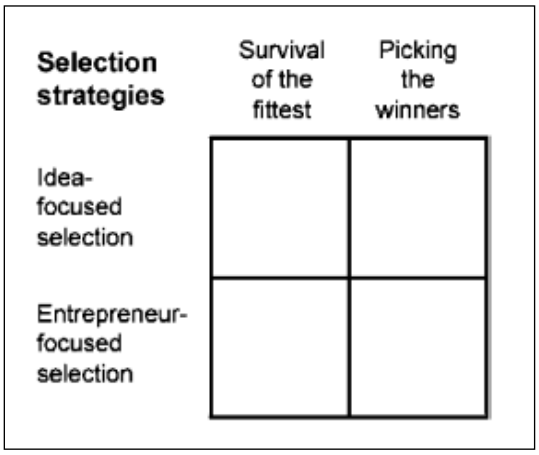
The authors also describe each model based on the activities undertaken to achieve the goal of the incubator. One of the activities is related to the selection strategy of incubatees. For example, the low selective model employs extremely low selection criteria in order to maximize spin-outs. The supportive model focuses on potential growth of the incubatees, and the incubator model focuses on growth and return on investment. While authors mention selection strategy, its implications on incubatees are not discussed. This is the reason why attention is paid to the selection strategy in the following section.

2.4.2 Selection Strategy

Some studies set out to analyze strategies of BIs, develop typologies and taxonomies in order to study the relationship between different types of incubators and discuss their ability of producing successful incubatees (Aerts, et al., 2007; Bergek & Norrman, 2008; Clarysse, et al., 2005; Di Gregorio & Shane, 2003; Grimaldi & Grandi, 2005; Schwartz & Hornych, 2008). Methods researchers apply to achieve this is by analyzing the selection procedure of BIs, the array of services offered and the way these services are transferred from the incubator to the incubatee. Employing strict selection procedure has been mentioned to be problematic since it causes selection bias (Aerts, et al., 2007; Hackett & Dilts, 2004b). If an incubator only selects firms that are weak but promising, this might lead to a higher survival rate not necessarily because of the support provided by the BIs but because of, for example, their maturity and proven credibility indicating that their products are viable on the market. The opposite might also be true; BIs might cause life-prolonged effects rather than enhancing the firms' survivability (Schwartz, 2008). Schwartz (2008) argues that selection procedures are not strong predictors of survivability long after the incubation stage. The results of his study show that incubator selection mechanisms do not substitute market selection.

Thus, the findings are somewhat divergent and further study may be needed to reveal conclusive evidence on a classification system's predictive ability. At this point in time, incubator classifications may only be used to provide insights on how an incubator may be managed and not as a predictor of their incubatees success (Hackett & Dilts, 2004b; Schwartz, 2008). It is therefore considered necessary to investigate the selection strategies that BIs employ in order to understand its implications for resource utilization by incubatees. Since the focus of this study is limited to resource utilization of incubatees—not their trajectory after incubation—the selection procedure might impact the way resources are being utilized, this is especially true for the nature of these resources. For example, if a BI selects only technology-based firms based on their growth potential, this strategy might help explain why a certain type of resource is being used more (for example, fast-prototyping capabilities of the incubator) rather than another resource (for example, the incubator's market research capabilities).

Figure 5 - Selection Strategies
Source: Bergek and Norrman (2008)



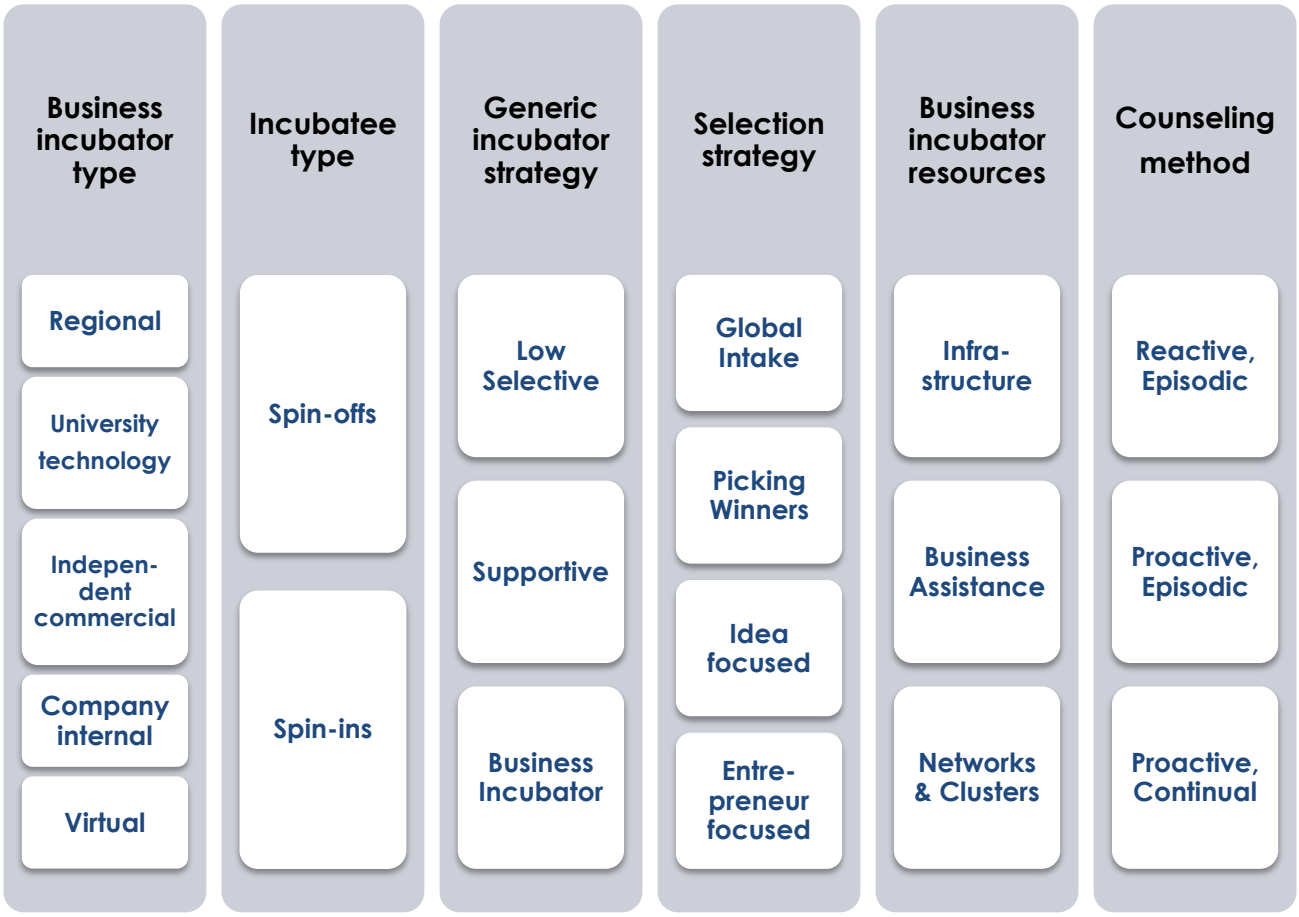
Bergek and Norrman (2008) distinguish between four approaches to how incubators select incubatees (Figure 5). When incubators employ the idea-focused approach, they tend to focus primarily on the viability of the business idea. When selecting incubatees based on entrepreneur and the management team, criteria such as personal experience, skills, characteristics weight more during selection. These first two approaches can be combined with "picking the winners" and "survival of the fittest" (or global intake) approach. When incubators are picking winners, they apply strict selection criteria in order to attract incubatees with the most growth potential. When the selection criteria are less rigid, incubators take on a larger number of firms and rely on markets to provide the selection process.

Bergek and Norrman (2008) admit that their approach have similar features compared to the models developed by Clarysse et al (2005). The four approaches to selecting incubatees can be combined with the models developed by Clarysse et al (2005). In doing so, it enriches the analysis of BI strategies by providing another layer of depth into the selection strategies of incubators. The selection strategy, as presented here, is therefore applied as an additional layer of analysis on top of the models discussed by Clarysse et al (2005).

2.5 Business Incubator Framework

This chapter set out to develop a framework to facilitate the analysis of BIs in an attempt to investigate the incubator's dimensions that might have an impact on how incubatees use incubator resources. The BI assessment framework is displayed in Figure 6. Dimensions such as, incubator and incubatee type, incubator resources, incubator strategy and counseling are emphasized.

Figure 6 - BI Assessment Framework



Chapter 3 – Problem Co-Solving Framework

3.1 Findings of Incubatee Development Studies

This section discusses relevant findings of studies conducted in the business incubation literature where the incubatee is the unit of analysis. Studies that analyze technology firms and employ case study designs are prioritized to make comparison of findings more meaningful (Table 6).

3.1.1 Utilization of BI Resources

Mian (1996) investigated the various services provided by university technology business incubators (UTBIs) that make a contribution to new technology-based firms (NTBFs). The author identified two main categories of services. The first category covers the typical BI services, such as office services, business assistance, rent breaks and business networks. The second category includes university-related services, such as technology transfer programs, student employees, laboratories/workshops, related R&D activity and equipments. The findings indicate that the most frequently used and highest valued services in the first category are; government grants and loans, business planning and business connections outside the incubator. In the second category, the most value-added university related services are reported to be; university image, laboratories/workshops and equipment, and student employees. The study doesn't cover the consequences of resource utilization for the incubated firms.

Burnett and McMurray (2008) explored the reasons why start-up firms choose to join BIs and how the incubators assisted the new venture during the incubation process. The findings reveal that the firms join the incubator to remove the feeling of being isolated from others. The firms want to take advantage of the opportunity to network with other incubatees and have access to various incubator services. Regarding the importance of incubator resources, accessibility to markets, access to internal networks, physical space, and access to mentoring were the most predominant ones.

A study conducted by Chan and Lau (2005) revealed that rental subsidies, central pool of resources, infrastructure and obtaining consulting/counseling services from the incubator are considered important incubator resources by the technology incubated firms. However, the firms did not perceive public imagine to be important, nor were they impressed by the marketing efforts organized by the incubator. Perhaps more importantly, networking / clustering and sharing of technology resources among firms did not contribute any significant value to the development of the firms.

3.1.2 Knowledge Transfer through Business Assistance

Rice (2002) explored the types of business assistance found in BIs and the factors affecting its execution. The author calls this the co-production dyad, and its output is business assistance. The findings suggest that the time intensity of the co-production must be strategically allocated by the

incubator manager to the incubatees. The incubator managers must invest more time and engage proactively while deploying the various incubator resources in order to exhibit a greater impact on the incubatee.

Table 6 - Previous Studies on Incubated Firms

Study	Method	Purpose	Findings
(Mian, 1996)	Case study; 6 UTBIs; embedded survey; 47 NTBFs.	Assess value-added contribution from UTBIs to NTBFs.	Grants & loans, business planning, connections outside of incubator, image, labs and equipment, student employees are considered valuable resources.
(Rice, 2002)	Case study; 8 incubators; interviews 32 firms, surveys.	Explore the types of business assistance and factors affecting its impact the incubatee.	Advice on business planning, teambuilding, financing, access to labs and equipment, and are frequently provided via networks and counseling.
(Vohora, et al., 2004)	Longitudinal Case study; 9 firms; 7 universities; interviews.	Model the formation and early growth of university spinout companies.	Firms need market knowledge, social capital, committed champion/entrepreneur, seed finance, strong management team, capability to reconfigure resources to continually develop.
(Chan & Lau, 2005)	Case study; 6 technology firms; interviews.	Examine the effectiveness of BI from a development process perspective.	Rental subsidies, resource pool, infrastructure and counseling are important. Less important resources include networks and public image.
(Studdard, 2006)	52 firms; single response self-report data; cross-cultural, interviews.	Explore how the firm's acquisition of knowledge from the incubator impacts performance.	The sole knowledge benefits gained by the firm from the incubator relationship, is a perception of enhanced reputation.
(McAdam & McAdam, 2008)	Longitudinal case study; 18 firms; 2 universities; interviews.	Explore the longitudinal use of unique resources of the USI by HTBFs at different lifecycle stages.	Important resources include, support infrastructure, networks and credibility. Challenges include, marketing, develop expertise within the firm, maintaining control, delegation and securing venture capital.
(Burnett & McMurray, 2008)	Case study; 12 firms; 2 incubators; semi-structured interviews.	Understand why start-ups choose incubators and what services they use.	Firms enter incubators to use networks & BI services. Access to markets and internal networks, physical space and mentoring are considered important BI services.

In addition, the incubatees must be properly prepared to utilize the advice and insights resulting from the co-production in order for the impact to be in full effect. The author also investigated the types of business assistance received via counseling and networking. The findings show that business planning / strategic planning, and advice about team building were the most frequent type of business assistant provided via counseling. Assistance to gain outside equity financing, legal and patent services, and access to labs, equipment, shops etc. were more frequently provided via networks.

Studdard (2006) examined the effectiveness of the business management knowledge acquired by newly developed high technology firms from interaction with incubator management. The study examined the results on the firms' new product development, technical competence, reputation and decreases in cost of customer sales from this association. The results demonstrate that improved reputation is the only significant outcome the firm gains as a result of the knowledge acquired through its interaction with the BI manager. The study implies that firms often join incubators not because they require additional knowledge, but because the incubator improves or enhances the reputation of the firm. It is also believed that reputation enhancement brought on by incubator association makes firms more attractive to venture capitalists because it increases their credibility. New product development, enhanced technical competence, and decreases in cost of customer sales were not affected by knowledge transfer through business assistance.

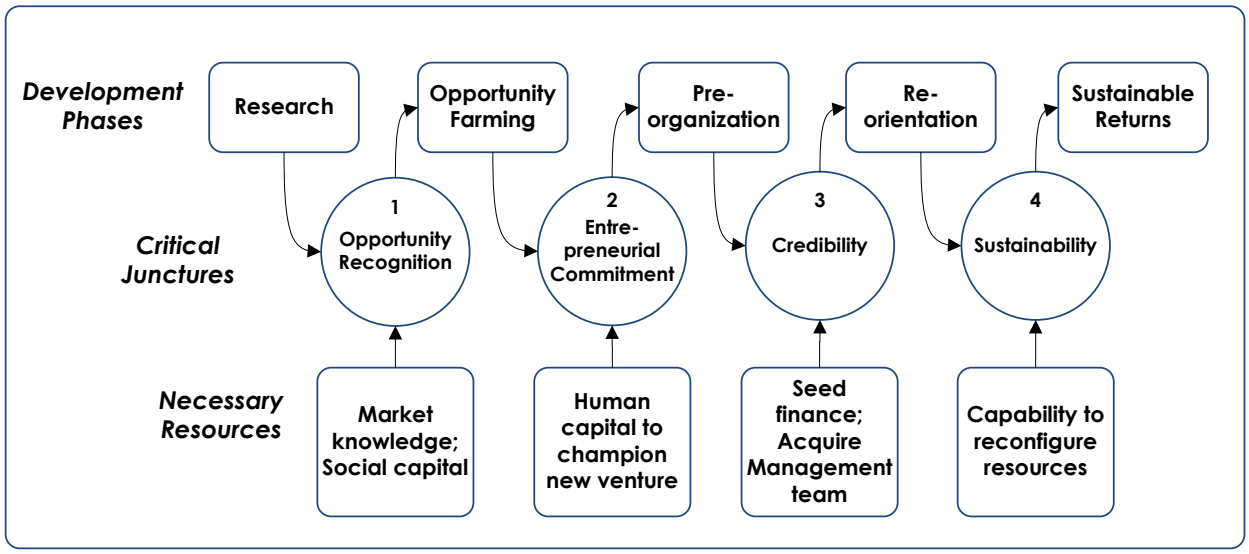
Finally, Burnett and McMurray (2008) found that firms rated a mentor or personal business advisor as highly important to the survival of their business. The type of mentoring that occurred in both incubators embraced a variety of business issues; for example, help with marketing strategies, such as identifying a market and developing a marketing plan, IP protection, and other areas of business planning.

3.1.3 Incubatee Development

Studies focused on the development of incubatees analyze firms at different stages of their development (Chan & Lau, 2005; McAdam & McAdam, 2008; Vohora, et al., 2004). These studies employ a longitudinal approach and follow the same cases for a long period of time (usually 3 years) (McAdam & McAdam, 2008), or ensure variance in the stages of development when selecting the sample of cases (Chan & Lau, 2005; Vohora, et al., 2004).

Vohora et al. (2004) investigated the development stages of university spinout companies (USO) and revealed the critical junctures USOs most overcome in order to continually develop. The observations showed two important elements in the development of university spinout companies (Figure 7). First, spinout companies go through an iterative non-linear development process consisting of five development phases. Second, in order to make the transition through the development phases successfully, the firms must face critical junctures in terms of resources and capabilities they need to acquire to progress to the next phase.

Figure 7 - Development Phases, Critical Junctures and Resources
Adapted from Vohora, et al. (2004).



The first critical juncture is recognizing an opportunity. Without developing, acquiring or accessing the capability to combine scientific knowledge with a commercially feasible offering that satisfies an unfulfilled market need, academic scientists are not able to proceed towards commercializing their technologies. The authors identified overcoming the critical juncture of opportunity recognition as the ability to synthesize scientific knowledge with an understanding of markets that is enhanced significantly by higher levels of social capital in the form of partnerships, linkages and other network interactions. Entrepreneurial commitment is the second critical juncture. Commitment is an act which binds the venture champion to a certain course of events. The authors propose that there is a need for an individual to be emotionally committed full time to resolving this uncertainty and intense complexity through championing the venture beyond the start-up phase. The entrepreneur's ability to gain access to and acquire an initial stock of resources is the third critical juncture. Universities can demonstrate the credibility of their university spinout companies to the market by presenting IP as a potential portfolio of products, demonstrating proof of concept of technological assets, clarifying the route to market and profitability, and being able to locate the venture off the university campus in order demonstrate clear intentions to develop the technology commercially. Once the venture has received seed financing and starts the process of commercially exploiting its technological assets, the study shows that it comes up against a final critical juncture; sustainable returns. It's imperative for the entrepreneurial teams to acquire the ability to continuously re-configure existing resource weaknesses, inadequate capabilities and social liabilities into resources strengths, distinct capabilities and social capital that will enable the university spinout company to generate returns.

McAdam and McAdam (2008) used a lifecycle approach to understand the development of high technology business firms (HTBFs) in University Science Park incubator (USIs). The authors identified several challenges related to their development. These challenges include; i)

getting access to funding, marketing and increasing sales revenues; ii) gaining independence by developing expertise within the firm; iii) delegation of responsibilities; iv) maintaining control and implementing systems; v) securing venture capital. The findings reveal that during the initial stages, provision of support infrastructure proved to reduce challenges associated with the practical side of venture creation. The University Science Park Incubator (USI) was identified not only as important within the portfolio of relationships but also critical in terms of facilitating developing networks with other third parties, including getting access to customers, suppliers and venture capitalists. The increase of perceived credibility of the incubatees was also mentioned, but the relevance of the incubator adding credibility declines over time as the firms become more mature.

3.1.4 Mentions of "Problem"

There is a hidden underlying consistency about the way authors mention "problems" across the studies reviewed here. Some authors mention problems implicitly and others mention it explicitly. For example, Vohora et al. (2004) define critical junctures as "complex problems" that occurs at a point along a new high-tech venture's expansion path preventing it from achieving the transition from one development phase to the next. The authors wondered what the key "challenges" are that incubatees face in their development. Rice (2002) mentions "short-term crisis" or "problems", suggesting that business assistance might help firms solve short-term problems by providing them with business assistance services. McAdam and McAdam (2008) uses the term "challenges" to describe the problems that incubatees must overcome at different lifecycle stages when managing growth. Burnett and McMurray (2008) identified "business issues" such as such as identifying a market and developing marketing plan, IP protection, and other areas of business planning that were embraced within the incubators. Chan and Lau (2005) also mention "solving problems" in a similar context. Regarding the mentoring system within incubators, the authors identify "the provision of advice on solving problems they [the firms] face during the incubation process" as a key feature of the mentoring system.

The frequency and consistency of which "problems" are mentioned across the literature is surprisingly notable. This shows that there is fertile ground to develop a framework around problem solving within incubatee development research stream that will contribute to this topic.

In the remainder of this chapter, three concepts that are central to the conceptual framework are discussed. These include; i) the RBV; ii) entrepreneurial opportunity recognition related to; iii) the problem solving perspective. These concepts are broken down into their essence and reconstructed into the Problem Co-Solving framework.

3.2 Resource-Based View in the BI Literature

The RBV, and the utilization of resources is a well known topic in the business incubation literature (Lockett & Wright, 2005; Löfsten & Lindelöf, 2005; McAdam & McAdam, 2008; Mian, 1996; Rice, 2002; Schwartz & Hornych, 2008; Vohora, et al., 2004). Many of these studies apply the RBV to support the logic that explains why incubator resources contribute to

new firm development. The RBV suggests that the (long-term) competitiveness of a firm depends on its endowment of resources that differentiate it from its competitors, that are durable, non-tradable, non-imitable and non-substitutable (Jay Barney, 1991; Dierickx & Cool, 1989; Rangone, 1999).

Some authors suggest that resources, capabilities and knowledge are closely interlinked (J. Barney, et al., 2001). Moreover, capabilities are also considered to be resources, capabilities are therefore also discussed in light of the RBV. Nickerson & Zenger (2004) define capability as the input-output combinations achievable with all possible mixed and levels of activities known to the firm. Winter (2003) defines organizational capability as a high-level routine (or a collection of routines) that, together with its implementing input flows, confers upon an organization's management a set of decisions options for producing significant outputs of a particular type. Makadok (2001) presents a broader definition of capabilities and referrers it to a firm's capacity to deploy resources, usually in combination, using organizational processes, to affect a desired end. They are information-based, tangible or intangible processes that are firm-specific and are developed over time through complex interactions among the firm's resources. They can abstractly be thought of as 'intermediate goods' generated by the firm to provide enhanced productivity of its resources, as well as strategic flexibility and protection for its final product or service (Makadok, 2001). Furthermore, capabilities fill the gap between intention and outcome, and they fill it in such a way that the outcome bears a definitive resemblance to what was intended (Dosi, et al., 2001). Thus, a firm's capability is essentially the firm's ability to develop, combine, reconfigure, and bundle resources through firm specific routines in order to produce value that is hard to imitate. Resources and capabilities are important for the effectiveness of the firm's performance (Jay Barney, 1991). Moreover, it is believed that in the early stages of new venture development, the identification and acquisition of resources—rather than the deployment or allocation of activities—is considered crucial for the firm's long-term success (see for example, Lichtenstein & Brush (2001)).

It can be argued that the BI facilitates the early acquisition and accumulation of resources and impacts how firms manage, combine, and deploy resources to create unique value. Studies that apply the RBV within an incubator context share a similar view. Aaboen (2009) explains that the new technology-based firms are so new that they initially have very few resources, and that the novelty of the product and the firm also make availability of the needed resources scarce. The incubator is expected to accelerate and facilitate the development of these firms. Furthermore, McAdam & McAdam (2008) argues that from a RBV, the incubator adds to the stock of resources available to the organization without incurring substantial costs. Vohora et al. (2004) also applied the RBV within this context. The authors argue that a resource-based perspective suggests that in order to progress through different phases of development, university spinout companies need to develop both resources and internal capabilities over time. While not directly related to the RBV, Rice (2002) expresses a similar view that is discussed so far. The author suggests that the inputs of the co-producers flow together to create the business assistance outputs that fill gaps in the resources of the entrepreneurial firms. Filling these gaps enhances the

capacity of the firm to deal with crises and problems and to pursue ongoing development of the firm, its products, its markets, and its financial resources. The notion of the incubator adding to the firm's stock of resources is also reflected in the way Phillips (2002) defines technology transfer. The author defines technology transfer as the transfer of a technology, technique, or knowledge that has been developed in one organization [the incubator] and then transferred to another where it is adopted and used [the incubatee] (Phillips, 2002).

Thus, many authors apply the RBV in business incubatee studies and agree on the view that BIs support new firm development by adding resources to their stock of resources. Consistent with the views presented in this section, the RBV is adopted as the first part of the framework. How problems are related to opportunity recognition is the subject of the next section.

3.3 Problem-Solving Perspective

3.3.1 Entrepreneurial Opportunity

There are several definitions of entrepreneurial opportunity, and opportunity recognition. Baron (2006) defines opportunity as a perceived means of generating economic value (i.e. profit) that previously has not been exploited and is not currently being exploited by others. Opportunity recognition is defined as the cognitive process (or processes) through which individuals conclude that they have identified an opportunity (Baron, 2006). Similarly, Barney, et al. (2001) define opportunity recognition when certain individuals have insights into the value of resources that others do not. Eckhardt and Shane (2003) define entrepreneurial opportunities as situations in which new goods, services, raw materials, markets and organizing methods can be introduced through the formation of new means, ends, or means-ends relationship. Opportunity discovery is related to the perception of the new means-ends framework that can guide information and resources to make decisions. Hsieh, et al. (2007) mention two types of opportunities, where novel problems are identified (e.g. as with different geographic markets) or novel solutions are found (e.g. as with innovative production processes and organizational forms). Thus, entrepreneurial opportunity is related to both the identification of valuable (novel) products or services and the valuable (novel) markets they serve. Opportunity discovery is the perception expressed by an individual (the entrepreneur) of these valuable product/service-market combinations.

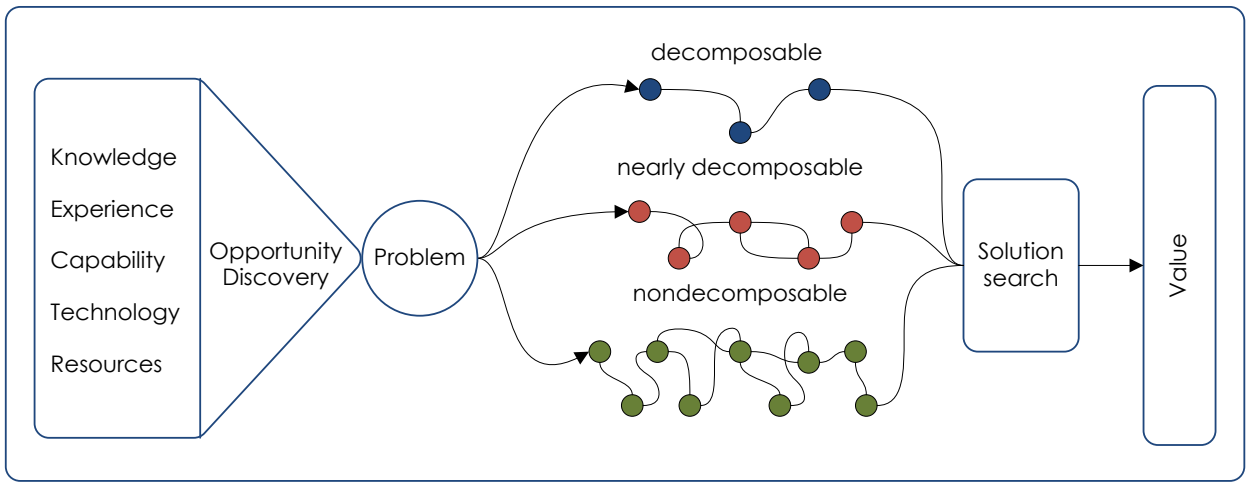
Hsieh, et al. (2007) go a step beyond these definitions of opportunity and discovery by relating opportunity to valuable problem-solution pairings and discovery to the process of searching for a valuable solution. The authors define entrepreneurial opportunity as a unique, valuable problem-solution pairing. While the opportunity is considered to be inherently valuable, the problem related to the opportunity has to be solved, in order for new knowledge or capability to be created (Hsieh, et al., 2007; Jackson A. Nickerson, et al., 2007; J. A. Nickerson & Zenger, 2004). Valuable solutions deliver value to the firm, either through enhancement or development of a product or service or by reducing the cost of production or delivery.

Discovering an opportunity (problem-solution paring) involves two activities; the entrepreneur can either stumble upon a problem, or deliberately select a problem to solve after recognizing an opportunity. The value of a particular problem depends on two factors: i) the values of the array of possible solutions, and; ii) the costs of discovering a particular valuable solution. After selecting a problem, the entrepreneur then organizes a solution search to effectively solve the problem (Hsieh, et al., 2007).

3.3.2 Problem Complexity

Problem-solving involves making design choices and commercialization choices about the products or services that are to be sold. These choices make up the solutions to the problems. 'Design choices' are related to those product- or service-oriented choices related to what the end customer directly perceives or experiences (e.g. the types of materials used, properties of the product). 'Commercialization choices' are related to those choices that the end customer does not perceive or experience (e.g. which supplier is contracted and the internal production processes). Marketing is an example that combines both types of choices, since it includes decisions about the design and commercialization. The complexity of a problem is a function of the degree to which the individual design choices—which define a solution—are either independent or interdependent in their contribution to the solution value. The authors discuss three degree of problem complexity. Decomposable problems are those problems where few interdependencies exist among knowledge sets. Nearly decomposable problems relate to those where changes made to choices being to interact dramatically in unpredictable ways with respect to the solution value. Problems are non-decomposable when the value of a change in any individual choice interacts with the value of many other choices (Figure 8).

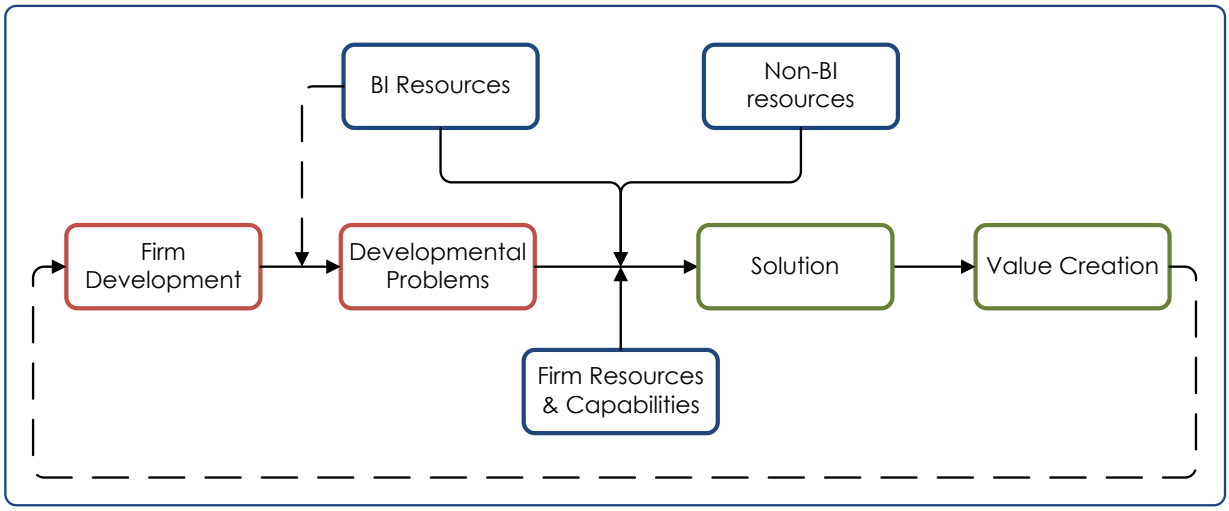
Figure 8 - Graphical Representation of the Problem Solving Perspective
Adapted from Hsieh et al. (2007) and Nickerson & Zenger (2004).



3.4 Problem Co-Solving Model

Firms that recognize opportunities have the ability to discover potential unexploited valuable solutions. In order to exploit this opportunity, firms must be capable to solve problems that will inevitably arise during the process of solution search. By solving problems, firms are able to add value to their bundle of resources. Within a supportive environment, it is argued that incubated firms can temporarily utilize resources provided by the incubator to increase their capability to solve developmental problems. The ability to solve a problem is considered a capability in itself (Zahra, Sapienza, & Davidsson, 2006), since firms have to be able to manage and combine resources in order to find valuable solutions. This is the underlying logic that connects the RBV; the problem solving perspective and new firm development within BIs onto the Problem Co-Solving Model (Figure 9). It is assumed that incubated firms already recognized an opportunity and therefore decided to start up a company to exploit the discovered opportunity. Opportunity recognition is often regarded as a starting point of the development of incubated firms (Lockett & Wright, 2005; Vohora, et al., 2004).

Figure 9 - Problem Co-Solving Model



The Problem Co-Solving Model captures the process of solution search within BIs. The model attempts to identify the types of resources that are used during the solution search when managing a problem. It is assumed that firms pursuit development and opportunity exploitation by executing a desired strategy. Problems considered relevant are problems that disrupt the development progress of the firm. When this occurs, firms proceed to solve problems by; using internal firm resources, BI resources, non-incubator resources, or a combination of those resources. The concepts within the model are build onto a framework that consists of three sections; i) developmental problems; ii) types of resources used; iii) effectiveness of solution search.

3.5.1 Developmental Problem

Problem Complexity

Inspired from the theory of the entrepreneurial firm, the degree of problem complexity is related to the amount of resources needed in order to manage a problem. Since a problem represents the absence of a solution (to address a desired need), complexity is observed in the amount and availability of resources necessary to solve the problem. The framework incorporates the three level of complexity. First, decomposable problems are low in complexity. The resources necessary to solve decomposable problems are available, easily accessible and are not interrelated to other resources. Second, nearly decomposable problems have a medium degree of complexity. The resources are available but not easily transferable among actors, making it interrelated to other resources. Finally, non-decomposable problems are highly complex. The needed resources are very scarce, specific, and highly interrelated with other resources making it a complex problem to manage.

Problem Awareness

It is necessary to make a distinction between two types of problems; predictable and unpredictable problems. Predictable problem are those problems that a firm deliberately chooses to solve. Predictable problems arise as soon as the opportunity is recognized in the form of a gap that the firm is aiming to exploit. Predictable problems are therefore often related to a perceived opportunity. Problems that firms stumble upon are those problems which are initially invisible to the firm. Because of low problem awareness, firms are unable to predict these types of problems.

It is argued that BIs could potentially play an important role in enhancing the firm's ability to predict problems in different areas, especially in those areas where the firm has deficient resources; this is illustrated by the arrow intersecting prior to the identification of developmental problems in the model (Figure 9). The BI could potentially provide (business) support that increases problem awareness beyond the capabilities of the firm making unpredictable problems visible to the firm.

Problem Types

Miles et al. (1978) developed a general model to explain how companies adapt to new environments. The authors view choices related to organizational adaptation as three broad problems: i) the entrepreneurial problem; ii) the engineering problem, and; iii) the administrative problem.

The entrepreneurial problem is described as the problem of identifying new target markets and market segments for a specific product or service. Examples of entrepreneurial problems include customer development, marketing, sales, pricing, etc. The engineering problem involves the creation of a system which operationalizes management's solution to the entrepreneurial problem. The system is defined as a technology or process for producing and distributing the chosen products or services. Examples of the engineering problems are, R&D, product development, production process, etc. The administrative problem involves rationalizing

and stabilizing those activities which successfully solve problems faced by the organization during the entrepreneurial and engineering phases. Some examples of administrative problem include, business and production processes, organizational structure, planning, business modeling, etc. Administrative problems also involves formulating and implementing those processes which will enable the organization to continue to innovate (R. E. Miles, et al., 1978). Problem types are included in the framework consisted with the typology developed by Miles et al. (1978). Using this typology can provide insight to understand what type of resources nascent firms use for each specific type of problem.

3.5.2 Resource Utilization

Firm Resources

Firm resources are internally managed, developed, and owned by the firm. Firm resources can be classified according to the categories proposed by Barney (1991): physical resources; human resources, and organizational resources. Physical resources include the physical technology used in a firm, for example, a firm's plant and equipment, its geographic location, and its access to raw materials. Human resources include the training, experience, judgment, intelligence, relationships, and insight of individual managers and workers in a firm. Organizational resources include a firm's formal reporting structure, its formal and informal planning, controlling, and coordinating systems, as well as informal relations among groups within a firm and between a firm and those in its environment. Because a small firm has limited resources, human resources and the new underdeveloped technology are probably the most common resource for the nascent firm.

Business Incubator Resources

During the incubation stage, firms are not only restricted to using their internal resources but they also have the option to use the resources provided by the BI. The framework used to capture the various BI resources is covered in Chapter 2 (2.2 Incubator Services). BI resources available to manage developmental problems are; i) infrastructure; ii) business assistance, and; iii) networks and clusters.

Non-Incubator Resources

Firms also have the option to use external resources available outside of the firm and the BI. The distinction is made between three types of resources: i) non-BI financial resources; ii) non-BI clients and partners, and; iii) non-BI networks. Examples of non-BI financial resources include bank loans, government subsidy, tax breaks, and investors that are not connected to the BI. Non-BI clients and partners refer to clients and partners that are not connected to the networks of the BI and are not mediated by the incubator. Non-BI networks include every party that is not mediated by the incubator and does not fall within the other two categories. Examples are, suppliers, institutions such as, chamber of commerce, municipalities, accountants, lawyers, consultants, industry related events, conferences, etc.

Table 7 - Components of the Problem Co-Solving Framework

	Concepts	Dimensions	Codes
Problem (RQ 2)	Complexity	Decomposable	Low Complexity
		Nearly decomposable	Medium Complexity
		Non-decomposable	High Complexity
	Awareness	Deliberately chosen	Predictable
		Stumbled upon	Unpredictable
	Types	R&D, Product Development	Engineering
		Management, Financing, Legal, Business Model	Administrative
		Marketing, Sales, Customer Development	Entrepreneurial
Resource (RQ 3)	Firm	Human, Physical, Organizational.	Firm Resource
	Business Incubator	Infrastructure	BI Infrastructure
		Business Assistance	BI Business Assistance
		Network & Cluster	BI Networks & Clusters
	Non-Incubator	Non-Incubator Clients & Partners	Non-BI Clients & Partners
		Non-Incubator Networks	Non-BI Networks
		Non-Incubator Financial resources	Non-BI Financial
	Basic & Salient	Necessary	Basic Resources
		Necessary & Sufficient	Salient Resources
	Control	Within the firm	Internal
		Outside the firm	External
Progress (RQ 4)	Solution Effectiveness	Unsolved	Low
		Partially solved	Medium
		Completely solved	High
	Solution Efficiency	Progression Function	Progress

Salient and Basic Resources

Basic resources are used while managing a problem but are not considered sufficient to successfully solve a problem. Salient resources on the other hand are both necessary and sufficient to effectively manage and solve a problem. For example, physical space (infrastructure) is considered a necessary resource for a software company to house its employees. However, it is not considered sufficient to solve the problem of software development. But for a hardware manufacturing company, physical space is considered both necessary and sufficient to be able to house and operate machinery during product development,

making the infrastructure a salient resource during production. This distinction is considered necessary to emphasize the importance of resources when used to manage problems.

Control

The definition of managing a problem (1.4 Research Questions) states that a firm should be able to *control* the necessary resources in an effort to manage a problem effectively. However, there could be instances where the firm is unable to effectively manage a problem because of its limited ability to control necessary resources or because of its limited participation in decision making processes. For example, think of the influence the government has in highly regulated and established markets when making decisions that could stagnate innovation agendas firms are seeking to promote. The framework distinguishes two modes of control; resources that the firm can directly control (within the boundaries of the firm) and resources that the firm cannot control (outside the boundaries of the firm).

3.5.3 Development Progress

Solution Effectiveness

The solution effectiveness is the extent to which a problem is solved at the time firms leave the incubator. Solution effectiveness is categorized as follows; i) effectiveness is low when the problem is still present; ii) effectiveness is medium when components of the problem are successfully solved; iii) effectiveness is high when the problem is entirely solved.

Solution Efficiency

Solution efficiency refers to the amount of problems solved during the incubation programme. When determining the solution efficiency, problem complexity is also taken into account (4.5.3 Progress). For example, solving a highly complex problem is considered more efficient than solving two simple problems in the same time window. An overview of the framework's components is presented in Table 7.

Chapter 4 – Methodology

4.1 Research Design

A research should contain the most effective design to answer the research questions posed in a study. The central research question is: *How do nascent high-tech firms utilize resources to manage developmental problems within business incubators?* After reviewing literature on research methods it is concluded that the case study design is the most effective research strategy for answering this research question. The main research question is a "how"-question that follows a descriptive approach to analyze the topic under study. Literature on research methods suggests the following (Yin, 2009); *Case studies are the preferred strategy when "how" questions are being posed, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context.*

Since the research question is aimed at understanding how firms manage developmental problems, it is necessary to describe the events involving actions that are taken to manage these problems. A case study strategy will focus on understanding the dynamics present within each single case (Eisenhardt, 1989). The 'dynamics' of firm development, problem management and resource utilization is the focal point within each case. The research design can involve single or multiple cases and numerous level of analysis (Yin, 2009). The decision is made to employ a multiple cases design with five cases. Multiple cases are generally regarded as more robust, providing the observation and analysis of a phenomenon in several settings (Eisenhardt & Graebner, 2007). Authors suggest that multiple cases should follow a replication logic in which cases are treated as experiments, with each serving to confirm or disconfirm inferences drawn from the others (Eisenhardt, 1989; Yin, 2009). Other important uses of cases research are said to be inspiration, motivation and illustration (Siggelkow, 2007). Finally, a longitudinal approach is chosen to cover the development of cases over a time window of six months.

The research design features two units of analysis: supportive environment (BI) and nascent firms (business incubatee), and one embedded unit of analysis: developmental problems. At each level of analysis, different data collection techniques are used, ranging from structured in-depth face-to-face interviews to the analysis of documents, archival records, databases and literature.

Regarding the selection procedure, each case must be carefully selected so that it either i) predicts similar results; a literal replication, or ii) predicts contrasting results but for predictable reasons; a theoretical replication (Yin, 2009). A case-selection procedure that facilities prediction of similar results (a literal replication), is employed. The goal of theoretical (or conceptual sampling) is to choose cases which are likely to replicate or extend the emergent theory (Eisenhardt, 1989). Generalizations from qualitative studies are analytic, not "sample-to-populations" (B. M. Miles & Huberman, 1994). In order to achieve literal replication using this sampling method, the selection procedure is based on the selection of cases that fit a criterion that is consistent and sufficiently narrow to facilitate the prediction of findings.

4.2 Case Sample

4.2.1 Population

The TOP incubation programme is a business supportive programme initiated by the University of Twente in the Netherlands. The participants of the TOP incubation programme consist of researchers employed by the university, PhD students, graduate students and entrepreneurs from the industry (Figure 10). In order to apply for the programme, the participants have to develop and present their business plans to the TOP committee. The TOP management stores these business plans in an archive together with other relevant information about the companies such as, meeting notes, intermediate progress reports, annual reports, presentation slides, etc., in short, sufficient information to facilitate the pre-selection of cases. A database is build based on this information and includes information on all of the recent incubated companies. Since its inception in 1984, more than 350 companies participated in the programme. On average, 15 companies participate in the programme each year. These companies range from university spin-offs catering to high-tech sectors, to start-ups providing services and products to an array of other (non high-tech) sectors. Because of the university's focus on various high-tech research fields, many technological inventions are commercialized through university spin-offs. A majority of these new high-tech firms participate in the TOP incubation programme to receive support during the first years of their development. The TOP programme can be therefore considered to be an attractive incubation programme to study the development of new high-tech firms.

4.2.2 Selection of Cases

The information that is shared between the incubated firms and the incubation managers during the programme are stored by the incubator managers. This information is made available during the research and is used during the selection of cases. A list of requirements is used in order to select a consistent sample of cases that facilitates the prediction of findings (Yin, 2009). The following requirements are used during the case selection procedure, in which the selected firm:

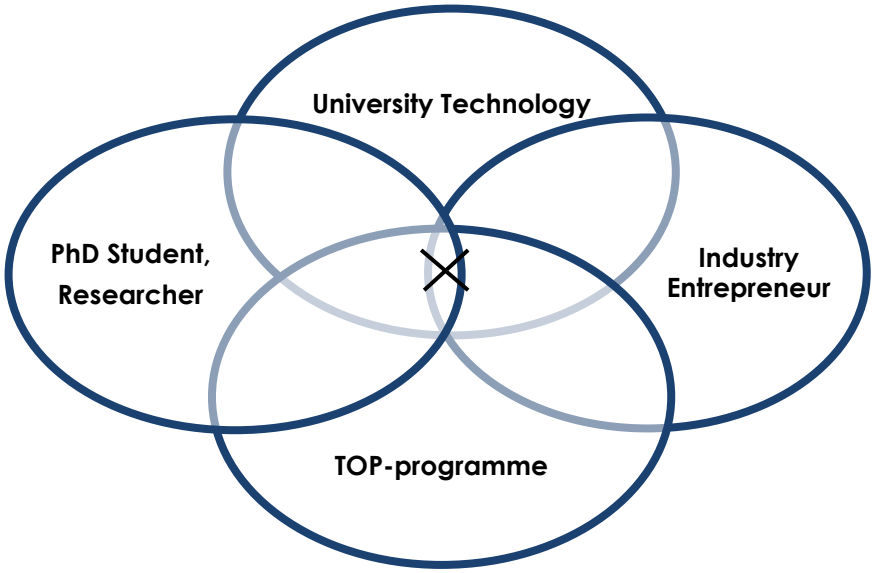
- participated for at least one year in the TOP programme and graduated within four months relative to when primary data is collected;
- are not older than three years;
- fit the definition of high-tech university spin-off firm.

The high-tech university spin-off firm is defined as venture based around a core technological innovation which had initially been developed at the university. The start-up team consists of at least one former university employee. This definition excludes business start-ups or "spin-ins" supported by the university whose products or services are not based on a core technological innovation developed at the university. Furthermore, the definition of high-tech industry and high-tech areas are adopted as defined by Eurostat[2].

[2] The Eurostat's definition of (medium and) high-tech industry includes: pharmaceutical and medical industry, industry for office equipment and computers, industry for radio, TV and other means of communication, industry for

Figure 10 shows the area marked by the "X" symbol which is defined as firms that are initiated by (former) UT employees and industry entrepreneurs that commercialize university technology and is supported by the TOP incubation programme.

Figure 10 - High-Tech University Spin-Off



In order to determine whether a company graduates within the time-window specified, the official starting dates when the company entered the TOP programme are retrieved. The starting date is used to estimate the graduation date through extrapolation. The official period of which a company stays in the programme is one year, but preliminary data collected suggests that there are some instances where companies stay between one to four months longer. To make sure no recently graduated company is overlooked, the delay of four months is taken into account. The procedure yielded a batch of 18 recently graduated companies (Table 9).

The second step is determining the official foundation date of each company. The official foundation date is defined as the year in which the company is registered at the Chamber of Commerce. The official foundation date is therefore retrieved from the Chamber of Commerce website using the company names or their KVK-numbers, both of which are retrieved from the database.

The third and final step is to determine whether the companies fit the definition of high-tech university spin-off. This is achieved by first determining if the company's economic activity contains a nontechnological classification. Every company that registers at the Chamber of Commerce receives a code that indicates the economic activity of the company. This coding

---

medical, precision and optical instruments, aerospace industry, chemical industry, machinery and equipment industry, motor vehicles and other means of transport (excluding building and repairing ships).
The following technology areas are considered high-tech: computers and other automated office equipment, micro-organic and gene technology, aviation, communication technology, semiconductors and lasers. Source, available at: http://epp.eurostat.ec.europa.eu and http://www.cbs.nl.

system is called Standard Industrial Classification ("Standaard Bedrijfsindeling" (SBI))[3]. Based on this classification it can be observed whether a company has a nontechnological or technological orientation. Table 8 includes all of the SBI codes of the companies in the pre-selected batch. Based on this classification, it is concluded that companies with an SBI of 731101 with an economic activity of "Advertising design and consultancy", 70221, "Consultant Management", and 86913 "Practices of psychotherapists and psychologists" are not developing high-tech physical products and are therefore excluded from the batch.

Table 8 - Batch of Preliminary Cases

ID	SBI Code	Classification	Activity
1*	711204	Technical design and advice for electrical, installation and telematics	Cryogenic micro coolers
2*	n.a.	n.a.	Micro needle arrays
3*	620102	Developing and producing custom software	Information driven electronic door- and way-signs
4	731101	Advertising design and consultancy	Graphic designing
5*	72193	Research and development on health and nutrition (not biotech)	Mobile patient monitoring
6*	72199	Other scientific research and development (not biotech)	Ammonia breathes analyzer
7*	2651	Manufacture of measuring, control, navigation and control	Portable virus/bacterium detector
8*	620102	Developing and producing custom software	Virtual identification services
9	n.a.	n.a.	Specialists in EMRAM within the Life Science industry
10*	72191	Research and development on agriculture and fisheries	Portable amino acid diagnostic tool
11*	2573	Manufacture of tools	High-tech laser machinery
12	86913	Practices of psychotherapists and psych ologists	Advice on teenage behavior
13	620102	Developing and producing custom software	Online web-shop platform
14*	72192	Technical R&D	Simulations of metal forming processes
15	70221	Consultant Management	Change-management consultants
16	2910	Manufacture of cars	Innovative automobile designs
17	620102	Developing and producing custom software	Information exchange through video telephony
18	222301	Manufacture of plastic products for construction	3D Rapid model prototyping

*High-tech university spin-off companies.

[3] The list of SBI codes with their respective classifications can be accessed at http://www.kvk.nl/, by using the key-word "SBI" in the search bar.

In order to increase the accuracy in the selection procedure, information is retrieved from the business plans of the remaining companies. The specific activity of the company as described in the company is then used to determine whether the company is a high-tech company or not. The business plans are also used to determine whether the company is a spin-off or a spin-in company. The team of founders of a spin-off company should contain at least one (ex-) employee of the university. This is achieved by analyzing the curriculum vitae of the founders and by tracing the origin to the technology being developed within the company, all of which are provided in the business plans. The companies with the ID, 4, 12 and 15 are nontechnology companies. Companies with the ID, 13, 16, 17 and 18 are defined as high-tech companies but their core technology is not based around a technology developed at the university and the founders are/were not employed by the university. The remaining companies are included in the final sample of cases.

4.3 Data Collection

Interviews served as the primary data collection method during the research. First, preliminary data are collected through semi-structured face-to-face interviews with four TOP experts; two TOP coordinators, and two key actors that were responsible for the developments of the TOP programme during its inception. During this phase, data is collected about the TOP programme aimed at understanding what support services are being provided and how these are provided. Second, primary data are collected through in-depth face-to-face structured interviews with the main founders of five different university spinoff companies. During this phase, data is collected aimed at understanding what developmental problems the companies experienced during the TOP-programme and how these problems were managed. Secondary data are collected to analyze what resources the companies used during the TOP programme. Data triangulation is established through the collection of secondary internal and external data in order to increase the validity and quality of the data. The majority of the secondary data is internal and confidential; this contributed to the reduction of respondent effects and maintained confidence in the collected data throughout the research. Secondary data covered a time-span of two years before primary data is collected, and six months after primary data was collected (where available). This resulted in a comprehensive and rich qualitative dataset.

4.3.1 Data Collection Methods

Questionnaire

The questionnaire is comprised out of 20 questions and 10 follow-up questions (APPENDIX A: Interview Questionnaires). The questionnaire contains both open ended questions and questions that allow respondents to assign ratings to answers using a 1-5 point unipolar scale with numeric labels. Scales are incorporated to quantify subjective reporting; this makes it easier to compare cases to each other, while using both quantitative and qualitative data. The combination of quantitative and qualitative data types is said to be highly synergistic (Eisenhardt, 1989). The

questions are designed to be reliable; providing consistent measures in comparable situations and valid; answers correspond to what they are intended to measure (Fowler, 2002). The questions are standardized across respondents and contain well-defined terms and wordings. The questions are no longer than 25 words, double barreled, ambiguous, positively and negatively worded questions are avoided, all in an effort to increase reliability and validity (Babbie, 2001; Fowler, 2002; Sekaran, 2003). Other techniques such as, naming and defining events, providing definitions prior to questions, and a clear reference to periods are also employed (Schaeffer & Presser, 2003). Furthermore, the funneling questioning technique is used, where the transition is made from broad to narrow themes throughout the questionnaire. The respondent is led from questions of a general nature to those that are more specific, and from questions that are relatively easy to answer to those that are progressively more difficult. This funnel approach facilitates the easy and smooth progress of the respondent through the items in the questionnaire (Sekaran, 2003).

Testing and evaluating the questionnaire

According to some authors, it takes between 12 to 50 cases to uncover flaws in a questionnaire (Presser et al., 2004). Acknowledging the fact that only a fraction of that amount of respondents is participating in this study, different methods are combined to properly evaluate and test the questionnaire. First, face-to-face interview is chosen to facilitate the testing and evaluating of the questionnaire in real-time during the data collection. Advantages of face-to-face interview are exploited to ensure the collected data is valid and consistent across respondents. The first two interviews are treated as pilot-interviews, where respondents are debriefed after the interview. This process proved to be helpful for streamlining the questionnaire. Second, the interviews are recorded to enable analysis of problematic behaviors during the interview afterwards, this technique is referred to as behavior coding (Schaeffer & Presser, 2003). Third, the interviewer relates his experiences with the questionnaire and offers his views about the questionnaire's problems after the interview session (Presser, et al., 2004). Finally, since the researcher had access to the business plans prior to the collection of primary data, some questions were purposely included in the questionnaire to test the accuracy of the respondent’s answers. The answers are then matched with the secondary data to reveal the extent to which these answers are accurate and valid.

Face-to-face interview

The questionnaire is administered during face-to-face interview sessions by the researcher. The main advantage of face-to-face interviews is that the interviewer can adapt the questions as necessary, clarify doubts, and ensure that the response are properly understood, by for example, repeating or rephrasing the questions (Sekaran, 2003). The interviewer can also pick up nonverbal cues from the respondent, any discomfort or problems that the respondent experiences can be detected through frowns, nervous tapping, and other body language unconsciously exhibited by the respondent (Sekaran, 2003). The reconstruction of retrospective events played an important role during the interview, making it easier for the interviewees to tell their stories

orally and most importantly, in details. The interviewer has the opportunity to explain the meaning of more difficult to understand concepts disguised in the questions, to make sure that respondents answer all the questions correctly and in their entirety.

The questions are administered in Dutch or English. The respondents are asked in which language they would like to answer the questions in order to make sure that they feel as comfortable as possible during the interview sessions. Fowler (2002) suggests to conduct the interview in the preferred language of the respondent in order to increase the validity of factual reporting. This is done to make sure that the respondents are able to express themselves better and therefore increase the comprehensiveness of the each answer given. Extra care is put into the translation of concepts and words across languages.

The respondents are also asked for their permission to record the interview sessions, in exchange of confidentiality, pointing out that the content of the recording is only used for the purpose of the study. Recording interviews helps the researcher to focus on the matter at hand during the interview session, instead of for example, taking notes, which might cause a distraction for both the interviewer and the respondent. Sekaran (2003) stresses the importance when it comes to listing attentively to the interviewee, evincing keen interest in what the respondent has to say, exercise tact in questioning, repeating and/or clarifying the questions posed, and paraphrasing some of the answers to ensure their thorough understanding. Not only is this better achieved by recording the interview sessions, the recordings are of great value during the analysis of data (transcription) as well.

4.3.2 Data Collection Process

Inviting candidates to the interview session

The strategy to approach the candidates involved sending out an invitation letter by e-mail. An invitation letter is sent via e-mail to all the candidates (APPENDIX B: E-Mail Introduction). Candidates that did not respond received a follow up e-mail 10 days after the first e-mail was sent. The overall tone of the invitation letter is written to give the reader an impression of freedom to participate in the research, and their value in doing so would have to be immediately visible in the letter. The first sentence of the letter mentioned “the department of NIKOS” (the department that commissioned the research) to increase the credibility of the invitation, to show the importance of the research and again, to stress that their participation would be valuable. Each interview is estimated to last 45 minutes, with the exception of the pilot-interviews, which lasted longer. The interview duration was not deflated to persuade respondents to participate in the interview sessions.

One important feature of the invitation letter was the possibility to conduct the interview at a location of the candidate’s choice. This has consequences for both response rate and bias (namely the selection effect) in the answers of the interviews. Since the interviews are scheduled on a location based in the vicinity of the university, companies that are still on the premises of the university are more likely to participate than companies that moved out of the offices of the university. Because companies that are still in the vicinity of the university are located closer to

the location of the interview. Furthermore, companies that are still in the vicinity of the university may be using a specific type of resource (e.g. office space, laboratory, university equipments, and have frequent meetings with scientific mentor) and therefore might explain why they are still on the university's premises. Thus, by proposing the possibility to also conduct the interview at a location of choice, the threat of both bias and selection effects are reduced.

Similar to the research questions, the invitation letter is written in both Dutch and English. The invitation letters are sent (with an included note: "For the English version please read below"). The candidates are referred to by their initials and last name in the opening sentence of the letter, to increase the personal tone and stimulate response. Carbon copies (CC) of the e-mails are also sent to the incubator management team, to show the candidates that the invitation is approved by the incubator management and therefore increase the credibility of the invitation.

Response

After sending the e-mail to all the candidates, eight candidates replied within the first two weeks, resulting in a response rate of 70%. However, two of these candidates were excluded from the research. One of the candidates could not participate in the interview due to a busy schedule. The remaining seven companies participated in the interview. It later appeared that two of the companies did not fit the definition of university spin-off as initially thought, and were therefore excluded from the analysis. Out of the five companies that participated in the interview, three were still located on the premises of the university at the time the interview was conducted.

Interviewer's experience

Briefings before each interview session ensured that each interviewee understood the goal of the interview and most importantly the nature of the questions and the definitions they contain. Before each session the interviewer reviewed the business plans of the respective firm that was scheduled for an interview. This was considered necessary in order to be able to understand the context in which the firm is operating in, whether it would be the market, product or technology developed by the firm. Most of these topics are explained in the business plans and therefore prepares the interviewer to ask the most meaningful follow-up questions when necessary.

At the beginning of each interview session, the interviewer explains the definitions of terminologies and concepts presented in the questions. Definitions of for example problem complexity, problem types, and (un)predictable problems are defined and illustrated with an example. The pilot interviews revealed that some of the questions could be merged into one question, making the questions produce more effective answers. Overall, the interviews went very well; every respondent was very motivated to give elaborate answers. After triangulating some the answers with secondary data, it can be concluded that the answers are consistent and accurate. Furthermore, none of the respondents seem to have felt uncomfortable disclosing information, this might have been related to the fact that they are the founders of their own company and with that comes the sense of freedom and self-accountability. All the necessary data was successfully and satisfactorily collected during the interviews.

Table 9 - Description of Case Data

Sources of Evidence (amount of pages)	Value	Case 1	Case 2	Case 3	Case 4	Case 5	BI	**Total**
Interview Transcripts	+++++	9	9	10	12	15	-	55
Business Plans*	++++	9	12	34	48	67	-	170
Meeting Notes*	+++++	3	13	14	7	14	-	51
Intermediate Reports*	+++++	3	25	27	17	11	-	83
Correspondence / E-mail*	+	2	3	-	1	1	-	7
Legal Documents	++	2	9	8	7	10	-	36
WebPages	+++	11	21	10	23	44	53	162
Press Releases / Magazines	+++	2	19	5	11	20	5	62
Other Publications	++++	24	12	8	5	11	546	606
Database	++	-	-	-	-	-	10	10
Interview Notes	+++	-	-	-	-	-	9	9
Total Amount of Pages :		65	123	116	131	193	623	1251
Audio/Video Length (hh:mm:ss)								
Interviews	+++++	46:20	57:00	1:02:00	1:50:00	56:00	5:15:00	10:46:20
Other (Video & Audio)	++	04:40	08:00	0:00	02:00	14:20	0:00	00:29:00
Total Length of Recordings :		51:00	1:05:00	1:02:00	1:52:00	01:10:20	5:15:00	11:15:20

*Documents containing confidential data, which consist of 50% of the total collected case-data evidence (measured in the number of pages).

4.3.3 Generated Data

The description of the case data is shown in Table 9. The majority (50%) of the collected data is considered strictly confidential, reinforcing the validity of data when triangulated with non-confidential data. Data was collected from ten different sources of evidence (interview recordings and transcripts counting as one).

Business plan is a written document that describes the current state and the presupposed future of an organization (Honig & Karlsson, 2004). The business plan contains information about the business strategy, descriptions of products and related markets the company is catering these products to. A business plan forces entrepreneurs to think their business ideas through systematically, confront assumptions, mitigate risks, reveals gaps in knowledge, map out challenges and lists the resources that are needed (Kubr, Marchesi, Ilar, & Kienhuis, 1998; Mullins & Komisar, 2009). This makes business plans an attractive source to collect data about resource utilization. However, business plans have the tendency to be overly optimistic and focused on ideal scenarios (Sahlman, 1997). Meeting notes and intermediate reports on the other hand contain detailed information on the actual progression of the companies during the TOP programme, and for that reason are considered more valuable. The participants are inclined to be open when discussing internal issues, and this is reflected in both the meeting notes and intermediate reports. Intermediate reports are usually produced every three months and are sent to the TOP managers to be discussed during meetings. The meeting notes are produced by the TOP managers; the meetings are well documented and the notes are overall very detailed, providing great insight from the TOP manager's perspective. More importantly, this adds a layer of transparency and provides an internal view of the firm's development that would otherwise be difficult to obtain in retrospect.

4.4 Data Analysis

4.4.1 Data management

Data management is considered critical for the analysis of data (B. M. Miles & Huberman, 1994); improper management of data could jeopardize the overall quality of the analysis. Effort is therefore devoted to activities such as data preservation, organizing and labeling of evidence, building a database and preparing the data for analysis. Data collected from the internet, such as web-pages, audio recordings, videos and photos are downloaded and stored on a local hard-drive. Web pages and rich text format (RTF) files were then converted into a portable document format (PDF). Audio and video files containing relevant data are also transcribed into text-format. Every file is labeled using a code to insure chronological order, for example, business plans are labeled "090403[BP][#1][45p]" and meeting notes "100817[MEET][#2][3p]". The files are coded using the ISO8601 format in order to assign calendar dates in a two digit basic format. For example, the numbers indicate the calendar date the content of the file was produced; "YYMMDD", followed by an abbreviation of the filename, the version of the file and the amount of pages the file contains. Digital files and documents are also created for non-digital data.

4.4.2 Transcriptions

Interview transcripts are produced to preserve, prepare and make the analysis of data feasible. Transcriptions are considered imperative in qualitative research (Davidson, 2009). The multiple purposes transcriptions serve, techniques, related issues of trustworthiness and its impact on validity are well documented in the transcription literature (Davidson, 2009; Johnson, 2011; Lapadat, 2000; MacLean, Meyer, & Estable, 2004; Matheson, 2007; McLellan, MacQueen, & Neidig, 2003; Tilley & Powick, 2002) and are taken into account. A transcription guide is developed by the researcher containing specific transcribing protocols and guidelines, elaborating on transcribing techniques, transcription notifications, and transcription software—all of which contribute to establishing reliability and validity (APPENDIX H: Transcription Guide).

The interview recordings are transcribed verbatim. The recordings are performed in a location with minimum background noise using a high quality recording device. This resulted in high-quality audio with minimum inaudible segments in the recordings. The transcripts are later edited for purposes of clarity, taking care as much as possible, not to affect the respondents intended meanings. Segments of the transcript's text are then extracted and organized under each theme presented in the questionnaire.

4.4.3 Analytic Strategy, Techniques and Tools

Analytic strategy

The general analytic strategies employed are case descriptions and pattern matching (B. M. Miles & Huberman, 1994; Yin, 2009). The cases are first described and analyzed individually (APPENDIX D: Descriptive Case Studies). Time-ordered displays are developed to organize important evidence chronologically using the date format described above (APPENDIX F: Time-Ordered Displays). The process of making these displays allows the investigator to become intimately familiar with each case. The idea of doing within case data analysis is to become intimately familiar with each case as a stand-alone entity (Eisenhardt, 1989). This process allows the unique patterns of each case to emerge before the pushing to generalize patterns across cases. In addition, it gives the investigator a rich familiarity with each case which, in turn, accelerates cross-case comparison (Eisenhardt, 1989). Cross-case synthesis is then performed as the specific analytic strategy by using word tables that display the data from each individual case according to a uniform framework.

Techniques and Tools

All the collected data files are imported into the Atlast.ti qualitative data analysis and research software. The chronological order is maintained due to the labeling method, which makes it easier to interpret the data during analysis. A list of pre-codes (Table 8) is developed during data collection and applied during data analysis using the software package. During data analysis the list of codes is further refined and expanded through post-coding of emerging concepts. This approach allows for both 'top-down' (or deductive) coding, and 'bottom-up' (or inductive)

coding. Both interpretive and descriptive coding is used. The codes are then imported into the network view in which nodes can be linked to one another. The network view displays each problem as the unit of analysis, the characteristics of the problems, and the resources used to manage each problem (APPENDIX G: Data Network Views).The data networks views are used to find patterns across cases during cross-case synthesis. Conclusions are drawn and analyzed through various analytical lenses to preserve and establish dependability of the procedure and credibility of the findings.

4.5 Operationalization

There are two areas where operationalization is applied; in the research questions, and during the interpretation of data collected from secondary sources. For example, data about developmental problems are primarily collected during interviews. Data about resource utilization are collected through secondary sources. The way the various concepts are operationalized takes these two approaches into account.

4.5.1 Problems

Problems Developmental problems are defined as those problems that have high criticality—these problems need to be solved in order for the firm to continue developing. Any other insignificant problems are not considered developmental problems since they do not threatened the development of the firm. This definition is used during the interview to inform respondents about the meaning of the word "problem" within this context.

Complexity The degree of a problem's complexity is defined by the amount of resources necessary to successfully manage and solve a problem. During the interview, respondents are asked to think in the amount of man-years necessary to work on a problem and the variety of resources necessary. The degree of complexity is measured using a 5 point scale.

Awareness Problem awareness is the ability of the firm to predict problems. Predictable problems are identified beforehand; unpredictable problems are identified after the firm stumbled upon the problem. The more unpredictable problems are observed, the lower the problem awareness is, and vice versa. Respondents are asked whether they could predict the problems they experienced beforehand, or if they stumbled upon the problem after the firm was founded.

Types Entrepreneurial problems are related to all activities that involve customers that directly promote sale efforts and revenues, e.g., marketing, sales, and customer development activities. Engineering problems are related to activities involving the development, production and delivery of products and services for users and customers. Administrative problems are related to activities that support engineering and entrepreneurial problems, and the activities to keep the business operating and developing, e.g. strategy development, business model design, legal issues, etc.

4.5.2 Resources

Resources Resources are broadly defined as anything that firms use in the attempt to manage and solve a developmental problem. The sources of these resources are identified as firm resources, BI resources, and other (non-BI) resources.

Firm Resources controlled and owned by the firm are considered to be firm resources. Examples include human resources, and the initial technology being development by the firm.

Business Incubator Incubator resources include infrastructure, business assistance, and other resources mediating through the BI's network.

Other Non-BI resources, or other resources, are acquired from sources outside the firm and the BI programme. Examples include customers, partners, suppliers, governmental bodies, financial institutions, knowledge institutions, etc.

Value Salient and basic resources are introduced in order to discriminate valuable resources against less valuable resources. Salient resources are necessary and sufficient resources to solve a problem. Basic resources are necessary but not sufficient to solve a problem. In order to make a distinction, all resources are included in a pool of resources, but only those that appear to be most valuable are coded as a salient resource. The remaining resources are then considered basic resources. A resource's value is measured by analyzing the meaning of the text, while taking the frequency of the text's occurrence into account.

4.5.3 Progress

Progress Developmental progress is measured in terms of solution effectiveness, and solution efficiency. The effectiveness of solution is defined as the degree to which a problem is solved. The development progression that a firm makes while being incubated is related to the amount of problems solved, and the complexity of these problems. The progression is calculated using a function which assumes that the degree of complexity is related to the potential value that can be extracted when solving a problem. The more complex to the problem is, the higher the value of the solution is considered to be. For example, highly complex problems receive a value of 3 points, while medium complex problem and low complex problem receive a value of 2 and 1 points respectively. If a problem is solved, the points will be multiplied by 1, if partially solved, by 0,5 and the problem remains unsolved by 0.

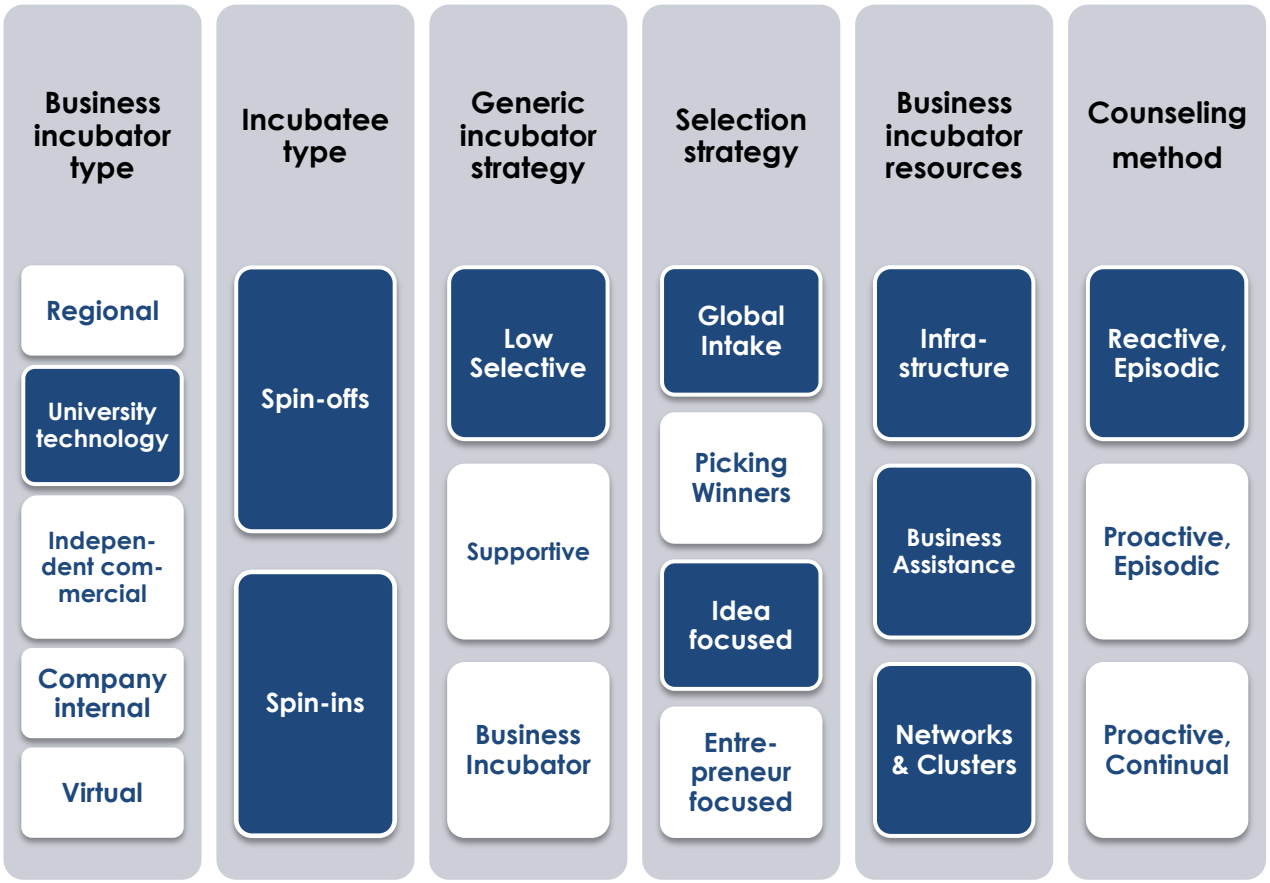
Scales are used to determine the technological and commercial progress made during the incubation programme. To determine the product stages, a scale is used, e.g.; 1) Concept; 2) In Development; 3) Working Prototype; 4) Functional Product with Limited Users; 5) Functional Product with High Growth. To determine the commercial stages, the following scale is used; 1) Market research; 2) Initial marketing efforts; 3) Acquired leads; 4) Acquired paying customers; 5) Increase in (returned) customers. Respondents are asked to select the stages the firm was in before being incubated, and then, after the firm left the incubator. The difference then reveals the progress firms made during the programme. Finally, other data are also collected, e.g. revenues, to measure the commercial progress of the firms.

Chapter 5 – Findings & Analysis

5.1 (RQ1) – Business Incubation Programme

The findings of the TOP programme assessment are shown in the BI framework (Figure 11). The colored blocks show the characteristics of the TOP incubation programme. The findings reveal the properties of the BI environment and the implications on resource utilization by the incubated firms. For the full analysis and description the TOP programme, see APPENDIX C.

Figure 11 - TOP Incubation Programme Assessment



5.1.1 Business Incubator-Incubatee Type

The TOP programme can be classified as a university BI, because the programme does not operate independently from the university. University BIs are set up by universities willing to adopt a directly entrepreneurial role in generating and spreading scientific and technological knowledge. University BIs are institutions that provide support and services to new knowledge-based ventures by placing the emphasis on the transfer of scientific and technological knowledge from universities to companies (Grimaldi & Grandi, 2005). Unlike the university, the TOP

programme itself has no technological focus, since the goal is to include a broad target of incubatees, including both spin-offs and spin-ins.

5.1.2 Business Incubator Strategy

Generic Strategy

Clarysse, et al. (2005) developed the generic strategy framework in which the TOP programme is analyzed as one of the cases in the sample of their study. The findings of that study are compared with the analysis to gain more insight into the strategy of the TOP programme. Clarysse, et al. (2005) concluded that the TOP programme belongs to the low selective model. The arguments to support this conclusion are compared with the findings of this study.

First, office space and infrastructure are shared within the university and plays a determining role depending on the nature of the firms that use it. For example, infrastructure might play a more significant role for high-tech firms than nontechnology firms, since infrastructure (lab-space, machinery) might be needed during product development. Second, the funds are derived from the European Social Fund and are granted in the form of loans, which are typically regarded as a means of subsistence rather than as start-up capital. However, more significant financial resources mediate through the university BI's network in the form of government grants. Third, the programme employs a small team of people (4 fte) familiar with existing government grant programs. For example, the team is familiar with application procedures for the STW grant, how to receive tax breaks, and other specific government grants that apply specifically for the type of firms. For example, high-tech firms can become eligible for tax breaks depending on their R&D activities. Finally, the success of the Low Selective Model is said to depend upon the (social) network which the programme has developed with various public agencies and the teaching curriculum of the university. The programme depends on the cooperation of the research/teaching staff within its network to fulfill the role of scientific mentors. In addition, the programme also relies on the collaboration with former participants or industry entrepreneurs to fulfill the role of business mentor. Unlike the scientific mentors, business mentors are not incentivized to provide their assistance to the incubatees.

The university's teaching curriculum covers three main areas, Technical and Engineering Sciences, Business and Social Sciences, and Behavioral Sciences. This means that a scientific mentor can be found for a variety of disciplines, reflecting the university's capability in supporting a wide variety of start-up firms through business assistance. Furthermore, the programme benefits of cluster effects by having other support programmes in the vicinity of the university. For example there are business support programmes from research institutes (e.g. Business Accelerator), from public-private institutes (e.g. Materials Innovation Institute), and from more independent support programmes (e.g. Venture Lab). All of these initiatives provide avenues for support to the incubated firms.

Selection Strategy

The selection strategy of the TOP programme can be defined as, natural selection (Clarysse, et al., 2005), 'survival of the fittest' or global intake approach (Bergek & Norrman, 2008). In the survival of the fittest approach, incubator managers apply less rigid selection criteria, take on a larger number of firms and rely on markets to provide the selection processes that over time will separate winners from losers. The loosely applied selection criteria results in a high selection rate of the target group. This selection strategy is mainly concerned with creating as many start-ups as possible.

The selection strategy seems to be closely related to the Low Selective Model the incubator employs. Running the BI is not the core activity of the university. The university shares its resources with the incubated firms rather than strategically allocating specific resources to increase start-up success. Moreover, the incubator applies revolving funds and does not invest heavily into the start-ups. It is therefore very unlikely that the university prioritizes investment in resources specifically for the incubation programme. As a result, the incubator does not apply strict selection criteria. Instead, the programme welcomes a wide variety of firms as long as the firms are knowledge intensive and have an innovative component in the business idea.

5.1.3 Business Incubator Resources

The TOP programme offers all of the basic resources covered in the framework; infrastructure, business assistance, networks and clusters. The cluster around the university and the organizations within its network appear to be offering a large portion of additional resources that are mediating through the programme's network. One important resource appears to be the scientific mentor, which is the facilitator of most resources offered by the organizations within the network. The incubation programme offers a wide range of infrastructure resources. This is mainly the case because of the technological focus of the university. Incubated firms have accesses to shared infrastructure such as laboratories, production spaces, equipments, and office space. Infrastructure resources can be used for free or against reduced (below market) prices. In contrast, business assistance is relatively limited compared to the infrastructure and network resources offered during the programme. Business assistance is provided in the form of financial loans, mentoring, business lectures, and feedback during meetings with the incubator management. The most significant portion of business assistance resources seem to mediate through the incubator's networks and clusters.

Counseling Method

Perhaps more important than the resources offered is the method of resource provision and utilization. Counseling refers to the actual diffusion of knowledge and advice to entrepreneurs in the domain of business start-ups (Rice, 2002). The TOP management discloses an important characteristic of their counseling method by stating that, *"…we don't assist the entrepreneurs unless they request for assistance first".* In the BI literature this method of providing assistance is known as reactive episodic counseling; the diffusion of knowledge and advice initiated by the incubatee (Rice, 2002). From a managerial perspective this approach is known as laissez-faire,

which means that the entrepreneurs are left entirely up to themselves and are provided with very little assistance unless they take the initiative (Bergek & Norrman, 2008). The TOP management coordinates the programme by fulfilling the role of a hub within a network. The management advices the entrepreneur and provides guidance by appointing the entrepreneur to the right sources when problems arise. The entrepreneur is expected to remain independent and take the initiative to approach, establish and maintain relationships with the business mentors, scientific mentors and the other organizations within the network.

5.1.4 Implications for Analysis

First, all of the incubator resources have been identified. It is now known what the properties of the incubator resources captured in the Problem Co-Solving framework are. Second, because of the global selection strategy, it is argued that the threat to selection bias is low. This means that firms that participate in the TOP programme are not selected because of the expectations that the business will succeed. Finally, because firms are essentially left entirely up to themselves, it is argued that it is more likely that assistance is requested after a problem is identified. This makes it possible to conceptualize the firm divorced from the BI. However, that is until the firm takes the initiative and requests for assistance or utilizes incubator resources. This on-demand approach to seek for support allows for a greater transparency to observe how firms utilize support and resources when managing problems.

5.2 (RQ2) – Developmental Problems

A total of twenty one problems are identified across all of the five cases. An overview of the problem characteristics and the resources used are displayed in Table 10. The following sections describe the most common problems found across cases and their characteristics. (For the full descriptive case studies see The electronic version of APPENDIX C is available in the attached CD ROM.
APPENDIX D:).

5.2.1 Problem Description

Product and Service Development

Product, process and service development are problems that all of the firms identified early on in their development. The firms deliberately choose these problems in an effort to address a perceived opportunity in the market. In some cases (C1; C3), the initial opportunities are identified by customers in various markets. In other cases (C2; C4; C5), the opportunity is identified within the firms, firms then proceed to develop a product to address the opportunity. Product, process and service development are all engineering problems aimed at providing value solutions to potential customers. These problems are considered to be the most complex problems compared to the other problems firms identify. One explanation for this might the unique innovative value firms attach to their products and services.

Table 10 - Developmental Problems & Resources

Problems	Complexity			Awareness		Types			BI Resources			Non-BI Resources			Firm Resources	Solution		
	High	Medium	Low	Predictable	Unpredictable	Entrepreneurial	Engineering	Administrative	Infrastructure	Assistance	Networks	Networks	Clients	Assistance		Solved	Partial	Unsolved
Case 1 - AluSIM																		
Product Development 1	O			O			O		**3**	1	**3**			2	2	O		
Product Development 2		O		O			O			1		**3**		1		O		
Value Proposition		O			O			O		2	1							O
Pricing Strategy		O			O	O				2	1							O
Revenue Model		O			O			O		2	1							O
Case 2 - CoolTech																		
Product Development	O			O			O		**3**	**3**	**3**	2		2	**3**			O
Market Scope	O			O		O						2			1			O
Initial Markets			O		O	O				**3**	2		2		2		O	
Marketing Strategy		O			O	O				**3**	**3**	1	1		2		O	
Case 3 - LaserTech																		
Process Development	O			O			O		**3**	**3**	**3**	1	**3**	2	2		O	
Value Proposition		O			O			O		2	1	2	1		1			O
Pricing Strategy		O			O	O				2	1	2	1		1			O

Table 10 - Developmental Problems & Resources (continued)

Problems	Complexity			Awareness		Types			BI Resources			Non-BI Resources			Firm Resources	Solution		
	High	Medium	Low	Predictable	Unpredictable	Entrepreneurial	Engineering	Administrative	Infrastructure	Assistance	Networks	Networks	Clients	Assistance		Solved	Partial	Unsolved
Case 4 - ePath																		
Product Development		O		O			O		2	1	**3**	1			**3**			O
Development Process	O				O			O		1	**3**	1			1			O
Business Strategy		O		O				O		2	1	**3**	2		1			O
Marketing Strategy		O		O		O				2	1	**3**	2		1			O
Production Materials		O			O			O		2	1	2						O
Case 5 - BodyMedia																		
Product Development	O			O			O		2	2	**3**	**3**	**3**	2	2		O	
Regulation & Distribution	O			O		O				1		2	2		1			O
Marketing & Sales		O		O		O				2	2	**3**	**3**		2			O
Legal Issues		O			O			O				2			**3**	O		
Total Assigned Value	8	12	1	11	10	8	6	7	13	37	33	33	20	9	28	3	4	14

Because of its inherent complexity, firms devote a lot of time and resources to find valuable, scarce, and specific solutions during product development. A surprising observation is that three firms (C1; C3; C5) initially offered services as their main offering in their product portfolio and later included physical products (C1; C5) and production processes (C3). Offering services first versus developing physical products is one of the first distinctions observed of how firms manage developmental problems. The evidence shows that resources related to BI infrastructure plays an important role in manage these types of problem. BI infrastructure appears to a necessary and sufficient resource to manage problems related to product and service development.

Market Scope, Initial Markets and Marketing Strategy

During product development, the scope of the market is often not yet defined (C2). Market scope refers to the breadth and depth of potential markets for a specific product. The market scope is closely linked to the products being developed in the firm's portfolio, because every product might be produced for a specific market. CoolTech (C2) identified this problem early on during its development. The root of the problem is the emphasis the firm places on product development early on. Products are developed with the technological innovation in mind (a technological push) and features for improving what already exists in the market. Because of the technology's wide application possibilities, CoolTech (C2) experiences difficulties when assessing the overall scope of potential markets it can address with its products. Defining the market scope is considered to be a very complex problem primarily due to the high uncertainty caused by unknown factors during product development.

On the other hand, defining initial markets is considered to be less complex. The evidence shows that all of the firms are able to identify and name potential clients across different markets early on. Selecting initial markets is a very important strategic decision because it directly influences product features, and both marketing and business strategy (C2; C4). For example, ePath develops software and applications to produce electronic signs to help people navigate within buildings. Because ePath is a nascent firm with limited resources it has to choose between three initial markets to target first; airports, hospitals or office buildings. While hospitals might seem the most attractive market because of the market size and high margins, it might not be the most convenient initial market to enter because the customer's demands (and regulations) are relatively higher. In addition, the consequences of something going wrong are also more significant, which in turn might put the young firm in a liable and vulnerable position. Guiding a patient to the wrong location during an emergency might lead to unnecessary costs or even cause the adoption of the new technology to fail in extreme cases. The same can be said when guiding a passenger to the wrong gate at an airport. In addition, software development is known to have long test phases before the product is reliable and free of bugs (C4). It might therefore be more beneficial for a start-up like ePath to target office buildings first since it provides a more beneficial environment to deploy the early versions of the product. The office market might not offer the most attractive profit margins, but it benefits the company during product development before targeting other markets. The case of ePath (C4) shows important

selecting the right initial markets is, and how it relates to product development and product testing.

Finally, the marketing and sales strategy or the "go-to market" strategy is another entrepreneurial problem that firms face (C2; C4; C5). Sales refer to understanding customer needs, and effectively matching products to those needs. Marketing strategy refers to the methods firms use to; i) create demand, ii) development a unique position (in the eyes of the customers) and; iii) reach (initial) customers through communication channels. While the previous two problems seek to answer "what" markets to approach, the marketing problem problems attempts to answer "how" to approach lunching customers effectively. In all of the cases, firms target businesses primarily, focusing their strategy on business-to-business (B2B) marketing. Developing a marketing strategy is considered to be an intermediate complex problem across all of the cases where it is observed. Two firms (C4; C5) were able to predict the marketing problem while the remaining firm (C2) stumbled upon this problem later in the firm's development. The remaining firms (C1; C3) did not experience this problem because these firms managed to find customers very early on.

Value Proposition

Value proposition can be defined as the bundle of products and services that create value for a specific customer segment (Osterwalder, Pigneur, & Clark, 2010). Two firms (C1; C3) stumbled upon the problem of defining and articulating the value proposition of their offerings. Emphasis should be placed on the creation of bundles of products and services for *specific* customers. Every customer has specific problems and requirements that need to be addressed by the firm. This means that firms (C1; C3) must design customized offerings to satisfy the customer's specific requirements.

In both of the cases (C1; C3) where this problem is observed, the firms did not fully understand the extent of which their products create value for their customers. As a result, firms stumble upon this problem after reaching their first customers. The evidence shows that crafting the value proposition is very difficult to achieve in isolation. Both AluSIM and LaserTech engaged in a dialogue with their customers in an effort to investigate what their customers value most. It appears that in order to successfully determine the value proposition, customers need to be willing to share internal (sensitive) information with the firms. Examples of such information might include, production costs, internal processes and design protocols. It turns out that negotiations may not be sufficient to solve this problem. Firms need to become intimately familiar with their customers before understanding how their products add value. Most of the initial products sold to these customers occur in the form of services and research projects (feasibility studies). It is not a onetime transaction but it's about building a relationship during a project over a longer period of time. In addition, it is also difficult for the customer to estimate how the value of the products they are buying will affect their business. This is because the products are relatively innovative, underdeveloped and its promised advantages have yet to be proven. Determining the value proposition is therefore a cooperative effort between the firm and its customers. It becomes very difficult for a firm to solve this problem alone or with the support

of the BI since the input of the customer is invaluable and even required to solve this problem effectively. The inability to understand the value proposition leads to another problem: developing an effective pricing strategy.

Pricing Strategy

There are various pricing mechanisms and pricing models when it comes to developing a pricing strategy (Browne, 2010; Osterwalder, 2004; Osterwalder, et al., 2010). The cost structure and pricing mechanism employed across the cases are displayed in Table 11. The findings reveal that pricing strategy appears to be a strong indicator to assess the developmental stage of the firm, the firm's control in the value chain, and its market / customer knowledge.

Table 11 - Cost Structure and Pricing Mechanism

	Cost Structure	**Pricing Mechanism**
Case 1 – AluSIM	Cost driven; variable costs	List price
Case 2 – CoolTech	Cost driven; variable costs	List price
Case 3 – LaserTech	Cost driven; variable costs	List price
Case 4 – ePath	Cost driven; variable costs	Volume dependent
Case 5 – BodyMedia	Value driven; fixed costs	Product feature dependant

Two firms (C2; C4) entered the incubation programme with a product concept, went into development during the incubation programme, and left with a working prototype. These two firms are relatively early in their developmental stage compared to the other firms (C1; C3; C5) who managed to develop a functional product with limited users and customers before leaving the incubation programme. The evidence shows that none of these firms are in possession of the required information to develop an effective strategy, with the exception of BodyMedia (C5). On the one hand, firms that are working on a prototype are not able to accurately compute production costs, since production details are not yet defined. These firms have to rely on production estimations in these early stages. On the other hand, even if the production costs are known (C1; C3), firms are not able to acquire the necessary information to know how much the customers are willing to pay. As a result, this forces the firms to rely on cost driven computations with a mark-up percentage to cover the margins. Both AluSIM and LaserTech (C1; C3) expressed the difficulties when switching the pricing strategy from cost driven to value driven cost structures. These firms often do not deliberately choose to employ a static list of price over of a dynamic pricing mechanism based on value, but are forced to do so because of their inability to assess the value proposition from the perspective of their customers. This shows the importance of having a well defined value proposition and a well crafted pricing strategy that justifies the value proposition for each specific customer segment. Firms that fail to find the balance between value proposition and pricing will miss the opportunity to gain additional revenue. This can be considered ineffective since these firms seek to enter the market with an innovative product when competition is still absent, which means that these firms have the

leverage to avoid competing on price. In addition, squeezing the most revenue out of their offerings early on is critical since financial resources are much needed resources for these nascent firms.

Finally, the pricing strategy of a firm also reveals the extent to which it has control over the value chain. ePath (C4) was not able to compute a price because of its reliance on partners and suppliers during the early stages of product development. The firm established a partnership early on that is responsible to manage over one third of the value chain. In addition, the firm was not able to acquire the necessary production parts from suppliers because the parts were still considered to be too expensive. The lack of (horizontal integrated) control over the value chain, and the reliance on suppliers makes it very difficult for ePath to manage and estimate the cost structure of production. The firm's strategy is to reach potential clients though its partners, but the evidence does not show that the firm managed to develop an effective pricing strategy with its partners. BodyMedia (C5) followed a similar approach, but instead, the firm established joint-ventures with key organizations and suppliers in order to maintain (vertical integrated) control over the value chain. As a result, the firm managed to maintain the desired value-driven price point intact without allowing the increased fixed costs decrease potential margins.

Thus, by analyzing the pricing strategy of a firm, one can quickly learn three key aspects of a firm; the developmental stage, value chain control and value proposition. For example, if a firm cannot determine its cost structure using factual data, this means that the firm is still underdeveloped and/or has limited control over its value chain. If a firm is employing cost-driven pricing with a percentage mark-up by default, chances are the firm doesn't understand its value proposition (and customers) well enough to be able to apply value-based pricing. It's not only important to know *what* the price is, but perhaps importantly is to know *how* and *why* firms set the prices that they do; this is can be understood by observing their pricing strategy. Similar to defining the value proposition, developing an effective pricing strategy is not a problem firms can solve in isolation. Customer input is required to determine the threshold customers are willing to invest in the new technology. As a result, firm resources and BI resources might be necessary but are not sufficient to solve this problem effectively.

Revenue Model

An important part of the revenue model is the revenue stream. A revenue stream represents the cash a company generates from each customer segment (Osterwalder, et al., 2010). There are different types of revenue streams, two examples are, transaction revenues from one-time payments or recurring revenues from ongoing payments (subscriptions, licensing, rent, etc.). AluSIM (C1) stumbled upon the problem of developing a revenue model for its customer segments. The problem's complexity lies in the great amount of possible configurations that exist, and searching for the configuration that works best for both the firm and its customers. Value proposition, customers segment and pricing strategy all have to be taken into account when searching for possible revenue streams. For example, AluSIM offers workshops, software implementations, consultancy and research. These products and services are bundled for specific customers depending on their needs. But what pricing strategy should be employed to price these

bundles? Should the software be licensed? Are hour-rates an attractive solution for providing consultancy and workshops? These are just some of the questions that AluSIM faced in an attempt to design a revenue model. Similar to the value proposition, this problem cannot be effectively managed in isolation. Knowing how customers will react to the various revenue streams can be crucial for a successful implementation of the revenue model.

Key Partnerships

Establishing relationships with key partners is a problem for firms that rely on other companies to add value to their value chain (C1; C2; C4; C5). Since nascent start-up firms tend to have limited resources, additional resources can be acquired through key partnerships. AluSIM (C1) outsourced some activities of product development, and CoolTech (C2) partnered up with suppliers and manufacturers. ePath (C4) established various partnerships in the form of strategic alliance with companies operating the markets the firm is interested in, in order to access potential customers. The firm also outsourced product design activities, sales, and onsite customer specifications to its partners. BodyMedia (C5) is the only firm that aggressively established relationships with key partners in the form of joint-ventures. The firm extended their efforts by partnering up with suppliers, distributors, research institutes, sales teams, and manufacturers. The problem of establishing relationship with partners is finding the right partners at the right time. For example, if a firm partners up with a distributor, the product should be at least in a working prototype stage. If the firm pursuits partnerships in an earlier stage and fails to deliver on its promise, the result might damage the firm's credibility. Since credibility is something that start-up firms often lack, the problem of establishing key partnerships should be managed carefully. Furthermore, as mentioned above, partners can provide valuable information in order to develop an effective pricing strategy.

An important observation within two cases (C4; C5) suggests that firms have the tendency to perceive the interests that partners show in their business as a validation that they are doing something right. For example, ePath (C4) mentioned the commitment of a partner and used it as evidence to suggest that their product will have a higher chance of succeeding once it is introduced in the market. This shows that establishing key partnerships can be perceived as an act of product validation by the firms. In most cases (C2; C3; C5) the utilization of BI resources helped firms establish key relationships with various partners. The evidence shows that the role the BI plays is significant for firms when it comes to establishing relationships with key partners.

Decision Makers and Influencers

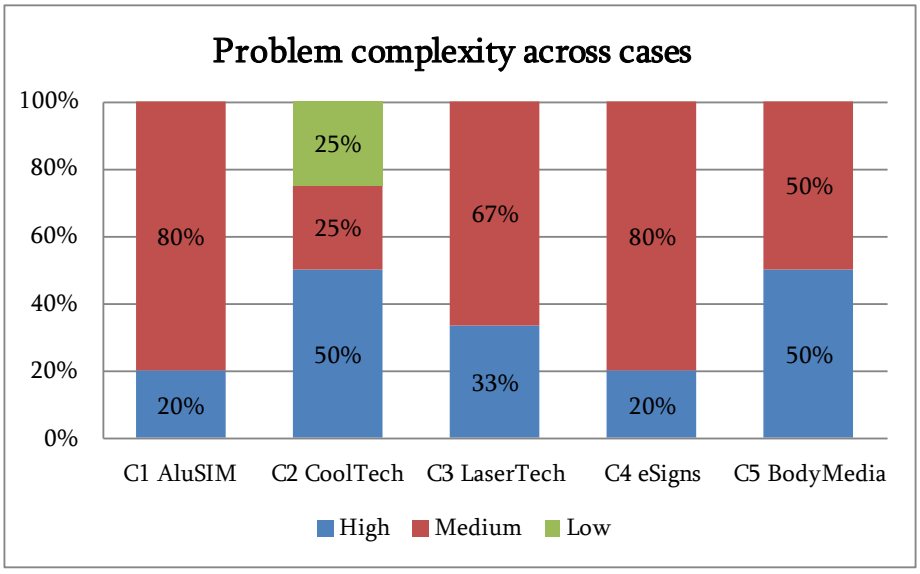
Innovative firms do not only have to cope with the inexistence of markets and customers, but also with the lack of regulatory guidelines and frameworks. There are several important stakeholders that firms must address aside from its customers. Some of the stakeholders observed in the cases include decision makers and influencers such as distributors, regulators, users, legislative bodies, and quality assurance institutes (C4; C5). In the case of BodyMedia, regulators (decision makers) have the authority to prevent the firm's solution to be implemented in current administrative procedures. Without the support of health insurers (influencers) the

current business model of BodyMedia might have to be altered. Decision makers and influencers are important actors because they can cause problems that are difficult to control and manage by the firms. For example, if health insurers decide not to cover the solution proposed by BodyMedia, it will have a stagnant result on the adoption of the products by the practitioners and patients (users). The complexity of this problem lies in the inability of the firm to control the problem effectively. Firms will have to think of alternative ways to deviate from the problem, or convince decision makers and influencers why they should regulate and accept their proposed solutions. Using firm resources and BI resources is insufficient to manage this problem effectively. Solving this problem relies on the firm's ability to co-manage the problem with external actors.

5.2.2 Problem Complexity

The highest degree of complexity account for 38% (n=8) of the total amount of problems. Only 5% (n=1) of problems have a low degree of complexity. The majority of problems (57%, n=12) firms experience have a medium degree of complexity. Moreover, Only 5% (n=1) of problems have a low degree of complexity. Figure 12 displays a similar distribution but for every case separately. CoolTech (C2) and BodyMedia (C5) are the firms that experienced the greatest amount of complex problems, two complex problems for each firm. CoolTech (C2) is the only firm that experienced a problem with low complexity, which is identifying initial markets.

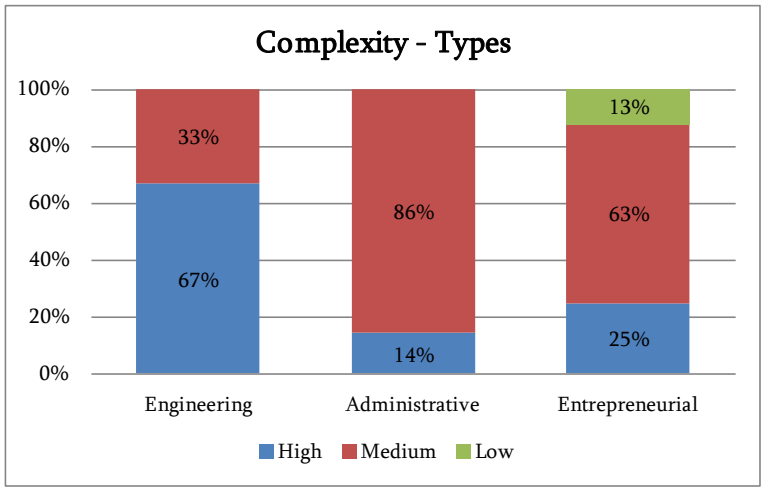
Figure 12 - Problem Complexity across Cases



The remaining cases (C1; C3; C4) only experienced one complex problem, with the remaining problems having a medium degree of complexity. Problem complexity and problem types are combined to reveal the amount and the degree of complexity across the types of problems that firms identified in Figure 13. A total of 6 engineering problems, 7 administrative problems and 8 entrepreneurial problems are identified. The data shows that the most (67%, n= 4) complex

problems are engineering problems. Administrative problems account for only 14% (n=1) of high complex problems, and 84% (n=6) of medium degree of complex problems. Finally, the majority (63%, n=5) of entrepreneurial problems are experienced as having medium degree of complexity. Entrepreneurial problems with a high degree of complexity account for 25% (n=2) and only one problem (13%) has a low degree of complexity.

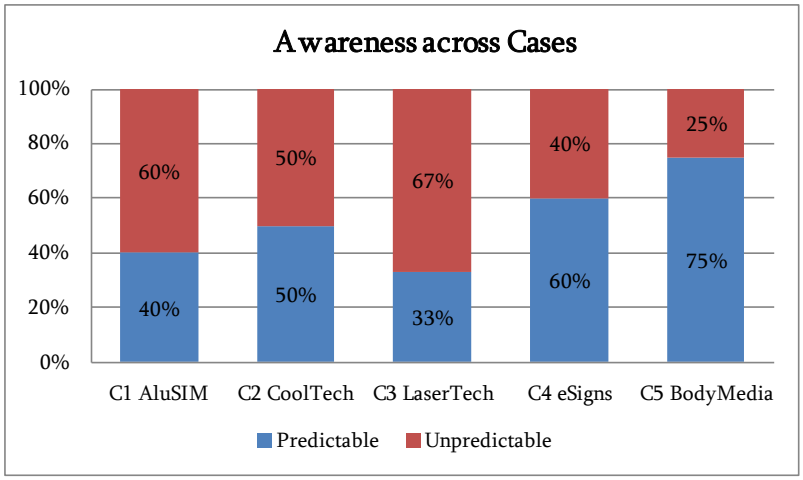
Figure 13 - Complexity and Types



5.2.3 Problem Awareness

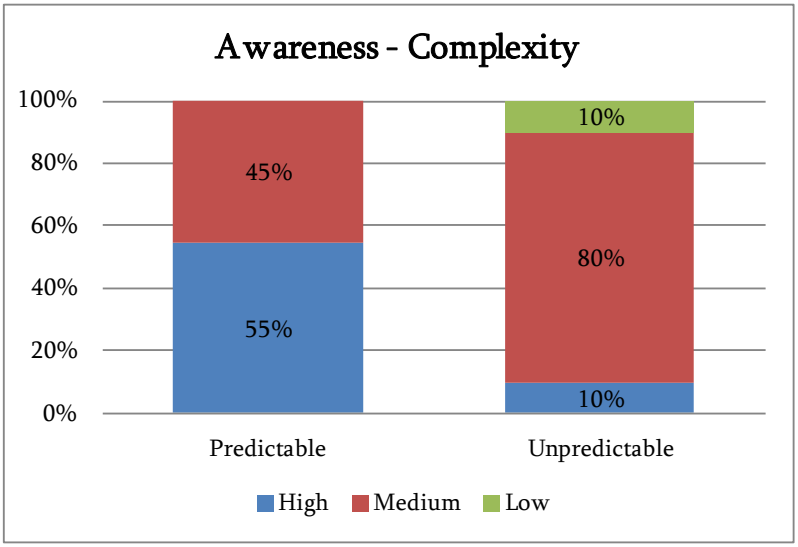
The ability firms have to predict problems is related to the problem awareness. Firms stumble upon the majority (53%, n=11) of problems during their development. Firms are able to predict and choose the remaining 47% (n=10) of problems. Taking a closer look at each case separately, the results show that BodyMedia (C5) and ePath (C4) are able to predict most of the problem they experience.

Figure 14 - Problem Awareness across Cases



CoolTech (C2) is able to predict two problems, but ended up stumbling upon two additional problems. AlumSim (C1) and LaserTech (C3) are not able to predict the majority of the problems; as a result these two firms have the lowest awareness to problems compared to the other cases. According to Figure 14, the majority (55%) of the predictable problems have a high degree of complexity. In contrast, the majority of the unpredictable problems have a medium degree of complexity. This means that firms are able to predict (or deliberately choose) complex problems and are unable to predict less complex problems.

Figure 15 - Problem Awareness and Problem Complexity



5.2.4 Problem Types

The types of problems are relatively equally distributed across the three types identified. Entrepreneurial problems are the most common problems (38%), with Administrative problems in second place (33%) and Engineering problem in last place (29%). Figure 19 shows the types of problem across cases. Every firm experienced all three types of problems with CoolTech (C2) being the only exception because it did not experience administrative problems. While these firms are high-tech firms, engineering problems are not the dominant problem type. Administrative and entrepreneurial problems account for more than 70% of the types of problems that these firms have to manage.

Finally, Figure 20 displays the type of problems that firms are able to predict. According to the evidence, firms are able to predict (or deliberately choose) all of the engineering problems. Surprisingly, the firms are only able to predict 14% of administrative problems. In addition, the firms stumbled upon 50% of entrepreneurial problems.

Figure 16 - Problem Type across Cases

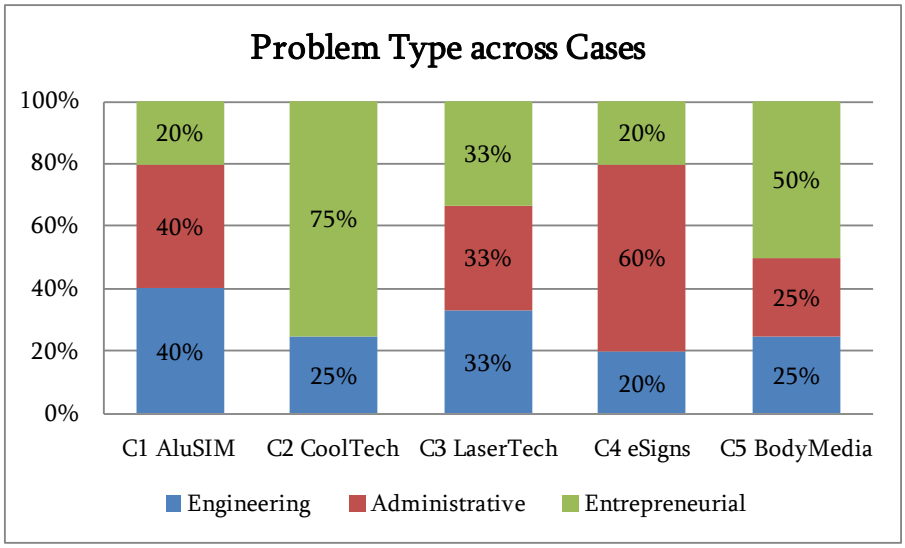
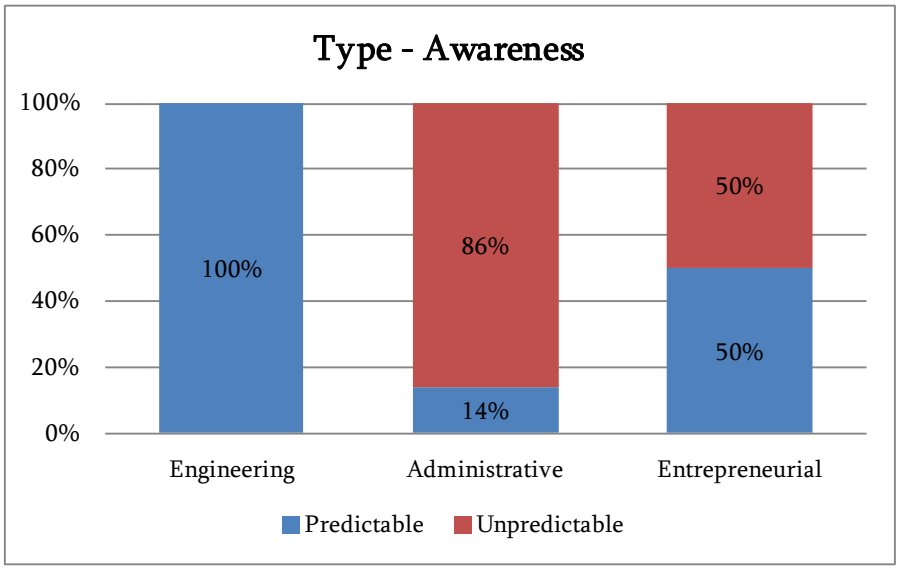


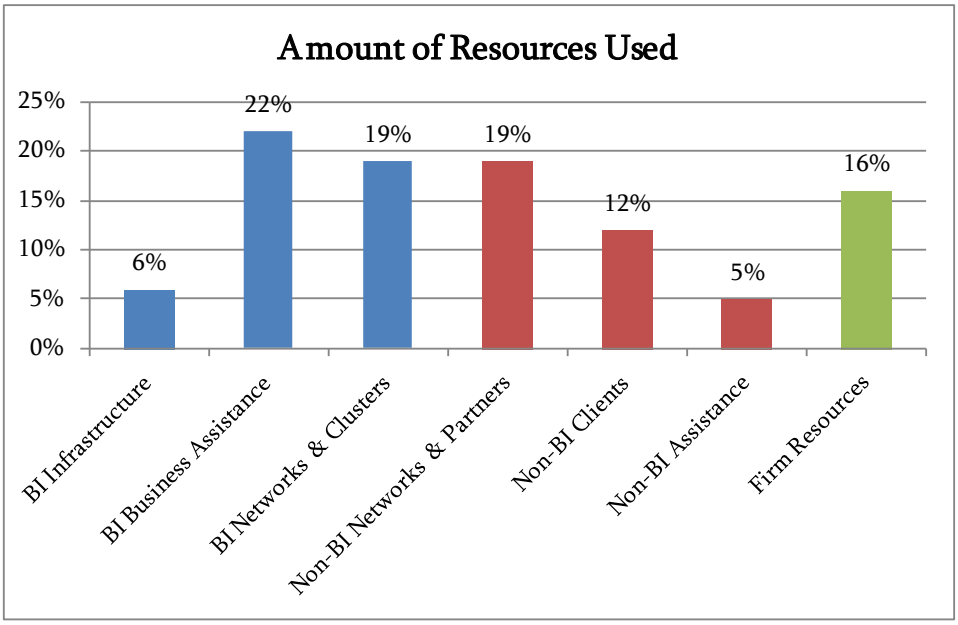
Figure 17 - Problem Type and Problem Awareness



5.3 (RQ3) – Utilization of Resources

The firms used various resources to manage developmental problems, as displayed in Figure 18. The most used resources to manage problems are BI Business Assistance (22%), BI Networks & Clusters (19%), Non-BI Networks and Partners (19%) and Firm Resources (16%). The firms used more BI resources (47%) than Non-BI Resources (36%) and Firm Resources (16%). However, the firms still used more Non-BI Resources and Firm Resources when combined (53%) compared to the total amount of BI resources (47%).

Figure 18 - Amount of Resources Used to Manage Problems



AluSIM (C1) and CoolTech (C2) both used more BI Resources than the other firms, see Figure 19. Meanwhile, Figure 20 shows the resource utilization spread across the degrees of problem complexity.

Figure 19 - Types and Amount of Resources used across Cases

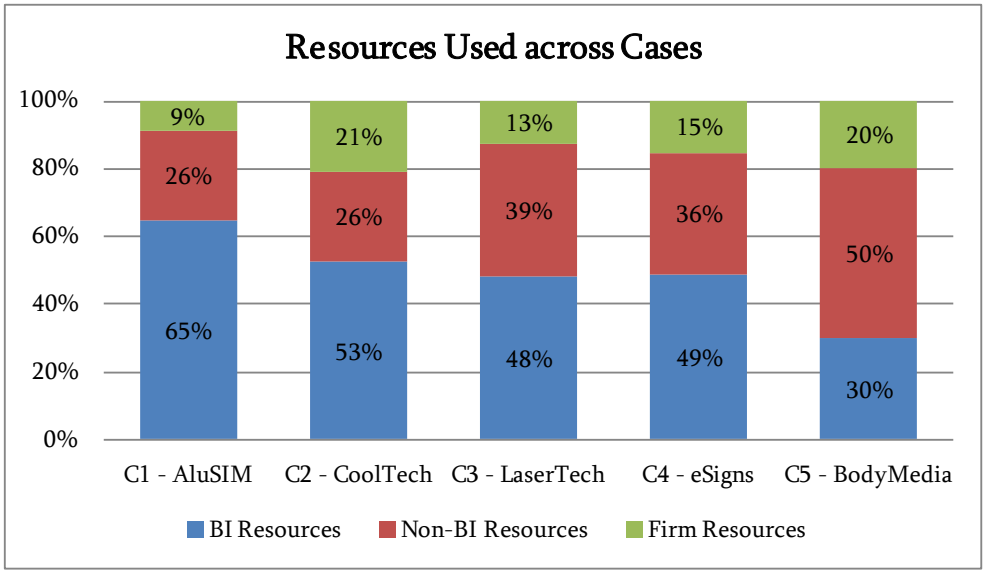
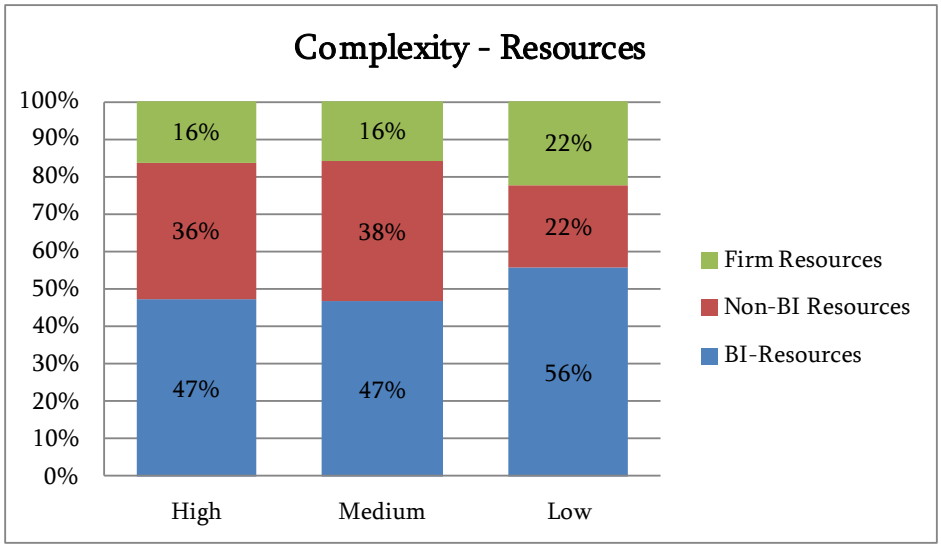


Figure 20 - Complexity and Resources



Resource utilization is distributed relatively evenly across all of the degrees of complexity. It does not really matter how complex the problems are, firms seem to be using the same amount of resources of each resource type. However, firms seem to be using more BI Resources (57%) for managing problems they stumble upon than for predicable problems (42%).

Because the amount of problem types are relatively the same for each case observed, it is interesting to see the cumulative result of the amount of resource firms use across the different problem types. When it comes to engineering problems firms use a lot more resources (value = 74) compared to the other types of problems. In an attempt to manage entrepreneurial problems, firms use relatively less resources (value = 59) than engineering problems, even though there are more entrepreneurial problems identified. In addition, even less resources (value = 38) are being used to manage administrative problems. Finally, the types of resources used are relatively evenly distributed across problem types. There are no significant differences observed in that regard.

5.4 (RQ4) – Development Progress

An overview of information related to the development progress of the firms is included in Table 12. The amount of value created reflects the amount of problems solved taking into account the degree of the problems' complexity (see 4.5.3 Progress to learn how value is calculated).

AluSIM (C1) unlocked 45% of the total amount of value by solving one highly complex problem and one problem with medium degree of complexity. The firm managed to acquire clients early on, and ended up with three clients by the end of the first year. The team was temporarily expanded after the firm hired a student to help with the product development. Most of the other product development activities were outsourced.

Table 12 - Development Progress

	Case 1 AluSIM	**Case 2 CoolTech**	**Case 3 LaserTech**	**Case 4 ePath**	**Case 5 BodyMedia**
Value Created	45%	17%	21%	0%	35%
Clients	3	1	11	0	7
FTE Growth	0	+2	+1	+4	+4
Product stage in BI	Concept	In development	Working prototype	In development	In development
Product stage after BI	Working prototype	Working prototype	Limited Users	Working prototype	Limited Users
Technological progress	+++	+++	+++	+++	++
Commercial progress	++	0	++++	0	+++
Revenue	€ 60,000	€ 30,000	€ 415,000	€ 0,-	€ 550,000
Grants & Loans	€ 20,000	€ 285,000	€ 1,610,000	€ 280,000	€ 470,000

The company went from having a product concept to a working prototype in the first year; this is reflects in the technological progression. In comparison, the commercial progress is less because of the shift in focus from providing a service to product development in the second half of the first year. Finally, the firm managed to earn revenues to finance product development.

CoolTech (C2) unlocked 17% of the total amount of value by partially solving two problems. After getting access to grants and loans, the team expanded with two FTE's to a total of three employees and one student. At the beginning the company had a concept of a product and worked two years to develop a working prototype. The firm worked with one client during a research project where they offered their expertise through research activities. The commercial progress remained stagnant because the firm didn't acquire any clients outside of the subsidized research projects. The firm relied on grant money to invest in product development.

LaserTech (C3) managed to partially solve a highly complex problem and unlocked 21% of value in the process. When the company was founded, the production process was still in development. However, the company quickly managed to build a process that could deliver a product/service to limited users. Surprisingly, the firm delivered their services to more than ten clients in the first two years of development. The firm acquired three of the first clients four months after being founded. As a result, the extra income could be used to further develop the

production process. In addition, the firm also participated in research projects where they benefited from grants from subsidized research projects.

ePath (C4) is the only firm that didn't manage to solve any problems and as a result didn't create a lot of significant value. The firm also didn't get in contact with any potential clients during its first year of development. However, the firm did hire four employees by the end of the first year. The technology moved from the concept stage and into development early on. A lot of resources were spent on product development. The firm developed a working prototype that was tested by users, but client input remained scarce. ePath relied solely on grants and loans to develop the company during its first year. The company didn't sell anything and therefore didn't earn any revenues.

BodyMedia (C5) (partially) solved two problems and therefore managed to create 35% of the total potential value. The firm engaged with clients early on by providing research services using an early version of the product prototype. BodyMedia acquired the product when it was still in development, from the university. After developing a working prototype the product was deployed at initial clients to be tested. By the end of the incubation programme, the company managed to have a functional product with limited clients and users. While the company received grants, the financial resources used to develop the product comes primarily from the generated revenues.

5.4.1 Solution Effectiveness

The majority (65%, n = 14) of developmental problems identified by the firms did not get solved during the business incubation programme. Only 14% (n = 3) of the problems actually were solved, and 19% (n = 4) were partially solved. Figure 21 shows that only AluSIM (C1) and BodyMedia managed to solve two problems and one problem respectively. ePath (C4) didn't solve any problems, meanwhile CoolTech (C2) managed to solve some components of two problems and LaserTech partially solved one problem. Perhaps even more interesting is the fact that firms use about 32% of BI Resources, 42% of Non-BI Resources, and the remaining 26% of Firm Resources to manage the problems that are solved (Figure 22). The firms that managed to partially solve problems used more BI Resources (51%) than Non-BI Resources (34%) and Firm Resources (15%). In an attempt to solve the other problems, firms used 48% of BI Resources, 36% of Non-BI Resources and 16% of Firm Resources.

Regarding the types of problems, most (33%) problems that are solved are engineering problems. Only 14% of administrative problems are solved, and 25% of entrepreneurial problems are partially solved (Figure 23). There isn't a significant difference between predictable and unpredictable problems when firms seek to solve these problems. A higher percentage (18%) of predictable problems is solved compared to problems firms stumble upon (10%). But, about 18% of predictable problems are partially solved and 20% of unpredictable problems are partially solved. As a result, less predictable problems (64%) remain unsolved compared to problems firms stumble upon (70%).

Figure 21 - Amount of Problems Solved across Cases

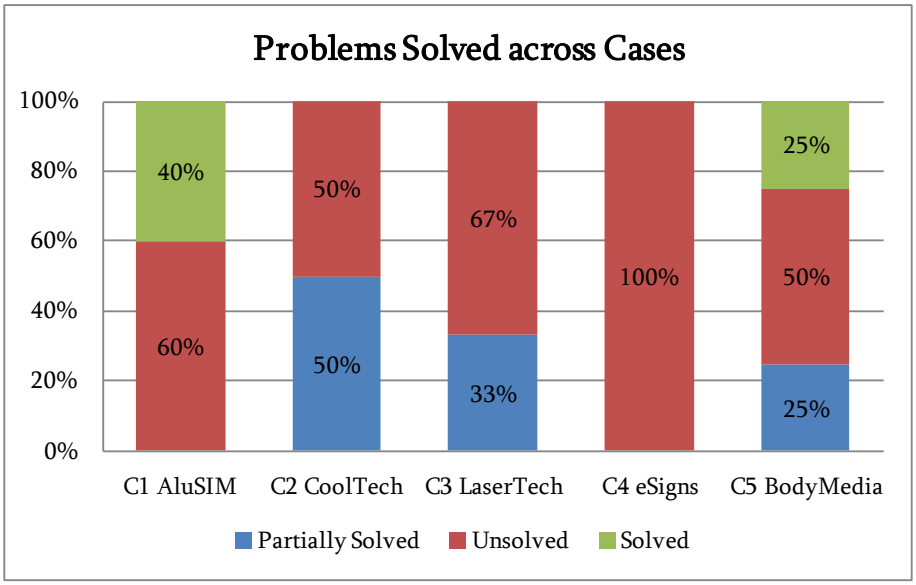
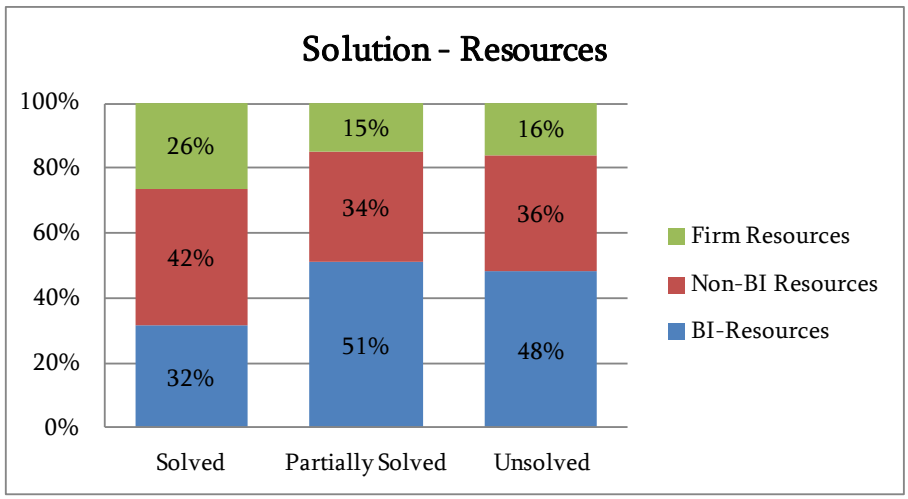
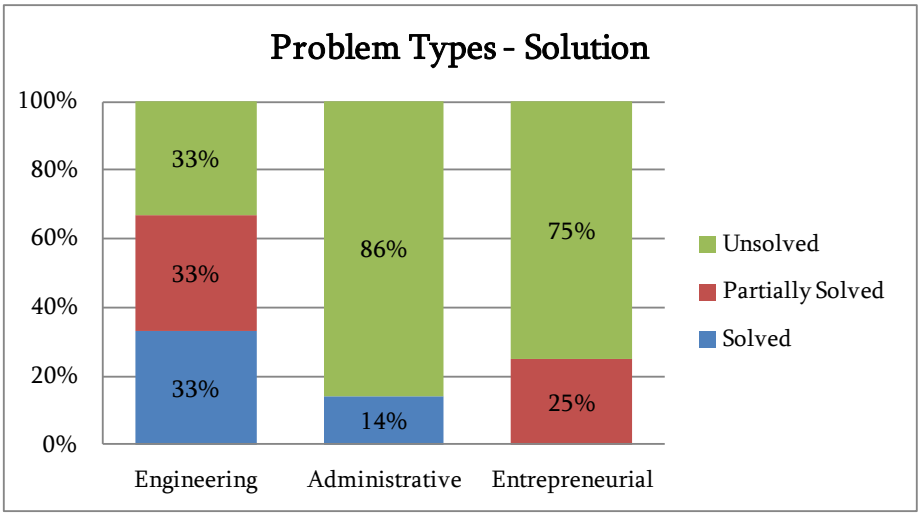


Figure 22 - Resources Used in Search for Solutions



Regarding the degree of complexity and problems solved, a higher percentage (17%) of problems with medium degree of complexity was completely solved compared to the more complex problems (13%). However, firms manage to partially solve more problems with a higher degree of complexity compared to problems that have a medium degree of complexity. This means that firms often focus on the relatively more complex problems that happen to be of the engineering problem type.

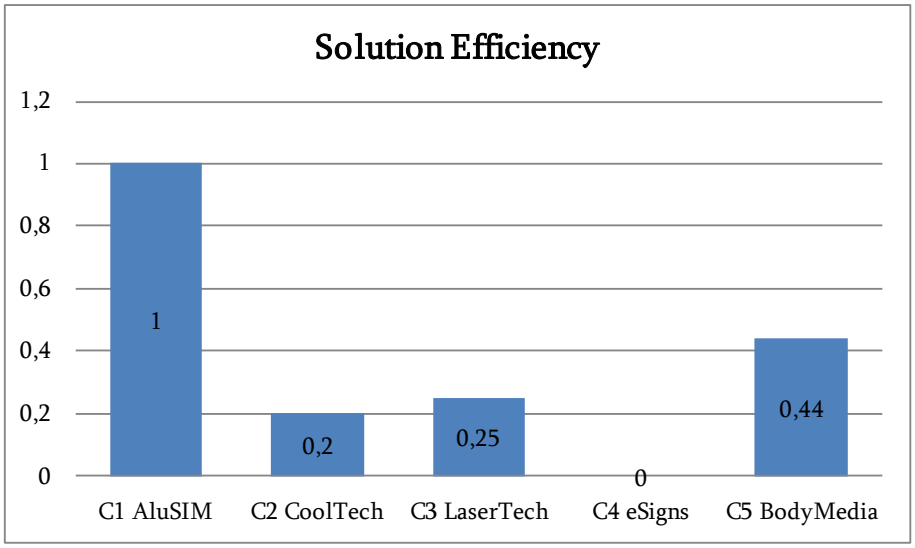
Figure 23 - Problem Types Solved



5.4.2 Solution Efficiency

Solution efficiency refers to the value created over a period of time. Unlike the value creation discusses so far, the efficiency introduces a time dimension into the equation.

Figure 24 - Solution Efficiency across Firms



For example, a firm that solves two complex problems within a year is considered more efficient than a firm that solves two complex problems within two years or two simple problems within six months. Figure 24 illustrates the solution efficiency across firms. AluSIM (C1) is considered to be the most efficient firm because it managed to create the most value (45%) within the shortest period of time (one year). BodyMedia (C5) followed in second place by creating 35% of value over a period of two years. ePath stayed in the incubation programme for one year, but didn't solve any problems. LaserTech (3) and CoolTech (2) both stayed two years in the

programme and unlocked 21% and 17% of value respectively. (The values used in Figure 24 are used solely for comparative/relative purposes.)

5.5 (Central RQ) – Exploring Problem Solving Dynamics

This section explores problem solving dynamics in an attempt to make sense of the findings and answer the central research question.

5.5.1 Why Problems Don't Get Solved

The first surprising finding is that the vast majority of problems remain unsolved during the first two years of the incubation programme. This raises the question as to why most problems don't get solved during this time period.

The evidence suggests that the first problems firms deliberately choose are considered to be relatively the most complex problems. These first problems are the initial entrepreneurial opportunity firms perceive and can be formulated as *"...if we manage to build this product, we can address an opportunity in that market"*. As a result, the first highly complex problems are related to product development which is related to engineering. Highly complex problems require a lot of resources, time and attention to manage over time. For example, LaserTech (C3) and BodyMedia (C5) both estimate that it will take more than ten man-years and a continual commitment to invest in product development in order to fully develop the first complete version of their products. But because these nascent firms don't have the necessary resources (capable labor and financial resources) to develop the products early on, they are forced to build and earn these resources first, and that often takes longer than two years.

The second reason why most problems don't get solved is because firms stumble upon unpredictable problems. On average, firms are confronted with two additional unexpected problems during their development. Because of the low awareness to unpredictable problems, firms have to redirect their attention to manage these problems as well. However, some firms (C2; C4) tend to take a reactive approach and temporarily ignore the problems they believe they will stumble upon, because they prioritize other problems, such as product development. Most of the problems firms are unable to predict are of the entrepreneurial and administrative types. Even though all of the unpredictable problems are perceived as having a lower degree of complexity compared to the predictable problems, they are often discovered later during the firm's development, and therefore remain unsolved.

The third and final reason why problems don't get solved is because solving problems is sometimes depended upon the co-managed efforts of actors outside the firm. Some problems are not fully controllable, and therefore not fully manageable by the firm alone. However, this does not mean that the firm cannot solve the problem, but the time it takes to solve the problem becomes dependent on the actions and decision making of external actors. For example, ePath (C4) found that the components supplied for assembly are too expensive. The source of the problem is found at the supplier which is external to the firm. BodyMedia (C5) also learned that policies have to be changed at a legal level before their solutions can be implemented effectively.

Changing legal policies is not a problem that BodyMedia can solve. Solving problems firms cannot control often means avoiding them by thinking of alternative solutions or choosing other problems to solve.

5.5.2 Two Start-Up Patterns: How Firms Manage Problems

The findings reveal that firms do not have to be very effective nor very efficient problem solvers in order to survive in the first two years. The evidence shows that some firms (C1; C3; C5) have the ability to create only a fraction of the total potential value and earn a significant amount of revenues to further improve their offerings. However, this is not the case for the remaining firms (C2; C4). This brings up the question as to why there is such a big difference between these two types of firms in the way they approach problem solving. It turns out that there are two distinctive patterns (parallel and sequential problem solving) that help explain how firms execute the start-up of a firm in the attempt to manage problems.

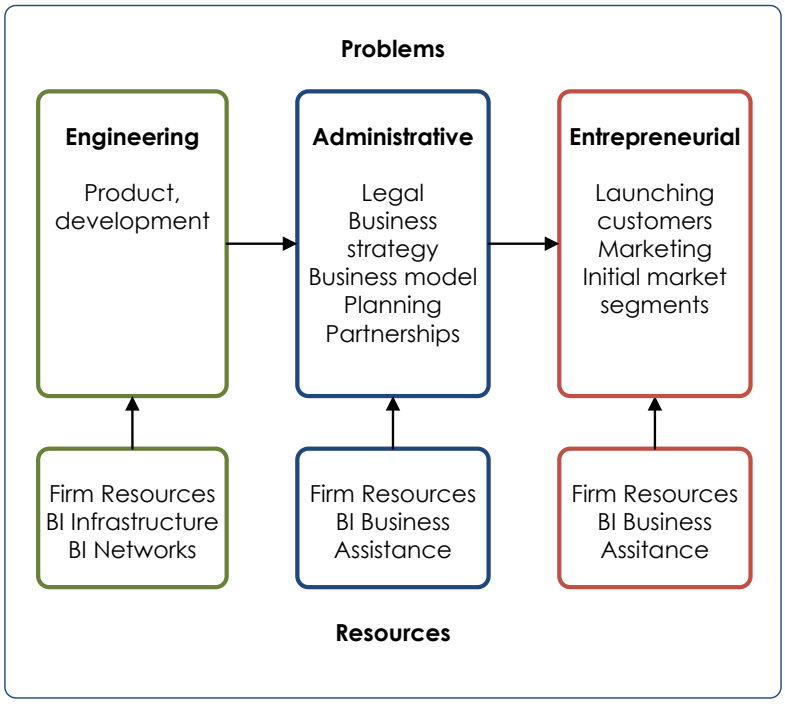
Vertical Focus: Isolated and Sequential Problem Solving

Vertical focus or sequential problem solving refers to the way firms approach the various types of problems in an isolated and orderly fashion (Figure 25). The tendency is to focus a lot on one problem, manage it, and then move to the next problem. Both CoolTech (C2) and ePath (C4) focused primarily on the engineering problems (product development), and focused less on administrative and entrepreneurial problems. Even though these problems have been identified they do not enjoy priority above product development. The founder at ePath expressed the difficulties of reducing their focus on product development, *"I stopped development, which brought tears to my eyes, because I'm a developer. This is my child and I wanted to do this myself, but when I constantly kept getting questions of my team—Is it done, is it done? I realized that I became a bottleneck for them".* It appears that the problems are being perceived as isolated modules that don't necessarily interact with each other simultaneously. The engineering problems don't interact with administrative problems, and entrepreneurial problems don't interact with the engineering problems, as illustrated in Figure 25. For example, CoolTech (C2) develops its products with a wide target market in mind. The firm reports having contact with thirteen potential customers in nine different market segments. The strategy to develop the product is to participate in subsidized research projects (as a sub-contractor) and use the results of the research to shape the product. After the product is launched, the company expects it to do well, even though defining initial markets and approaching markets are problems that remain unsolved. The approach to manage these entrepreneurial problems is passive, because the founder believes that the markets will define themselves, and the pieces will fall in place once the product is getting ready for launch. Thus, instead of the firm going out to the customers, the customers will come to the company in search for their solutions. "Build it, and they will come" is a common believe the founders posses.

Instead of being actively engaged in solving entrepreneurial and administrative problems, these firms scout for potential problems in these areas. Firms tend to rely on administrative procedures such as; planning, strategizing, and extrapolation techniques to prepare for problems

they predict that will have to be solved in the future. An example of this is when ePath calculated the cost price for components needed for assembly and making assumptions about what is considered too expensive for a certain target market.

Figure 25 - Vertical Focus: Problems are Isolated



Some of the key characteristics of sequential problem solving are covered below.

The focus Firms that take on a vertical approach to managing problems tend to focus a lot on engineering problems. While administrative and entrepreneurial problems are identified, firms do not actively engage to manage these problems simultaneously with the engineering problems. For example, ePath focused a lot on prototype testing and user testing in collaboration with other universities. Prototype/user testing is considered engineering problem because the end-users are not the paying customers. The company reports that the test results are great, but the evidence does not show that the results could be translated to solve any entrepreneurial problems (e.g. win over potential customers). Finally, firms tend to focus a lot on the desire to launch a complete, finished product with a well rounded amount of features. For example, the founder of ePath says *"My expectations of what a product should be is that the product has to be perfect at launch, the level of quality should be very high."* This approach leads to product development in isolation.

Isolated product development Isolation means that firms approach each problem separately, without taking interaction and feedback among problems into account. For example, in both cases (C2; C4) product development occurs with the collaborative efforts of universities, external actors, distributors, end-users, with the paying customer being the only exception. ePath didn't want to show an early version of their software product to potential customers because it

had too many bugs. The company assumes that implementing an early version of the software means that the maintenance costs will be too high. Product development occurs behind closed doors until the company is confident enough to release a complete and finished product to its potential customers. CoolTech (C2) started early development with a potential launching customer, but the potential customer pulled away during the course of development. CoolTech (C2) didn't manage to acquire another potential launching customer afterwards and continued conducting product development with the support of the BI and the university.

Validation Firms that focus on managing problems vertically don't seek customer's validation of their value propositions. Instead, they receive validation from other sources expect from their own potential customers. For example, firms can participate in competitions organized by the BI where they can win prizes and awards. Companies are often judged based on the technology's potential, market size, business plans, etc., and not on whether the customers want to buy their offerings. ePath's founder mentioned that they won a grant after going through an elaborate screening process, pointing out that they must be doing something right because otherwise they would have not won. Similar validation is expressed when ePath managed to attract key partners as a strategy to penetrate specific market segments. The assumption is that the firm must be doing something right since key partners are showing so much interest. However, none of these efforts have shown to translate into neither customer validation nor entrepreneurial problem solving. The same is true when firms conduct prototype testing and end-user testing, because input from the paying customer is left out of this process.

Financial resources Because of the heavy emphasis on product development during the first years, firms are unable to generate a lot of revenue. Firms acquire financial resource to cover development costs through grants offered via the BI networks. The financial resources are used for technical and market feasibility studies and product development. For example, CoolTech (C2) earned revenues by participating in a subsidized research project. Firms rely on grants, subsidies since they are not able to earn additional resources through sales.

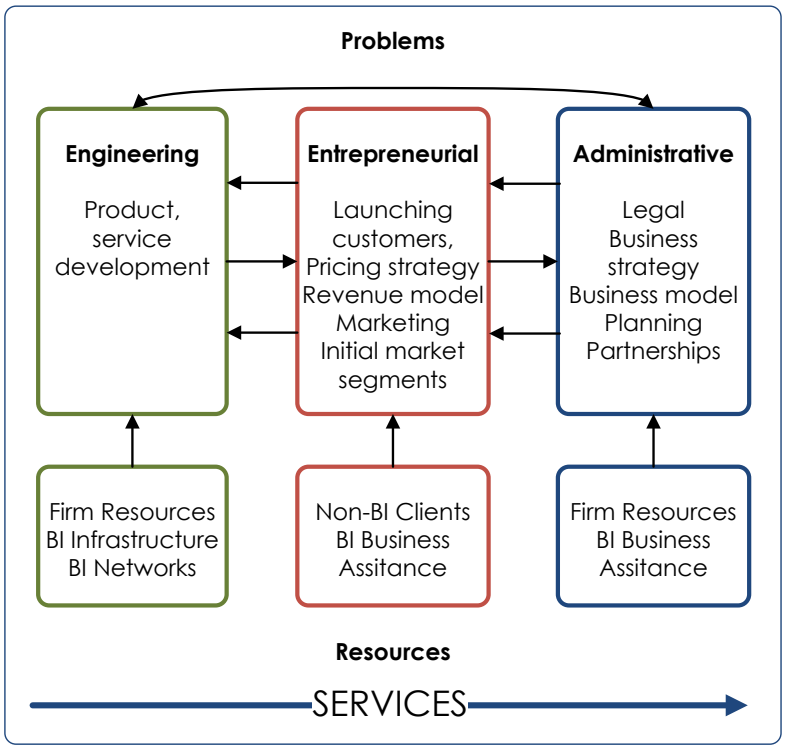
Team growth There is an increase in personnel growth observed in firms that focus on vertical problem solving despite driving no revenue from customers. These firms invest in personnel primarily to support product development. ePath (C4) also hired a business developer and a marketing manager early on but the approach taken is to wait for the product to be ready before executing on the business and marketing strategy they developed.

Assumptions The underlying assumption is that customers are willing to buy the firms' offerings once the products are introduced into the market. This assumption is never tested until the product is fully developed. However, these assumptions are not proved valid in the two cases (C2; C4) because the product was not ready by the time the firms left the BI. As a result, vertical focusing doesn't offer a lot of space for testing assumptions about the firms' value propositions (entrepreneurial problem solving). The vertical approach leaves a lot of room for making assumptions, guesses, estimations, predications, none of which have shown to solve any problems effectively.

Horizontal Focus: Parallel Problem Solving

Horizontal focus or parallel problem solving refers to the way firms approach the various types of problems simultaneously (Figure 26). The tendency is to focus on all of types of problems with the emphasis being on both engineering problem (product development) and entrepreneurial problem (customer development).

Figure 26 - Horizontal Focus: Problems are Interdependent



Both AluSIM (C1) and LaserTech (C3) managed to acquire customers in less than three months after entering the BI. Firms that focus horizontally across problems do not wait until there is fully developed product. In contrast, the tendency is to manage entrepreneurial problems and engineering problems simultaneously. Both BodyMedia (C5) and LaserTech (C3) admit that the early technology being used contained a lot of *"rubbish"* and were too *"amateurtistic"*. However, both companies used the technology in its unfinished state to provide offerings to early clients. In the case of AluSIM, the firm acquired customers before starting on product development. LaserTech managed to attract interested clients through publications of the founder's research findings before the company was even founded. AluSIM (C1) and LaserTech (C3) both prioritized customer development (entrepreneurial problem solving) above product development (engineering problem solving). Figure 26 illustrates that the horizontal approach acknowledges the back-and-forth interaction between the three types of problems. For example, BodyMedia (C5) had to come up with a solution to protect sensitive user information in order to obtain a CE Mark. The problem initially started as an administrative problem (applying for the CE Mark), but the solution had an engineering component. The engineering team had to

implement a communication protocol to ensure the user's data is protected. What the firm assumed is an administrative problem had to be solved with an engineering solution. By having a horizontal focus firms essentially 'slice' horizontally through a small portion of all the problems identified. Firms repeat the process until all of the problems are managed, but not necessarily solved. Some of the key characteristics of parallel problem solving are covered below.

The focus Firms that apply a horizontal focus tend to engage in all of the three types of problem simultaneously. There is also a tendency to prioritize entrepreneurial problems; however, the other problems are not ignored. For example, when AluSIM (C1) was founded, the company offered mainly advisory services. After realizing that a client is interested in an unfinished research, the decision was made to build a product based on the research findings. LaserTech (C3) and BodyMedia (C5) did something similar by offering services using unfinished versions of their technology. These firms do not seek to provide a fully finished product to their initial clients. Instead, they co-developed their products with clients by initially offering services and then slowly expanding to physical products. This approach leads to a dialogue with customers during product development.

Open product development Firms that approach problems horizontally don't conduct product development behind closed doors. Much of the product development occurs in collaboration with end-users, interested clients and other key external actors. For example, BodyMedia established contact with more than forty organizations to collaborate on their platform. The company also used grant money to establish a joint-venture to conduct research and development with another organization. When AluSIM realized that clients wanted a software product, the company built one component of the software and outsourced the other part of the component. The product was co-developed by two firms to cater to identified needs of initial clients. This approach replaces the isolation factor during product development with a more open and collaborative development effort.

Validation Because firms offer services very early on, clients are able to validate or reject the firm's value proposition very early on. Being engaged with clients early on removes the need to search for validation in other places. However, there is still a technical validation process that needs to take place. Technical validation means that the product is performing as indented and meets certain requirements. For example, AluSIM allowed a research institute to validate its simulation software to make sure it is accurate. Similarly, BodyMedia managed to acquire a CE-Mark for their products as evidence that their products have been validated for safety procedures. The evidence shows that these firms acknowledge that, while technical validation is important it does not automatically translate into customer validation.

Financial resources Firms that engage in horizontal problem solving don't rely on grants exclusively for product development. In fact, none of the three firms (C1; C3; C5) had access to significant financial resources when they were founded. Instead, firms rely mostly on rent-free loans offered by the BI, tax breaks offered by the government and revenues generated from their initial clients. The grants that LaserTech (C3) and BodyMedia (C5) managed to acquire are not for product development purposes like it is the case with CoolTech (C2) and

ePath (C4). LaserTech's grant approval is tied to a European research project. Similarly, BodyMedia's grant approval is tied to a R&D joint-venture with another research organization. While spin-off knowledge is used for product development, the additional financial resources are not used directly for product development. As a result, firms are forced to generate revenues to cover most of the product development costs. As mentioned previously, firms achieve this by providing services early on.

Team growth Because of the limited financial resources, personnel growth occurs when the firm is generating enough revenues to cover most of the personnel costs. The cases illustrate that firms pursuit inexpensive methods to reach a desired goal, without having to hire additional personnel. For example, BodyMedia (C5) established relationships with researchers to fulfill the role of ambassadors. The company allows researchers to use their technology to conduct investigations under the condition that the name "BodyMedia" has to be mentioned in the publication. BodyMedia used this method to generate publicity within scientific community and the world of medicine. The company also participated in various competitions, not with the sole purpose to win, but to generate free publicity. Journalists are invited on several occasions to write about the progress being made by the company. The stories are then published in local news papers and on various websites. There is also a tendency to persuade partners, and suppliers to collaborate with these firms (C3; C5) early on in exchange for exclusive deals in the future. Thus, instead of hiring marketing personnel to address promotional needs, BodyMedia found other less expensive ways to generate publicity for the company.

Assumptions Observations indicate that firms don't assume that early clients want a complete finished product. As a consequence, firms don't wait until the product is finished, but instead offer a service with the limited available resources firms have at the time. The case of LaserTech (C3) illustrates that early clients are not particularly interested in the unfinished state of the product. It appears that early customers value the technology very early on by recognizing its future potential and are therefore willing to pay for the services offered by the firms. In addition, because of the provision of services, the firm's value proposition is tested in the early stages of product development. Market risk is lowered by allowing customers to validate the value proposition making the need to formulate assumptions less necessary.

The Importance of Providing Services

A separate section is devoted to stress the importance of proving services during the early developmental stages of a high-tech firm. Offering services to initial clients seems to be one of the key characteristics that distinguish firms that adopt a vertical focus versus firms that adopt a horizontal focus. However, offering services is a result of actions that firms take during the firm's development. Firms approach the offering of services as a temporary effort to address the needs of initial clients before the product is fully developed. Firms do not necessarily set out to provide services early on but it is considered to be a very convenient method for several reasons.

First, financial resources are very scarce during a firm's start-up. Without the access to capital through investors, financial institutions or government grants, firms are forced to search for alternative ways to fund the start-up. Services provide firms with early revenue streams to

cover personnel costs. Labor is important during product development, and is often the highest expenditure. Additional equipments necessary for product development are accessed through the BI.

Second, by providing services, firms are able to establish relationships with their initial clients. There are a lot of advantages that comes accompanied with having a close relationship with clients. For example, firms are able to collect important information about the needs of their clients. Since the approach is on a small scale, clients can be seen as individual stand alone cases. Firms don't have to conduct elaborate market research early on. Instead, they expand from client to client based on the observations made, and continue with this method to address other clients. The feedback collected during the process is also used to shape (new) product development and address engineering problems.

Third, services help clients validate the firm's value proposition. Because of this, firms are able to refine their value proposition by focusing on the areas that clients seem to value the most. Knowing what clients value the most will help firms develop an effective pricing strategy for their products. Services also help firms experiment with different revenue streams, and other aspects of the business model (C1; C3).

Fourth, by establishing a dialogue with initial clients firms increase their awareness to unpredictable problems. For example, AluSIM (C1) and LaserTech (C3) discovered problems in the areas of value proposition, pricing strategy and revenue model. However, firms that do not offer services also discover unpredictable problems, but the difference is that the problems do not originate from contact with clients. The problems are based on assumptions that the firms have about their initial clients.

Finally, services forces firms to address all types of problems simultaneously. Because of the contract based transactions, firms have to complete a project and deliver services within a given time-window. The evidence shows that firms (C1; C3) often deliver first, and then think of better solutions afterwards. Thus, offering services is an important characteristic of firms that manage problems in parallel.

5.5.3 How Resources Are Used to Manage Problems

The findings show that the resources that are most used includes BI Business Assistance, BI Networks & Clusters, Non-BI Networks and Partners, Firm's Internal Resources and Non-BI Clients. Firms use more Non-BI Resources and Firm Resources than BI Resources to manage problems. Furthermore, there doesn't seem to be a significant difference between the type of resources firms use and the degree of problem complexity. Firms tend to use more BI Resources to manage unpredictable problems than predictable problems. This might be some of the benefits that firms enjoy after stumbling upon unpredictable problems while being incubated. Firms use more resources to manage engineering problems, then entrepreneurial problems, and lastly, administrative problems. However, when looking at problem types in isolation, there is little difference observed between the types of resources used to manage the different types of problems.

BI Infrastructure The BI Infrastructure is mainly used for product development purposes. Complex engineering problems tend to be managed with the use of BI Infrastructure in combination with firm and non-BI resources. All of the firms observed used BI Infrastructure during product development. However, the degree of which the BI Infrastructure resources are used varies from high (C2; C3) to low (C1; C4; C5) across cases.

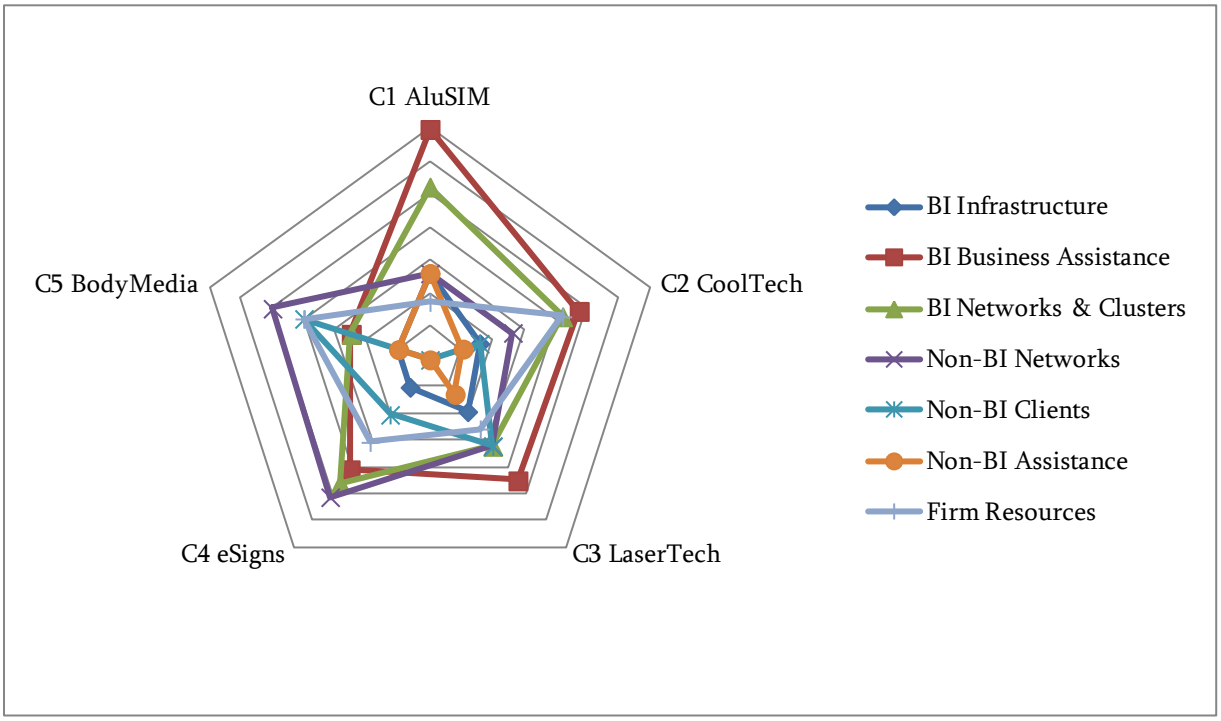
BI Business Assistance BI Business Assistance is provided by scientific mentors, business mentors, and incubator managers. Business assistance are used to manage entrepreneurial (C2; C3; C4; C5) and administrative problems (C1; C3), and on occasions engineering problems (C2; C5). While business assistance is provided in some cases (C1; C4) aimed at managing administrative and entrepreneurial problems, the problems remain unsolved. However, business assistance seems to increase the firm's awareness to problems instead of solving it. For example, AluSIM (C1) identified the opportunity to develop a product after attending panel discussions during a training programme.

The founder of ePath acknowledged the importance of managing the development process after having conversations with the business mentor. Regarding the engineering problems, most of the entrepreneurs hold PhD degrees in engineering and are considered to be experts in their field. The founder of LaserTech (C3) pointed out that they are considered to be the scientific experts, making the support received from the scientific mentor less significant. BI Business assistance is not considered to be a very valuable resource to solve engineering problems. However, the scientific mentor fulfills a very important role in connecting the firms to the BI's network.

BI Networks & Clusters Resources provided through BI Networks are often used to manage engineering problems related to product development. For example, AluSIM allowed a research partner in the BI's network to validate the firm's simulation software. CoolTech established partnerships with former incubated firms to perform R&D activities. The university also fulfills the role of research partner, as shown in the cases of CoolTech (C2), ePath (C4) and BodyMedia (C5). Finally, financial resources are mediated through the university in the form of grants. The majority of the grant money is used to fund product development. As mentioned previously, the scientific mentors have an important role in guiding the entrepreneurs through the BI's networks and clusters.

Non-BI Networks & Partners Firms use resources provided through Non-BI Networks & Partners to outsource activities that firms cannot carry out internally. BodyMedia (C5) and ePath (C4) are good examples of firms that use these resources to their advantage. BodyMedia mobilized a significant amount of resources through its partnerships with suppliers, R&D institutes, international universities, research centers, and distributors. For these firms, Non-BI Networks and Partners are necessary resources to be able to manage developmental problems.

Figure 27 - All Resource Types across Cases



Non-BI Clients Resources provided by early clients proved to be invaluable to some firms (C1; C3; C5). In the case of AluSIM, an early client helped the firm identify an opportunity to develop a product. Aside from the benefits of driving early revenue from initial clients, the evidence suggests that firms need clients to solve entrepreneurial problems. Client resources are used to shape product development (C1), finance product development (C1; C3; C5), define initial markets (C2), and refine value proposition and pricing strategy (C1; C3).

Non-BI Assistance Some firms (C2; C3; C5) did not use a lot of Non-BI assistance. Non-BI Assistance is provided in the form of financial resources to cover product development expenses. For example, LaserTech (C3) financed equipments with a bank loan. BodyMedia accessed additional financial resources through various governmental programs that benefits high-tech startups focused on R&D. Firms that make use of Non-BI assistance have a tendency to avoid accessing financial resources through loans (C5), selling shares (C2; C4), or negotiate agreements with financial institutions. Firms often use valorization grants, revenue, subsidy, research grants, and financial resources provided by the BI. Offerings of financial investments by angel investors, venture capitalists or investment banks remains surprisingly absent in all of the cases observed. Other alternative ways of funding, such as crowd funding, also remains absent.

Firm Resources Firms resources consist primarily out of the entrepreneurial team (human resources) and the technologies initially transferred from the university to the firm. Firm resources are used to manage all of the three types of problems. A significant amount of firm resources are used to manage engineering problems. However, firm resources are not necessarily sufficient to manage developmental problems types across cases.

Chapter 6 – Discussion

6.1 Findings and Extant Literature

6.1.1 Business Incubation Literature

Comparing the findings of this study to the findings of previous studies reveals more similarities than contradictions. Perhaps the most significant contribution of this study is the realization that *how* firms utilize resources is in essence a methodological problem. The problem deals with the methods firms apply when using resources in an effort to manage developmental problems. The success of a start-up might have more to do with the methodology firms apply when managing problems, than with the resources they use, or even the chosen product-market combination. The two typologies identified, vertical focus: sequential and horizontal focus: parallel problem-solving, shows two distinctive approaches firms employ during the start-up of a firm. The vertical focus deals with a stage-based approach to problem solving, while the horizontal approach addresses all of the problems simultaneously. Vohora, et al. (2004) found that firms go through an iterative non-linear development process consisting of five development phases. The fourth development phase is the reorientation phase. In the reorientation phase firms *"…faced some degree of turbulence in their development due to learning how to manage the evolution of different aspect of business in parallel"* (Vohora, et al., 2004, p. 158). The reorientation phase resembles the way firms approach problem solving from the horizontal perspective. It appears that firms that employ a vertical focus share similarities with the second phase described by the authors as the opportunity farming phase. The authors write, *"…it appeared that during the opportunity farming phase too much emphasis was placed on developing the technology and too little on identifying, accessing and targeting key customers in the value chain"* (Vohora, et al., 2004, p. 158). The evidence found in this study shares similarity as firms who adopt a vertical focus tend to allocate most of the resources to solve technical engineering problems related to product development. Firms that employ a horizontal focus seem to move very early on to the reorientation phase, without investing too many resources during the opportunity farming phase.

Regarding the type of problems firms encounter mentioned in the BI literature, the notable absent problem observed is the need for venture capital (McAdam & McAdam, 2008; Vohora, et al., 2004). While in some cases (C2; C4) firms solved this problem by acquiring financial resources through governmental grants, the remaining firms (C1; C3; C5) were able to generate sufficient revenue to cover the initial start-up costs.

The important BI resources mentioned in the literature are very much in line with what is observed in the case studies. For example, the evidence shows that government grants, loans, infrastructure, networks and business connections outside the incubator (Chan & Lau, 2005; Mian, 1996), are also considered valuable. Especially connections outside the incubator related to customers, partners and suppliers. In contrast, resources related to legal services and patents (Rice, 2002) and accessibility to markets and customers (Burnett & McMurray, 2008), appear to be lacking in some of the cases observed (C2; C4).

6.1.2 Contribution and Side-Effects of BIs during Problem-Solving

The findings show that only 14% of problems are actually completely solved, while 19% of problems are partially solved. The BI still contributes in several (indirect) ways when firms are attempting to manage problems; however there are also some side-effects observed.

First, through business assistance, the BI increases the awareness of firms by helping them predict problems (C1; C2; C4). Most of the problems firms become aware to are related to administrative (e.g. strategy, value proposition) and engineering (e.g. product development) problem types, with the entrepreneurial problem type being the exception.

Second, through the BI's network, firms benefit from the access they have to research partners (C1; C2; C3; C5), suppliers (C2; C3), human resources (C1; C2; C5), (European) research projects (as subcontractors), and financial resources (government grants). Most of these resources are used for product development. Whether a product is being validated by a research partner, or the firm is assigned as a subcontractor to deliver a product or service, or components are being supplied for assembly, solving an engineering problem is the BI's main contribution here.

Third, while the evidence shows that the BI does helps firms to manage administrative and engineering problems, entrepreneurial problems are often remaining unaddressed. As a result, firms have to seek for solutions to the entrepreneurial types on their own. This might help explain why some firms (C2; C4) do not seem to prioritize entrepreneurial problems, and therefore do not manage these problem types during the initial years.

Fourth, firms that have access to significant amount of financial resources (e.g. grants) seem to focus relatively more on solving engineering problems compared to firms that do not have access to such resources. Firms with limited access to financial resources have shown to drive revenues very early on because they are forced to approach initial clients in order to acquire the access to additional financial resources. As a result, these firms are confronted with a wider array of problem types, and are able to develop validated solutions to these problems much faster. Thus, allowing firms to have access to substantial amount of financial resources might provide an environment that is too comfortable with the consequence that it promotes product development instead of customer development.

Finally, there appears to be another side-effect caused by the BI. There is a sense of validation that firms develop when acquiring grants, or winning awards after participating in competitions organized by the BI. Firms might misinterpret these achievements with validation of their value propositions by actors within the environment of the BI. However, it must be pointed out that these achievements should not be substituted with the validation of the firm's value proposition by actual customers. It should be clear that market validation cannot be simulated within the BI as the evidence shows that it does not solve entrepreneurial problems effectively. Technical product validation does not automatically translate into customer and market validation.

6.2 Contribution of Theories and Frameworks

6.2.1 Business Incubator Assessment Framework

The BI assessment framework developed in this study does not explicitly integrate theories into the framework. For example, Chan & Lau (2005) presented structural theory and cluster theory to discuss potential explanations of how BIs might contribute to new firm development. Hackett & Dilts (2004a) developed their BI process model with the real options-driven theory to explain how BIs increase the likelihood that a new firms survives its early stages of development. However, the BI framework proved to be useful for assessing characteristics of BIs that might have an impact on the development of nascent firms. For example, the findings show that it is possible to conceptualize firms divorced from the BI even though they are physically located within the BI. The assumption is that incubated firms are actively using BI resources to manage developmental problems. The findings reveal that this assumption is not necessarily true in some cases. In fact, firms might also be using a lot of non-BI resources that are often not included in most BI frameworks. The purpose of the BI framework is to quickly scan BI environments and to observe key areas that are affecting the firm's development in meaningful ways. The BI contributes by being one of the few BI frameworks that applies a lens from the standpoint of the incubated firm.

6.2.2 Resource-Based View

The RBV is often used to support the argument that BIs improve the firm's ability to extract rents from "bundles of innovations" as a function of resource value, rareness, imitability and substitutability (Jay Barney, 1991; Hackett & Dilts, 2004a). The findings show that this view might be to narrow, since firms often rely on a combination of firm, BI and Non-BI resources (initial customer, partners and suppliers) to solve developmental problems and create value. Previous studies have often assumed that value creation occurs primarily between the incubated firm and the BI, and that the success of the incubated firms is seen as the responsibility of the BI (Hackett & Dilts, 2004a). The evidence provides motivations to come up with an argument that departs from this view to also include resources that are unrelated to the firm or the BI. Some efforts to manage developmental problems and produce value far exceed the capabilities of the BI to a point that it is considered unrealistic to expect that value creation should only be restricted within the BI. Finally, the RBV indicates that for a nascent firm, it is perhaps more important to employ the right methodology to acquire valuable resources from its initial customers than it is to produce those resources internally.

6.2.3 Entrepreneurial Problem Solving

The problem-solving perspective is perhaps the perspective that provided the most meaningful insight during the observations. The problem solving perspective suggests that entrepreneurs are able to pair valuable problem-solution pairings to create new products or address new markets. Moreover, complexity of problems is related to the interdependency among individual solution

sets that make it possible to solve a complex (and a relatively more valuable) problem. However, these individual problems also interact with other problem types that need to be managed. The observations reveal that developmental problems are highly interrelated. Firms that manage problems in parallel perceive complexity when addressing these interrelated relationships between problems. The problem co-solving model suggests that nascent firms use BI resources and non-BI resources during the search for solutions. In most cases, observations confirm this assumption. However, the problem co-solving framework lacks important aspects that need to be included in the new model.

6.3 Rebuilding the Problem Co-Solving Model

The attempt to rebuild the model is achieved by employing the methods proposed in the literature (Carlile & Christensen, 2006; C. M. Christensen & Carlile, 2009; Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Sutton & Staw, 1995; Yin, 2009). The three steps that researchers who are building descriptive theory generally pass through are said to be observation, categorization, and association (C. M. Christensen & Carlile, 2009). A similar approach is applied to expand upon the problem co-solving model.

The first step of observation is already covered in the case studies and analyses. The second step of categorization is addressed by making a distinction between the two approaches that firms employ when managing problems. In the final step, relationships are associated with category-defining attributes and the outcomes observed. The following sections discuss such attributes.

6.3.1 Defining Relationships

The category defining attributes and the outcomes observed are displayed in Table 13. Notable highlights include added emphasis on problem types as a defining attribute, sequential and parallel problem solving, and the notion of validation. The emphasis on solution and value creation is softened since the evidence suggests that problems do not have to be solved in order for a firm to progress during its initial year(s).

Problem Types

The way firms manage the various problem types defines the attributes' outcomes between parallel and sequential problem solving (Table 13). The difference is that some firms manage various problem types simultaneously, while other firms choose to manage each problem type in an isolated sequential fashion. Firms that manage problems in sequentially tend to manage engineering problems first, administrative problems second, and entrepreneurial problems last. Firms that focus on parallel problem solving tend to start by managing entrepreneurial problems first, engineering problems second, and administrative problems last. This pattern appears to dictate the outcome of the remaining attributes, as explained below.

Problem Complexity

The evidence suggests that problems are highly interdependent and interactive. Firms that manage problems sequentially tend to perceive a problem to be complex because of the engineering problems. These problems are often identified by the firm itself, during product development. Other remaining problems that firms identify but do not manage are perceived to be complex because of the lack of resources (information) to address these problems. Firms that focus on parallel problem solving tend to experience complexity in the degree to which various problems interact with one another. Problems can be complex on their own, but the real complexity lies in the management of various problems that interact with one other simultaneously.

Table 13 - Differences between Parallel and Sequential Problem Solving

Attributes	Parallel – Horizontal Focus	Sequential – Vertical Focus
Problem Types	Entrepreneurial problems are prioritized, while other problems are not ignored.	Engineering problems are prioritized, while others are temporarily ignored.
Problem Complexity	Complexity is caused by managing several problems simultaneously.	Complexity is caused by the search of engineering solutions.
Problem Awareness	Problems firms stumble upon are caused by initial customers.	Firms don't actually stumble upon problem, they attempt to predict problems.
Salient Resources	Customer resources and BI infrastructure are considered salient.	Firm resources and BI assistance (financial resources) are considered salient.
Progression	Firms progress by offering services initially, and gradually expand to physical products.	Progression is measured in terms of the technological progress made during product development.
Validation	Market validation is prioritized.	Technical validation is prioritized.
Growth Logic	Customer growth occurs gradually through the provision of services. Revenue promotes team growth.	Firms seek to target a large population of customers after the product is completed. Initial start-up investments promote team growth.
Assumptions	Assumptions about the solution are tested through the provision of services.	While technical aspects of products are tested, the final solution is tested in the market until after the product is completed.

Problem Awareness

Firms that solve problems in parallel, stumble upon most problems after the initial contact with customers. In contrast, firms that solve problems sequentially attempt to predict problems based on assumptions about important problems that need to be managed in the future. While the BI may provide support to help firms become more aware, it mostly increases problems related to administrative problem types.

Salient Resources

There are no significant differences in the types of resources, or the amount of resources used between the two categories. However, there is a difference observed in how firms organize resources across categories. Firms that approach problems sequentially tend to accumulate resources in the very early stages of development and allocate these resources to solve engineering problems. These firms rely mostly on financial and human resources to conduct R&D activities. Firms that manage problems in parallel tend to allocate resources to provide services to their initial clients. These firms rely mostly on BI infrastructure to produce the services, and customer resources to shape product development and manage entrepreneurial problems.

Progression

When defining progress in terms of the revenues generated, firms that focus on parallel problem solving progress faster. The same is true when progress is defined as the amount of problems solved and value created. Progression is achieved by offering services. In contrast, firms that solve problems sequentially seem to perceive progress as defined by the product development progress and the financial and human resources acquired to sustain this development. For example, completing a concept product, acquiring grants and hiring personnel are considered to be important achievements or milestones.

Validation

The model suggests that firms seek for two types of validation. Technical validation is related to the product or service being developed. A product is validated when it works as intended, and has all the necessary features that the firm thinks customers are going to use. Market validation refers to achieving a product-market fit, and finding out if clients adopt the value proposition. That firms that solve problems sequentially do not seek for market validation early on. Instead, the focus is on using resources to validate the technical solution of the engineering problems. In contrast, firms that manage problems in parallel seek market validation prior to technical validation.

Growth Logic

Growth logic is another attribute that contains perhaps the most significant differences between parallel and sequential problem solving. To explain the differences, examples and logic found in scientific methods are used including, sampling logic, reasoning and research strategies.

Firms adopting the parallel method of solving problem, treat their initial customers as multiple cases, across various market segments (contexts) that are still undefined. Using the marketing terminology, the initial customers fall within the innovators or early adopters category of customers (Moore, 2002). Firms then search for customers' problems and needs in an effort to provide customized solutions. To determine the potential value of the solutions, firms offer services as an efficient and fast method to validate the firm's value propositions early on. Firms continue to go from customer to customer to observe if the solution's value is maintained across problems in a variety of contexts (markets). If the value decreases, firms amend the solution or search for other problems. The differences between the contexts later define the market segments. Based on the feedback received from customers, and the observations made, inductive reasoning is used to expand to larger populations of customers within market segments. It can be argued that the benefits of this approach decrease both market risk and technological risk because market validation is sought before technical validation without the need of substantial initial investments. According to Blank, markets with customer or market risk are those where the unknown is whether customers will adopt the product (S. Blank & Dorf, 2012; S. G. Blank, 2006). Technological risk refers to the unknown whether a firm can solve engineering problems (product development). Using this growth logic, firms attempt to close the gap (and reduce market risk) between the early adopters and the early majority within a market segment.

Firms adopting the sequential method of solving problems seem to employ different growth logic. These firms treat their initial customers as a large population of customers within different segments. It appears that firms initially identify a variety of market segments based on their products which is assumed to effectively solve problems within these market segments. These firms assume that they know what their potential customers value within these populations, and expect that a significant amount of clients will adopt the solutions once the product is launched. However, these assumptions are never tested until the product is introduced into the market. Firms focus on providing proof that the technology works by validating it and lowering technological and engineering risk. However, less attention is given to market validation or reduction of market risks. Deductive reasoning is applied to support the logic that the solution is valid across customers (innovators, early adopters, early majority), and market segments within the population. Because the technological validation process (R&D) often requires a lot of resources (technological, human, and financial resources), market risk increases while technology risk decreases.

Assumptions

Following the parallel method, firms assume that initial clients are willing to pay for services even though the product itself is not finished. This is perhaps possible because of the growth logic these firms employ. Because of the initial provision of services firms are able to optimize their customized solutions over a period of time. In contrast, the sequential approach shows that firms aim to fully develop a "perfect" product before launching. This might be related to the fact that these firms target a wide population of customers. Launching an unfinished product into a wide market might not work in the firm's favor. However, this assumption remains untested.

6.3.2 Parallel versus Sequential Problem Solving

Is parallel problem solving better than sequential problem solving? The evidence suggests that the parallel approach has more benefits than the sequential approach. Some arguments based on the findings that support this view are summarized below.

First, developmental problems are interdependent and highly interactive. This means that an administrative problem can be solved by implementing and engineering solution, and that an entrepreneurial problem can be solved by changing and engineering component. While managing various problems types simultaneously is considered to be relatively more complex, it seems imperative to find solutions more effectively. Firms that manage problems sequentially tend to ignore entrepreneurial problems; this might lead to an ineffective search for solutions that fit together across all of the problem types. Second, it considered unreasonable to invest heavily in product development without creating demand or solving entrepreneurial problems first. A study found that firms that focus too much on product development (engineering problem) instead of customer development (entrepreneurial problem) tend to fail faster (Marmer, Herrmann, Dogrultan, & Berman, 2012). The authors argue that firms that focus too much on product development have the tendency to have an execution mindset which does not allow them to listen to customers and learn if their products are actually something that their customers want. Third, because firms do not approach clients early on, they are dependent on other sources to attract financial resources, such as subsidies, and grants. In addition, the evidence shows that parallel problem solving leads to sustainable cash flow faster than sequential problem solving. Fourth, by accumulating and stacking resources without solving the entrepreneurial problems, risk is also being accumulated. This is being motivated by the assumption that market acceptance will be reached after the product is completed. Firms that manage problems in parallel approach clients very early on and therefore reduce the market risk significantly. In addition, these firms often have limited access to subsidies and grants and are therefore forced to drive revenues early on. Finally, the parallel problem solving forces firms to validate their ideas and value propositions by offering services to their initial clients. The sequential approach does not allow the opportunity for customer validation during the product development phase.

6.3.3 Hypothesis

The following hypotheses are formulated in an effort to expose anomalies between the attributes' relationships. These hypotheses are given as examples of directions for future research avenues.

H1: *Firms are more likely to progress when the three problem types have been managed simultaneously, (but not necessarily solved).*

The first hypothesis attempts to confirm the significance of the interdependent nature of problem-solution dynamics. If the solutions to problems are truly interdependent, managing problems simultaneously might be favored above sequential problem solving.

H2: *Firms that prioritize entrepreneurial problems are more likely to succeed over time than firms that prioritize other problem types.*

By prioritizing entrepreneurial problems, firms reduce market risk by validating their solutions (value proposition) before solving engineering and administrative problems. In other words, parallel problem solving is more effective than sequential problem solving.

H3: *Firms that offer services initially are able to solve problems more effectively than firms that do not offer services.*

Customer resources are important to manage problems. By offering services, firms are able to access these resources early on, without the need to develop physical products. The evidence shows that customer resources are necessary to solve problems like developing a pricing strategy, bundling products and services, and determining a revenue model.

H4: *BI's business assistance (financial resources) increases the firm's focus on engineering problem solving.*

BIs that provide significant amount of financial resources to start-ups might create an environment that is too comfortable. This comfort might promote engineering problem solving (product development) behind closed doors. This effect is seen in the attributes of the sequential problem solving method.

H5: *Pro-active BI counseling promotes new product development by helping firms become more aware to problems and identify opportunities.*

Firms react to opportunities by searching for solutions and building new products to address the opportunities. The evidence suggests that pro-active counseling can stimulate opportunity discovery which might lead to new product development.

H6: *Initial clients (in a B2B market) are more likely to be interested in the potential of the product in the future, than the current unfinished state of the technology.*

This hypothesis questions the observation that initial clients are not necessarily interested in a finished and "perfect" product with complete set of features. Initial clients appear to treat the new technology as an extension of their commitment to invest in innovation. It is the possibilities that the technology offers in the future that attracts initial clients and not particularly in the finished product. However, this hypothesis needs to be tested in a wider population and under other conditions.

Chapter 7 – Conclusion

7.1 Conclusion

This study set out to investigate how nascent high-tech firms manage developmental problems within BIs. The approach taken is from the perspective of the firm, by analyzing the various resources firms utilize to manage and solve developmental problems. The incubator environment is also analyzed to reveal what resources the BI offers and how firms consume these resources in an effort to manage problems. Conclusions are drawn for each research question.

RQ1: What are the characteristics of the business incubator; what are the support resources and how are these resources being provided?

The TOP programme can be classified as a university BI, because the programme does not operate independently from the university. Unlike the university, the TOP programme itself has no technological focus, since the goal is to include a broad target of firms, including both spin-offs and spin-ins. The TOP programme offers all of the basic resources covered in the framework; infrastructure, business assistance, and networks. The incubator programme applies a loosely selection criteria, which results in a high selection rate of the target group. The selection strategy is mainly concerned with creating as many start-ups as possible. The method of providing business assistance is very reactive and episodic. Business assistance and much of the related resources are provided on-demand, after the incubated firm requests for it. As a result, the incubator management team intervenes after being approached by the firms. The BI management coordinates the programme by fulfilling the role of a hub within a network. The entrepreneur is expected to remain independent and take the initiative to approach, establish and maintain relationships with the actors and organizations within the network.

RQ2: What are the developmental problems experienced by the firms and what are their characteristics?

The dimensions introduced to analyze problems include, problem complexity, problem awareness and problem type. The majority of problems firms experience have a medium degree of complexity, as expected. The remaining problems are considered to be highly complex, since problems with a low degree of complexity are not very common. Engineering problems have a higher degree of complexity, while entrepreneurial and administrative problems have a medium degree of complexity. This finding is not surprising considering that the core business of a high-tech firm often revolves around engineering solutions. Regarding the problem awareness, the amount of problems doubles during the firm's development since firms stumble upon additional problems. On average, firms experience four developmental problems in their initial two years. The predictable problems firms choose to solve have a higher degree of complexity (engineering

problems) compared to the problems firms stumble upon. This means that firms are unable to predict administrative and entrepreneurial problem types. The type of problems firms experience is very evenly distributed across cases. The most common engineering problem types are product and service development. Entrepreneurial problems include define the market scope and initial markets, and develop a marketing strategy. Finally, creating bundles of products and services for specific customers, developing pricing strategies and revenue models, and establish relationships with partners are examples of administrative problems firms are confronted with.

RQ3: What are the resources being used during problem solving and what is the BI's contribution?

The findings reveal that firms use slightly more non-BI resources than BI resources to manage problems. The most used resources to manage problems are business assistance, networks, non-BI networks (e.g. partners), and firm resources. Resource utilization is distributed relatively evenly across all of the degrees of complexity. It does not really matter how complex the problems are, firms seem to be using the same amount of resources of each resource type. However, firms seem to be using more BI resources for managing problems they stumble upon than for predicable problems. When it comes to engineering problems firms use relatively more resources compared to the other types of problems. In an attempt to manage entrepreneurial problems, firms use relatively less resources than engineering problems. In addition, even less resources are being used to manage administrative problems.

The evidence shows that firms use a mix of firm resources, non-BI resources and BI resources. In several instances using BI resources alone has shown not to be sufficient to manage problems effectively. BI resources are used primarily to manage engineering problems, such as product or service development. BI resources are valuable as they consist of about the half of the total amount of resources firms use to manage problems. In addition, resources mediating through initial clients have shown to be necessary to manage important components of entrepreneurial, administrative and engineering problems. Firms combine incubator, non-incubator and firm resources as they all are necessary in order to manage problems effectively.

The BI contributes by raising the awareness to administrative and entrepreneurial problems, however, these problems often remain unsolved. Firms tend to use more BI resources to manage unpredictable problems than predictable problems. This might be some of the benefits that firms enjoy after stumbling upon problems while being incubated. In some cases, business assistance motivated firms to recognize opportunities, which led to new product development. BI infrastructure has shown to help firms solve engineering problems, and help firms provide services to initial clients. However, there are also side-effects observed caused by the BI's environment. These include an emphasis on engineering problem solving over entrepreneurial problem solving. Access to significant financial resources allows firms to direct their focus on product development and ignore other problem types. Finally, BI's can cause a false sense of validation of the firms' value propositions because firms might misinterpret validation of actors

within the BI with market validation. It should be noted that market validation cannot be simulated within the BI as the evidence shows that resources provided by initial customers are very important to help manage entrepreneurial problems effectively.

RQ4: How do firms progress based on the problems solved?

Surprisingly, firms do not progress by solving a lot of problems, as initially thought. There are three main reasons why problems don't get solved during the first two years of a firm's development. First, it takes a lot of time and resources to search for solutions to highly complex engineering problems. Second, firms have to deal with unexpected problems they are unable to predict. In addition, firms sometimes deliberately choose to ignore these problems in order to prioritize other problems. Finally, while all problems can be managed, not all problems can be solved within the capabilities of the firm since the control firms have over the problem is sometimes limited.

Firms progress by providing services using unfinished technology to initial clients. This is a surprising finding considering that all of the firms focus on product development and aim to provide physical products. Firms approach the offering of services as a temporary effort to address the needs of initial clients before the product is fully developed. Firms do not necessarily set out to provide services early on but it is considered to be a very convenient method for several reasons. First, services provide firms with much needed additional financial resources through revenue. Second, by providing services, firms are able to establish relationships with their initial clients and acquire client specific resources to improve product development. Third, services help clients validate the firm's value proposition early on. Fourth, by establishing a dialogue with initial clients firms increase their awareness to unpredictable problems. Finally, services forces firms to address all types of problems simultaneously. The findings show that firms that offer services progress more in terms of revenues gained and problem types identified than firms that focus only on product development.

Central RQ: How do nascent high-tech firms utilize resources to manage developmental problems within business incubators?

The answer to the central research question problems is twofold. It can be concluded that the way firms utilize resources is grounded in the methodology firms adopt to manage problems. The findings reveal that the methodology is based on the type of problems firms choose to focus on. There are two patterns observed in which firms prioritize product development (engineering problem solving) or customer development (entrepreneurial problem solving) when managing problems.

Some firms choose to solve the entrepreneurial problem first by developing the initial customer base early on by offering services. These firms manage the three types of problems in parallel, or simultaneously. Instead of targeting a population of potential customers, these firms adopt a case-based approach, where customers are approached one by one. Instead of focusing

on completing product development, services are offered with incomplete versions of their technology. Instead of developing products behind closed doors, these firms co-developed their products with initial clients and key partners. The BI plays a very important role in mediating financial resources. But perhaps more interesting is the fact that firms sell their services because they do not have access to initial financial resources. It must be pointed out that financial resources in the form of initial investment are in some cases neither necessary nor sufficient during the start-up of a firm.

The second pattern reveals that some firms choose not to offer services, but would rather invest in product development first. This method leads to product development in isolation, where firms prioritize engineering problem solving. These firms target larger populations of potential clients. Because the focus is on technological validation, market validation is left untested until the product is completed. The underlying assumption is that clients are willing to buy the solution once it is completed. Because of the access to substantial initial investments, firms can conduct technical and market feasibility studies and product development. These patterns reveal that some firms rely more on BI business assistance in the form of financial resources while other firms rely on non-BI customer resources in the attempt to manage developmental problems. The evidence shows that all the three problem types are highly interactive and interdependent. It can therefore be concluded that is more beneficial to manage problems in parallel.

It becomes increasingly clear that the value proposition of BIs has its limits when applying the problem co-solving framework. Resources of initial clients have shown to be both necessary and sufficient to solve the most important entrepreneurial problems faced by the firms. The evidence has not shown that entrepreneurial problems can be solved in isolation or with the resources provided by the BI. The earlier firms can gather input from their customers the better, because it will shape engineering and administrative solutions accordingly. Most of the firms agree that they could have not been founded without the help of the BI. The evidence also shows that firms do in fact use a lot of BI resources when it comes to managing developmental problems, especially engineering problems. The bottom line is that firms need all three types of resources to solve the three types of problems. In this sense, the BI's value proposition is limited, because firms need to also combine non-BI resources to effectively manage and solve developmental problems.

7.2 Contribution and Recommendations

7.2.1 Research

This study aims to expand the incubatee development research stream by understanding how nascent firms use resources to manage problems. The findings contribute to research in several ways.

The study conceptualizes the firm divorced from the BI, something that is seldom done in previous research. This approach allows the incubator's value proposition to be assessed from the perspective of the firm. The findings lead to strong arguments that support the notion that the

method of how problems are managed is more important than the resources used. This notion contradicts with the current RBV within a start-up context. Moreover, it appears that resources from outside the firm (initial customer) are considered to be necessary and sufficient for a successful start-up of a firm. Thus, the current RBV might not be the most appropriate framework to understand how firms are created using resources.

Furthermore, the notion that start-up is about the methodology of how to manage various problem types has insightful implications for both entrepreneurship and BIs. By understating this methodology, entrepreneurship frameworks can be taught, developed and applied more successfully. This is particularly valuable within a BI environment.

7.2.2 BI Managers

Incubator managers are faced with a challenging task: to successfully macro-manage the mass production of nascent firms. Every stakeholder involved has high expectations of the outcomes and the incubator manager is no different. The findings provide incubator managers with insight that promotes the improvement of methodologies surrounding the macro-management of new start-ups. One can argue that start-up failures are caused by self inflicted wounds. This means that it doesn't matter how many resources a firm has, or how good the business idea is, if there is a lack of knowledge surrounding the method of execution and problem solving, the business might still fail. The following is composed out of the lessons learned and recommendations to guide BI managers to reduce the chances that such failures occur.

First, the overarching lesson of this study to realize that understanding *how* firms manage problems is about the methodology that firms employ when managing problems. This includes both how firms manage problems and how they use resources. An appropriate methodology to start-up a business might be more important than the resources involved. Second, BI managers should focus on developing and implementing start-up methodologies that promote entrepreneurial problem solving. Practical examples include experimentations with initial clients, market validation processes, and the provision of services to early clients in order to improve learning. BI managers should be able to, for example, design methods to test and validate business models, assumptions, value propositions and ideas. Finally, the evidence shows that there is a dangerous side-effect firms might suffer from when participating in competitive events (e.g. business plan competitions). Events where prizes or rewards are involved might mislead participants into thinking that their business idea is legitimate without ever talking to initial clients. Instead, BI managers should promote the significance of customer development (entrepreneurial problem solving) and its implications on product development.

7.2.3 Entrepreneurs

By investigating and exposing developmental problems, entrepreneurs and business practitioners can become aware of the potential problems firms are faced with during the start-up of a business. This information is invaluable considering that most new start-ups have a limited margin of error before failing and going out of business. Being able to predict the problems beforehand can improve the firm's ability to prioritize and manage resources more effectively.

The following list is composed out of the lessons learned in an effort to help entrepreneurs become better at building successful start-ups.

First, according to the evidence, firms that approach problems simultaneously in parallel progress faster than firms that approach problem solving in a sequential and isolated fashion. It is recommended to approach customer development and product development simultaneously, since these problems are tightly interrelated. Second, firms that progress faster approach initial clients by offering services initially, not (physical) products. These firms do not wait until the product is fully development. Third, market validation is achieved by solving entrepreneurial problems, i.e. develop a customer base. Fourth, assumptions about the firm's value proposition should be tested before the products are fully developed. This reduces the market risks, and allows important customer resources to be used during product development.

7.3 Limitations and Future Research

This study covers firm development in one type of BI environment, which limits generalization beyond its current configuration. For example, firms might manage problems more effectively (and develop faster) in BI environments that employ a more proactive and continual method of counseling. Future research can focus on the opportunity to study how firms manage problems in other types of BI environments.

The same can be said for the nature of the incubated firms included in the sample. Innovative high-tech firms are selected here based on the assumption that these types of firms select a wider array, and perhaps more complex problems relative to low-tech firms that do not actively seek to promote the innovation agenda. The selected firms operate primarily within B2B markets, excluding B2C markets. Research designs of future research can facilitate literal replication, theoretical replication or a combination of both by selecting other types of firms and incubator environments with differing configurations. For example, instead of only focusing on high-tech firms, service-based firms can also be included in the sample.

In addition, researchers should not dismiss the possibility to approach and include data collected from the firm's early clients or other external actors. Insight gained from clients can, for example, reveal whether the association firms have with BIs enhances clients' perceived credibility of the firms. It is already known that venture capitalists find incubated firms more attractive (Shane & Stuart, 2002; Studdard, 2006). It is therefore interesting to learn if this is also true for clients. Credibility, or the promise to deliver, might play an important role when there isn't a finished product on the table. As a result, credibility might impact the clients' willingness to invest in the firms' unfinished products. If this hypothesis can be confirmed by evidence, it will improve the understanding of how BIs help firms solve important entrepreneurial problems.

The possibilities for future research reveal the current underdeveloped state of business incubatee development studies. A collaborative effort is necessary from researchers across disciplines to continue to push the business incubation's wheel of science in interesting new directions.

7.4 Self-Reflection and Learning Objectives

After repeatedly asking questions about what problems entrepreneurs are confronted with during the early stages of a firm's development, it is considered appropriate to turn a critical lens on my own research experience and reflect on the answer while doing so.

Personal interests and goals I aspire to become a serial entrepreneur and business owner in the future. Entrepreneurship has always been a subject of interest to me. Having the opportunity to conduct research within an environment of a BI where there are a lot of start-ups was seen as a vehicle to learn more about entrepreneurship. My goal was therefore to become as closely involved as possible with the subject matter, while also searching for and creating new knowledge in the process. I can now safely profess that the lessons that I have learned far exceed the scope of this research. I look back at the years of hard work and dedication as a learning experience that will pay off in the future in some shape or form. However, the research itself was not very smooth; the following is a compilation of the problems I had to solve during the project.

Qualitative research It was clear from the beginning that I was particularly interested in doing qualitative research in the form of case studies. It is said that case study research is among the hardest types of research to do because of the absence of routine formulas (Yin, 2009). Quantitative research methods are often favored in the curriculum, and having a lack of understanding about qualitative research combined with the challenge associated with this type of research increased my interest in this research method. In addition, a case study research allows the researcher to make intimate observations of a current phenomenon by, for example, colleting primary data and conducting interviews, etc. Thus, the case study strategy allowed me to conduct qualitative research for the first time and become intimately familiar with the evidence, both of which satisfied my personal goals of maximizing the learning experience.

Data collection The amount of cases I set out to analyze at the beginning of the study was four. However, data was collected from a total amount of seven cases. Seven cases proved to be a double-edged sword; it doubled the amount of work, but also significantly enhanced the richness of the study, since none of cases resembles one another. The evidence collected from each case did not contain redundant information, every case contributed to answering the research question from a different insightful perspective. While all of the cases made it into the data analysis stage, the decision to exclude two cases was made in order to reduce the amount of work. It was a very hard decision to make, considering the amount of work that was already put into the cases, however, the decision turned out to be a smart decision.

Data analysis I stumbled upon three problems during data analysis. First, I underestimated the amount of work and skill that involves in producing quality transcriptions of recorded interviews. I solved this problem by becoming a student assistant to transcribe and analyze recorded interviews for two research departments at the university. There, I developed a transcription guide where all the software, tools, and methods are documented. I also learned the implications a bad transcription can have on the overall quality of the research, and how to avoid such transcripts. Second, I had to develop my own methods to organize and analyze the data

while combining it with existing ones. To solve this problem I relied mostly on the Atlas.TI software package for qualitative data analysis and coding. Furthermore, I experimented with various methods using word tables, and other techniques. The final problem is related to the iterative nature of doing case studies. According to Yin (2009), case study analysis is the most difficult stage of doing case studies, and novice investigators are especially likely to have a troublesome experience. I was no exception. Even though the problem was predictable; it took a lot of time because I could not find a pattern in the data right away. I solved this problem by using the output provided by Atlast.TI, writing cases, and other data reduction techniques to simplify the observations. I also distanced myself from the data at times, to develop a helicopter view of the data.

Case-study format I assumed that each case study could be structured similarly, but I was wrong. Even though each case had overlapping characteristics, the cases demanded a specific approach when the evidence is analyzed. I therefore found it challenging to design a consistent structure to present each case as if they were similar, in order to maintain analytic consistency. I managed to solve this problem without compromising the important evidence that was relevant to answer the research question. In addition, it was necessary to study the specifics of each case, and understand their business in depth, in order to understand the problems in details. This was another aspect that I didn't think was necessary, but knowing every case like I know the palm of my hand seemed to be the key ingredient to analyze the cases in-depth.

Planning Perhaps the most important aspect of multiple-case studies I have learned is that the actual work begins after data analysis. Because of the bottom-up coding, the evidence becomes the main source for the development of new concepts that are previously absent from the conceptual framework. In addition, the iterative process of playing with the data and search for meaningful patterns can hardly be planned. In my experience, iteration is a process of search without making actual progress, until the search is over. The iteration process was very time consuming and frustrating at times, it therefore required lot of focus and patience. I started to believe that the problem was related to my lack of researcher insight or capacity. However, some authors believe that methodological quagmires, mazes, and dead ends are not necessarily a product of researcher incapacity, but of qualitative data themselves (B. M. Miles & Huberman, 1994). I also realized that the case-study methodology places as much emphasis on the means as it places on the end. All in all, the learning experience was full of challenges, but the challenges make the reward and learning experience of completing such research a lot more satisfying.

References

Aaboen, L. (2009). Explaining incubators using firm analogy. *Technovation, 29*(10), 657-670.

Adkins, D. (2002). *A Brief History of Business Incubation in the United States*. Ohio: NBIA Publications.

Aerts, K., Matthyssens, P., & Vandenbempt, K. (2007). Critical role and screening practices of European business incubators. [doi: DOI: 10.1016/j.technovation.2006.12.002]. *Technovation, 27*(5), 254-267.

Anderson, T. R., Daim, T. U., & Lavoie, F. F. (2007). Measuring the efficiency of university technology transfer. [doi: DOI: 10.1016/j.technovation.2006.10.003]. *Technovation, 27*(5), 306-318.

Ateljevic, J., & Dawson, A. S. F. (2010). Business incubators: New mechanism for economic/enterprise development or passing fad? Exploring complex relationship of the growing phenomenon in the context of Scotland. *International Journal of Entrepreneurship and Innovation Management, 12*(2), 217-240.

Audretsch, D. B., Falck, O., & Heblich, S. (2011). *Handbook of Research on Innovation and Entrepreneurship*: Edward Elgar.

Babbie, E. (2001). *The practice of social research* (9 ed.). Belmont, CA: Wadsworth Publishing.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*(17), 99–120.

Barney, J., Wright, M., & Ketchen, D. J. (2001). The resource-based view of the firm: Ten years after 1991. [Editorial Material]. *Journal of Management, 27*(6), 625-641.

Baron, R. A. (2006). Opportunity recognition as pattern recognition: How entrepreneurs "connect the dots" to identify new business opportunities. [Article]. *Academy of Management Perspectives, 20*(1), 104-119.

Baum, J. R., & Locke, E. A. (2004). The Relationship of Entrepreneurial Traits, Skill, and Motivation to Subsequent Venture Growth. *Journal of Applied Psychology, 89*(4), 587-598.

Bergek, A., & Norrman, C. (2008). Incubator best practice: A framework. [doi: DOI: 10.1016/j.technovation.2007.07.008]. *Technovation, 28*(1-2), 20-28.

Bessant, J., & Tidd, J. (2011). *Innovation and Entrepreneurship* (2 ed.): John Wiley & Sons.

Blank, S., & Dorf, B. (2012). *The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company*: K & S Ranch.

Blank, S. G. (2006). *The Four Steps to the Epiphany: Successful Strategies for Products that Win*: Cafepress.com.

Broekstra, M., Karnebeek, A. J., & Sijde, P. C. v. d. (2002). *Improving the Quality of University Spin-off Programmes: Towards a Quality Management System*. Enschede: Twente University Press.

Browne, S. (2010). Traction: How Innovators Can Achieve Sustained Revenue Growth.

Bruneel, J., Ratinho, T., Clarysse, B., & Groen, A. (2012). The Evolution of Business Incubators: Comparing demand and supply of business incubation services across different incubator generations. *Technovation, 32*(2), 110-121.

Bruyat, C., & Julien, P.-A. (2001). Defining the field of research in entrepreneurship. *Journal of Business Venturing, 16*(2), 165-180.

Burnett, H. H. M., & McMurray, A. J. (2008). Exploring business incubation from a family perspective: How start-up family firms experience the incubation process in two Australian incubators. *Small Enterprise Research, 16*(2), 60-72.

Campbell, C., & Allen, D. N. (1987). The Small Business Incubator Industry: Micro-Level Economic Development. *Economic Development Quarterly, 1*(May), 178-191.

Carayannis, E. G., & von Zedtwitz, M. (2005). Architecting gloCal (global-local), real-virtual incubator networks (G-RVINs) as catalysts and accelerators of entrepreneurship in transitioning and developing economies: lessons learned and best practices from current development and business incubation practices. [doi: DOI: 10.1016/S0166-4972(03)00072-5]. *Technovation, 25*(2), 95-110.

Carlile, P. R., & Christensen, C. M. (2006). The Cycles of Theory Building in Management Research (working paper) (pp. 26). Boston: Harvard Business School.

Chan, K. F., & Lau, T. (2005). Assessing technology incubator programs in the science park: The good, the bad and the ugly. *Technovation, 25*(10), 1215-1228.

Christensen, C. M. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*: Harvard Business School Press.

Christensen, C. M., & Carlile, P. R. (2009). Course Research: Using the Case Method to Build and Teach Management Theory. [Article]. *Academy of Management Learning & Education, 8*(2), 240-251.

Clarysse, B., Wright, M., Lockett, A., Van de Velde, E., & Vohora, A. (2005). Spinning out new ventures: a typology of incubation strategies from European research institutions. *Journal of Business Venturing, 20*(2), 183-216.

Colombo, M. G., & Delmastro, M. (2002). How effective are technology incubators? Evidence from Italy. *Research Policy, 31*(7), 1103-1122.

Corsten, H. (1987). Technology transfer from universities to small and medium-sized enterprises -- an empirical survey from the standpoint of such enterprises. [doi: DOI: 10.1016/0166-4972(87)90039-3]. *Technovation, 6*(1), 57-68.

Daft, R. L. (2009). *Organization Theory and Design* (10 ed.): South-Western Cengage Learning.

Davidson, C. (2009). Transcription: Imperatives for Qualitative Research. *International Journal of Qualitative Methods, 8*(2), 36-52.

Di Gregorio, D., & Shane, S. (2003). Why do some universities generate more start-ups than others? *Research Policy, 32*(2), 209-227.

Dierickx, I., & Cool, K. (1989). Asset Stock Accumulation and Sustainability of Competitive Advantage. *Management Science, 35*(12), 1504-1511.

Dosi, G., Nelson, R. R., & Winter, S. G. (2001). *The Nature of Dynamics of Organizational Capabilities*. New York: Oxford University Press Inc.

Eckhardt, J. T., & Shane, S. A. (2003). Opportunities and entrepreneurship. [Article]. *Journal of Management, 29*(3), 333-349.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review, 14*(4), 532-550.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory Buidling From Cases: Opportunities and Challenges. *Academy of Management Journal, 50*(1), 25-32.

Fowler, F. (2002). *Survey Research Methods* (3rd ed.): Sage Publications.

Grimaldi, R., & Grandi, A. (2005). Business incubators and new venture creation: an assessment of incubating models. [doi: DOI: 10.1016/S0166-4972(03)00076-2]. *Technovation, 25*(2), 111-121.

Hackett, S. M., & Dilts, D. M. (2004a). A Real Options-Driven Theory of Business Incubation. *The Journal of Technology Transfer, 29*(1), 41-54.

Hackett, S. M., & Dilts, D. M. (2004b). A Systematic Review of Business Incubation Research. *The Journal of Technology Transfer, 29*(1), 55-82.

Hansen, M. T., Chesbrough, H. W., Nohria, N., & Sull, D. N. (2000). Networked Incubators. [Article]. *Harvard Business Review, 78*(5), 74-84.

Hisrich, R. D., & Smilor, R. W. (1988). The university and business incubation: Technology transfer through entrepreneurial development. *The Journal of Technology Transfer, 13*(1), 14-19.

Honig, B., & Karlsson, T. (2004). Institutional forces and the written business plan. *Journal of Management, 30*(1), 29-48.

Hsieh, C., Nickerson, J. A., & Zenger, T. R. (2007). Opportunity discovery, problem solving and a theory of the entrepreneurial firm. [Article]. *Journal of Management Studies, 44*(7), 1255-1277.

Johnson, B. E. (2011). The speed and accuracy of voice recognition software-assisted transcription versus the listen-and-type method: a research note. *Qualitative Research, 11*(1), 91-97.

Kline, S. J. (1985). What is technology? In R. C. Scharff & V. Dusek (Eds.), *Philosophy of technology: the technological condition: an anthology* (pp. 209-212): Blackwell Publishers.

Kubr, T., Marchesi, H., Ilar, D., & Kienhuis, H. (1998). *Starting Up: Achieving success with professional business planning.* Amsterdam: McKinsey & Company, Inc. Switzerland.

Lalkaka, R. (1996). Technology Business Incubators: Critical Determinants of Success. *Annals of the New York Academy of Sciences, 798*(1), 270-290.

Lapadat, J. C. (2000). Problematizing transcription: Purpose, paradigm and quality. *International Journal of Social Research Methodology, 3*(3), 203-219.

Lichtenstein, B. M. B., & Brush, C. G. (2001). How Do "Resource Bundles" Develop and Change in New Ventures? A Dynamic Model and Longitudinal Exploration. [Article]. *Entrepreneurship: Theory & Practice, 25*(3), 37.

Lockett, A., & Wright, M. (2005). Resources, capabilities, risk capital and the creation of university spin-out companies. *Research Policy, 34*(7), 1043-1057.

Löfsten, H., & Lindelöf, P. (2002). Science Parks and the growth of new technology-based firms--academic-industry links, innovation and markets. [doi: DOI: 10.1016/S0048-7333(01)00153-6]. *Research Policy, 31*(6), 859-876.

Löfsten, H., & Lindelöf, P. (2005). R&D networks and product innovation patterns--academic and non-academic new technology-based firms on Science Parks. *Technovation, 25*(9), 1025-1037.

MacLean, L. M., Meyer, M., & Estable, A. (2004). Improving Accuracy of Transcripts in Qualitative Research. *Qualitative Health Research, 14*(1), 113-123.

Makadok, R. (2001). Toward a synthesis of the resource-based and dynamic-capability views of rent creation. *Strategic Management Journal, 22*(5), 387-401.

Marmer, M., Herrmann, B. L., Dogrultan, E., & Berman, R. (2012). Startup Genome Report: A new framework for understanding why startups succeed. pp. 67).

Matheson, J. L. (2007). The voice transcription technique: Use of voice recognition software to transcribe digital interview data in qualitative research. *The Qualitative Report, 12*(4), 547-560.

McAdam, M., & McAdam, R. (2008). High tech start-ups in University Science Park incubators: The relationship between the start-up's lifecycle progression and use of the incubator's resources. *Technovation, 28*(5), 277-290.

McLellan, E., MacQueen, K. M., & Neidig, J. L. (2003). Beyond the Qualitative Interview: Data Preparation and Transcription. *Field Methods, 15*(1), 63-84.

Mian, S. A. (1994). US university-sponsored technology incubators: an overview of management, policies and performance. [doi: DOI: 10.1016/0166-4972(94)90151-1]. *Technovation, 14*(8), 515-528.

Mian, S. A. (1996). Assessing value-added contributions of university technology business incubators to tenant firms. [doi: DOI: 10.1016/0048-7333(95)00828-4]. *Research Policy, 25*(3), 325-335.

Mian, S. A. (1997). Assessing and managing the university technology business incubator: An integrative framework. [doi: DOI: 10.1016/S0883-9026(96)00063-8]. *Journal of Business Venturing, 12*(4), 251-285.

Miles, B. M., & Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook* (2nd ed.): SAGE Publications.

Miles, R. E., Snow, C. C., Meyer, A. D., & Coleman, H. J., Jr. (1978). Organizational Strategy, Structure, and Process. *The Academy of Management Review, 3*(3), 546-562.

Moore, G. A. (2002). *Crossing the Chasm: Marketing and Selling High-Tech Products to Mainstream Customers* (2 ed.): HarperBusiness Essentials.

Mullins, J. W., & Komisar, R. (2009). *Getting to Plan B: Breaking Through to a Better Business Model*: Harvard Business Press.

NBIA. from http://www.nbia.org/

Nickerson, J. A., Silverman, B. S., & Zenger, T. R. (2007). The `problem' of creating and capturing value. *Strategic Organization, 5*(3), 211-225.

Nickerson, J. A., & Zenger, T. R. (2004). A knowledge-based theory of the firm-the problem-solving perspective. [Article]. *Organization Science, 15*(6), 617-632.

OECD. (1997). *Technology Incubators: Nurturing Small Firms*. Paris: Organisation for Economic Co-operation and Development.

Osterwalder, A. (2004). *The Business Model Ontology - A Proposition in a Design Science Approach.* Unpublished PhD Thesis, University of Lausanne, Lausanne.

Osterwalder, A., Pigneur, Y., & Clark, T. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*: John Wiley & Sons.

Phillips, R. G. (2002). Technology business incubators: how effective as technology transfer mechanisms? [doi: DOI: 10.1016/S0160-791X(02)00010-6]. *Technology in Society, 24*(3), 299-316.

Porter, M. E. (1990). The Competitive Advantage of Nations. [Article]. *Harvard Business Review, 68*(2), 73-93.

Porter, M. E. (1996). *What is strategy?* Boston, Mass.: Harvard Business School Press.

Porter, M. E. (1998). *Clusters and the new economics of competition*. [Boston, Mass.]: Harvard Business School Press.

Porter, M. E. (2008). *The five competitive forces that shape strategy*. [Boston, MA]: Harvard Business School Publishing.

Presser, S., Couper, M. P., Lessler, J. T., Martin, E., Martin, J., Rothgeb, J. M., et al. (2004). Methods for Testing and Evaluating Survey Questions. *The Public Opinion Quarterly, 68*(1), 109-130.

Rangone, A. (1999). A Resource-Based Approach to Strategy Analysis in Small-Medium Sized Enterprises. *Small Business Economics, 12*(3), 233-248.

Rice, M. P. (1992). Intervention mechanisms used to influence the critical success factors of new ventures: An exploratory study. *Troy, NY: Rensselaer Polytechnic Institute.*

Rice, M. P. (2002). Co-production of business assistance in business incubators - An exploratory study. [Article]. *Journal of Business Venturing, 17*(2), 163-187.

Ries, E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*: Crown Publishing Group.

Rothaermel, F. T., & Thursby, M. (2005a). Incubator firm failure or graduation?: The role of university linkages. *Research Policy, 34*(7), 1076-1090.

Rothaermel, F. T., & Thursby, M. (2005b). University-incubator firm knowledge flows: assessing their impact on incubator firm performance. [doi: DOI: 10.1016/j.respol.2004.11.006]. *Research Policy, 34*(3), 305-320.

Sahlman, W. A. (1997). How to Write a Great Business Plan. *Harvard Businss Review*(july-august).

Sarasvathy, S. D. (2001). Causation and Effectuation: Toward a Theoretical Shift from Economic Inevitability to Entrepreneurial Contingency. *The Academy of Management Review, 26*(2), 243-263.

Sarasvathy, S. D., Dew, N., Velamuri, S. R., & Venkataraman, S. (2005). Three Views of Entrepreneurial Opportunity

Handbook of Entrepreneurship Research. In Z. J. Acs & D. B. Audretsch (Eds.), (Vol. 1, pp. 141-160): Springer US.

Schaeffer, N. C., & Presser, S. (2003). The Science of Asking Questions. [Article]. *Annual Review of Sociology, 29*(1), 65-88.

Schumpeter, J. (1934). *The Theory of Economic Development*: Harvard University Press.

Schumpeter, J. (1942). *Capitalism, Socialism and Democracy*. New York: Harper.

Schwartz, M. (2008). Beyond incubation: an analysis of firm survival and exit dynamics in the post-graduation period. *The Journal of Technology Transfer, 34*(4), 403-421.

Schwartz, M., & Hornych, C. (2008). Specialization as strategy for business incubators: An assessment of the Central German Multimedia Center. [doi: DOI: 10.1016/j.technovation.2008.02.003]. *Technovation, 28*(7), 436-449.

Scillitoe, J. L., & Chakrabarti, A. K. (2010). The role of incubator interactions in assisting new ventures. *Technovation, 30*(3), 155-167.

Sekaran, U. (2003). *Research Methods for Business: A Skill Building Approach* (4 ed.): John Wiley & Sons, Inc.

Shane, S., & Stuart, T. (2002). Organizational Endowments and the Performance of University Start-ups. *Management Science, 48*(1), 154-170.

Siggelkow, N. (2007). Persuasion With Case Studies. *Academy of Management Journal, 50*(1), 20-24.

Stam, E. (2008). Entrepreneurship and Innovation Policy. *SSRN eLibrary*.

Studdard, N. L. (2006). The effectiveness of entrepreneurial firm's knowledge acquisition from a business incubator. *International Entrepreneurship and Management Journal, 2*(2), 211-225.

Sutton, R. I., & Staw, B. M. (1995). What Theory is Not. *Administrative Science Quarterly, 40*(3), 371-384.

Tamásy, C. (2007). Rethinking Technology-Oriented Business Incubators: Developing a Robust Policy Instrument for Entrepreneurship, Innovation, and Regional Development? *Growth and Change, 38*(3), 460-473.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic Capabilities and Strategic Management. *Strategic Management Journal, 18*(7), 509-533.

Tilburg, J. J. v., & Hogendoorn, P. (1997). *Het Succes van Innovatief Ondernemen: De Spin-off van de Ondernemende Universiteit*. Enschede: Twente University Press.

Tilley, S. A., & Powick, K. D. (2002). Distanced Data: Transcribing Other People's Research Tapes. *Canadian Journal of Education / Revue canadienne de l'éducation, 27*(2/3), 291-310.

Todorovic, Z. W., & Moenter, K. (2010). Tenant firm progression within an incubator: Progression toward an optimal point of resource utilization. *Academy of Entrepreneurship Journal, 16*(1), 23-40.

Udell, G. G. (1990). Are business incubators really creating new jobs by creating new business and new products. *The Journal of Product Innovation Management, 7*(2), 108-122.

Vohora, A., Wright, M., & Lockett, A. (2004). Critical junctures in the development of university high-tech spinout companies. *Research Policy, 33*(1), 147-175.

Winter, S. G. (2003). Understanding dynamic capabilities. *Strategic Management Journal, 24*(10), 991-995.

Yin, R. K. (2009). *Case Study Research: Design and Methods* (4 ed.). California: SAGE Publications Inc.

Zahra, S. A., Sapienza, H. J., & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. [Review]. *Journal of Management Studies, 43*(4), 917-955.

Zedtwitz, M., & Grimaldi, R. (2006). Are service profiles incubator-specific? Results from an empirical investigation in Italy. *Journal of Technology Transfer, 31*(4), 459-468.

List of Software & Tools

Table 14 contains information on the software and equipments used during the research.

Table 14 - Software and Tools

Description	**Applicability**	**License / Source**
Adobe Reader X	Manage PDF's, comments and highlighting tools	Freeware
ATLAS.ti (v 6.2)	Qualitative data analysis, coding	University of Twente
EndNote X4	Import and manage citations	University of Twente
Express Scribe	Transcription / Dictation software	Freeware
iTunes - "Qualitative Methods of Research"	Develop research methodology	Free (on iTunes)
PDFCreator / PDF995	Convert WebPages into PDF files	Freeware
Microsoft Office Add-in "Save as PDF"	Convert RTF (Word) files into PDF files	Free (standalone version)
Microsoft Office Excel 2007	Quantitative analysis, produce tables and charts	Microsoft
Microsoft Office Visio 2007	Visualization of diagrams and figures	Microsoft
Microsoft Office Word 2007	Word processing	Microsoft
Switch Audio File Converter	Convert audio files	Freeware
Van Dale 2010 / Euroglot Pro	Language translation & dictionary	University of Twente
RescueTime	Manage time and productivity	Freeware
YouTube Downloader Extension for Opera web browser	Download and store video and audio files from YouTube	Freeware
Opera, Google Chrome, Internet Explorer, Firefox	Web browsing	Freeware
Zoom H4n Portable Digital Audio Recorder (hardware)	Record interviews	University of Twente
Headphones / earphones (hardware)	Listen to interview recordings (while transcribing)	Provided by the researcher

APPENDIX A: Interview Questionnaires

A1 – Questionnaire 1: Incubator Managers & Experts

Respondent : …….	Date : ….-….-……..
	Duration : …..-….. | …..-…..
A – The TOP Programme; Vision, Mission & Concept	
1	*I have recently read an article that was published in the newspaper of the university reporting that the TOP programme is its 25th of operation.* What was the motivation to start the TOP programme here at the University in the 1980's?
2	What was the initial vision of the TOP programme when it was introduced?
3	Describe the concept of the TOP-programme.
4	What is the current mission of the TOP programme?
5	Has the mission evolved a lot during the last 10 years? If yes, how?
B – Responsibilities	
6	When did you become involved in the TOP programme?
7	What is your professional background?
8	What are your main responsibilities as TOP manager?
9	Describe the day-to-day activities involved in your job.
C – Incubator Resources	
10	TOP provides an array of resources and support services. What do these resources and support services consist of? Example: Training; Business mentor; Scientific mentor; Loan; Office space; Networks.
11	What are the most requested services being offered by TOP to its participants?
12	How are these services being provided?
13	Describe all of the activities involved during TOP programme starting from first contact to the last contact. Please elaborate the answer from both your perspective and that of the participants.
14	What are the selection criteria to enter the TOP programme?
15	*I am aware that there are more universities in the Netherlands that are currently offering similar programs to promote business start-ups, for example Delft University of Technology has YES! Delft and Eindhoven University of Technology has an Innovation Lab;* What sets the TOP programme apart when compared to these other programs?

D – Performance Evaluation	
16a	Is there an evaluation system in place to evaluate the performance of the TOP programme?
16b	If yes, what performance indicators are used during this evaluation?

A2 – Questionnaire 2: Entrepreneurs

Company : …….....	Date : ….-….-……..
Respondent : …….	Duration : …..-….. | …..-…..
A – Founding the Company	
1*	*In the following question, the "official foundation date" is defined as the year and month the company was registered at the Chamber of Commerce.* When was the company founded?
2*	What was your involvement in founding the company?
3*	What was the main motivation behind the start-up of the company?
Products, Services and Markets	
4a*	Describe the main products the company is offering/developing.
4b*	Describe the main services the company is offering/developing.
5*	*The following question is related to the answers you gave in the last two questions; feel free to be specific about each possible combination of your answers.* Describe the main markets the company is targeting with the products and services just mentioned.
6	*In the following question "when" is defined as the time-period in your professional career.* When did you realize that there is an opportunity to commercialize the technology?
Initial Involvement with the TOP-program	
7	How did you come in contact with the TOP-management team? *Examples: through colleagues, internet sources, networking events, other.*
8	What are the main reasons you decided to apply to the TOP-program?
9*	*In the following question, "when" is defined by the year and month.* When did you officially enter the TOP-program?
10	*The following questions are related the events that occurred after the first contact was made with the TOP-management (with Patrick, Jann, etc.), and the day you officially entered the TOP-program.* What where the main topics discussed during the initial meetings?
11a	Did the TOP-management provide support or feedback when you were developing the business plan?
11b	If yes, how did you implement the feedback into the business (plan)?

12a	Did you receive any other type of support before you were accepted in the program?
12b	If yes, describe how the support was provided, and how these were implemented.
B – Developmental Problems	
Product Development	
13a	*The following question is referring to the phases of the product/service development.* Briefly explain the development process that the product has to go through before it is market ready.
13b	How developed was the product the day you officially entered the TOP-program? *underdeveloped* ____ : ____ : ____ : ____ : ____ *market ready* 1 2 3 4 5
13c	How developed was the product the day you officially exit the TOP-program? *underdeveloped* ____ : ____ : ____ : ____ : ____ *market ready* 1 2 3 4 5
Primary-, Secondary-, and Types of Problems	
A development problem is defined as a lack of solution; the gap between the current situation and the desired situation that prevents the company from developing. *Primary problems are defined as visible and predictable problems that act as an obstacle to achieve a desired situation or solution.* *Secondary problems are defined as unpredictable or unexpected problems, problems that one stumbles upon that impedes the company to achieve a desired solution.*	
14	What made you come to the conclusion: "Okay, I can make this technology into a product and sell it". What was the opportunity you discovered, related to this technology?
15a	What were the obvious predictable problems that the company had to solve in order to successfully exploit the opportunity you mentioned in your previous answer?
15b*	How would you categorize these problems? *Examples of possible categorizations: Financial, Marketing, Management, R&D, Technical, Production, Administrative, etc.*
16	Describe the main activities undertaken during the TOP-program in the attempt to solve these problems.
17a	*The following question is referring to the period when the company was founded until the co-founders exit the TOP-programme.* Describe the unexpected problems that the company stumbled upon during this period.
17b*	How would you categorize these problems? *Examples of possible categorizations: Financial, Marketing, Management, R&D, Technical, Production, Administrative, etc.*

18	Describe the main activities undertaken during the TOP-program in the attempt to solve these problems.
Problem Complexity	
*Problem complexity is defined as the amount, variation of **resources** and **time** (man-years) necessary in order to successfully manage a problem.*	
19	Was it clear to the company how these problems could be managed? Include an example in the answer. P1: Very vague ____ : ____ : ____ : ____ : ____ Very Clear 1 2 3 4 5 P2: Very vague ____ : ____ : ____ : ____ : ____ Very Clear 1 2 3 4 5 P3: Very vague ____ : ____ : ____ : ____ : ____ Very Clear 1 2 3 4 5 P4: Very vague ____ : ____ : ____ : ____ : ____ Very Clear 1 2 3 4 5 P5: Very vague ____ : ____ : ____ : ____ : ____ Very Clear 1 2 3 4 5
20	How specific are the solutions to each problem you mentioned?
21	Describe the complexity of each problem mentioned so far in terms of the necessary resources (such as the know-how/man-years/technology and activities involved) in order to solve each problem.
	P1: Simple ____ : ____ : ____ : ____ : ____ Very complex 1 2 3 4 5 P2: Simple ____ : ____ : ____ : ____ : ____ Very complex 1 2 3 4 5 P3: Simple ____ : ____ : ____ : ____ : ____ Very complex 1 2 3 4 5 P4: Simple ____ : ____ : ____ : ____ : ____ Very complex 1 2 3 4 5 P5: Simple ____ : ____ : ____ : ____ : ____ Very complex 1 2 3 4 5
22	Which of the following resources provided during the TOP-program are relevant for the start-up of the business?
	Office space: not relevant ____ : ____ : ____ : ____ : ____ very relevant 1 2 3 4 5 Secretarial Support: not relevant ____ : ____ : ____ : ____ : ____ very relevant 1 2 3 4 5 Laboratory Facilities: not relevant ____ : ____ : ____ : ____ : ____ very relevant 1 2 3 4 5 Scientific Mentor: not relevant ____ : ____ : ____ : ____ : ____ very relevant 1 2 3 4 5 Business Mentor: not relevant ____ : ____ : ____ : ____ : ____ very relevant 1 2 3 4 5 Training: not relevant ____ : ____ : ____ : ____ : ____ very relevant 1 2 3 4 5 Loan: not relevant ____ : ____ : ____ : ____ : ____ very relevant 1 2 3 4 5

	Networking: not relevant ____ : ____ : ____ : ____ : ____ very relevant 1 2 3 4 5 Other: please elaborate.
C – Effectiveness of Solution	
23	Which of the problems were completely solved during the TOP-programme?
24	What is the current status of the problems that still remain unsolved?
25	What was the most critical progression made during the TOP-programme?

APPENDIX B: E-Mail Introduction

Dear [first name, last name of TOP participant],

The department of NIKOS at the University of Twente is currently conducting a research based on new firm development within supportive environments. We are aware that you have recently participated in the TOP-program and therefore would like to invite you for an interview. The purpose of the interview is to gain a better understanding of how entrepreneurs receive business support during the TOP-program. We are very interested in interviewing you since your experience as a TOP participant can be of great value.

The interview is scheduled to last approximately 45 minutes and will consist of a short introduction of the topic and a question-and-answer session.

The interview will be held at Capitool 15 building on the Business and Science Park of the University of Twente. Other possibilities include a location of choice based on your request.

We would like to schedule an interview session with you between [date] and [date]. Please let us know of your availability on those dates.

If you have questions, feel free to contact us. We would like to thank you in advance for your cooperation.

Yours Sincerely,

Terrence Ogenio

APPENDIX C: Business Incubator Case Study

The electronic version of APPENDIX C is available in the attached CD ROM.

APPENDIX D: Descriptive Case Studies

The electronic version of APPENDIX D is available in the attached CD ROM.

APPENDIX E: Interview Transcripts

Interview transcripts are produced to preserve the authentic nature of the answers given by the respondents during interviews. Ensuring the highest possible validity is the main goal here. For example, quotations are used throughout case descriptions and analysis to allow the reader to make alternative independent observations, if necessary. The transcripts are used as input for within case analysis, case description and data coding.

The electronic version of APPENDIX E is available in the attached CD ROM.

APPENDIX F: Time-Ordered Displays

Time-Ordered Displays are used in an effort to build a chronological narrative of the firm's activities based on the collected evidence. Perhaps more important than the output, is the process of making the displays. The process allows the researcher to make sense of the data by prioritizing, analyzing and interpreting important information. Notice that the researcher's observations and interpretations are also included in the "Remarks" column. The Time-Ordered Displays serve as important input for making the Data Network Views.

The electronic version of APPENDIX E is available in the attached CD ROM.

APPENDIX G: Data Network Views

The following data network views are used to spot the dominant resources firms use to manage a specific problem. Every collected piece of evidence that is coded serve as input for the creation of these data network views. Despite the dense network presentation, interesting patters emerge when observed carefully. (The data network views are produced using the qualitative data analysis software package ATLAS.ti).

The electronic version of APPENDIX G is available in the attached CD ROM.

APPENDIX H: Transcription Guide

The transcription guide is an initiative of the author that materialized during his contribution as student assistant in research projects conducted by the department of Center for Higher Education Policy Studies and the Institute for Teacher Education, Science Communication & School Practices at the University of Twente. The goal of the guide is to help researchers and transcribers (student assistants) produce consistent quality transcripts more efficiently. The ultimate goal is to preserve the validity of data during the transcription process which in turn will contribute to better research.

The electronic version of APPENDIX H is available in the attached CD ROM.