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STARTING UP IN BUSINESS NETWORKS

Why Relationships Matter in Entrepreneurship

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Lise Aaboen • Antonella La Rocca • Frida Lind
Andrea Perna • Tommy Shih
Editors

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Contents

List of Figures

List of Tables

Introduction: Starting Up in Business Networks—Why Relationships Matter in Entrepreneurship

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Few people would object to the contention that relationships matter in entrepreneurship. In the research field of entrepreneurship, there has been increasing attention to the social relationships of the entrepreneur and to the role of networking in starting up a business (e.g. Fayolle, Jack, Lamine & Chabaud, 2016; Hoang & Antoncic, 2003; Hoang & Yi, 2015; Jack, 2010). Research has shown that social relationships and the networks of entrepreneurs matter because they are resource entrepreneurs that can leverage in the starting up process. Instead of focusing on the social relationships, this book focuses on the initial customer and supplier relationships of a start up developed at an early stage and examine why these are important in starting up a new business venture.

Our interest in how start ups develop the initial business relationships with customers and suppliers is rooted in two research streams and perspectives. The first is entrepreneurship studies that focus on organising a new venture. The second is the research stream that investigates relationships between industrial suppliers and customers—the Industrial Marketing and Purchasing (IMP) research tradition. The former research stream has its origin in the late 1980s when Gartner (1988) challenged the focus of research in entrepreneurship on the individual entrepreneur. He argued that the question, 'Who is the entrepreneur?' is the wrong question. Gartner's argument was that if we are to explain why and how new businesses develop we should examine the process of organising and integrating resources in the early stages of the new venture. This perspective gave rise to calls for a process-oriented approach to new venture creation (Landström, Harirchi & Åström, 2012). Over the past 30 years, there have been repeated calls to investigate the dynamics of new venture creation (Kaulio, 2003) and to get better insight into a new venture's initial entry into the business network (Milanov & Fernhaber, 2007; Stuart & Sorensen, 2007). Reviewing the literature on new venture creation, Ambos and Birkinshaw (2010) found that it offers little information relating to 'the detailed process—the dynamics of constituent elements and the sequences of events—through which new ventures evolve' (p. 1125). This book has its origin in the belief that new business ventures evolve through their initial relationships with customers and suppliers. Consequently, if we are to explain the journey of start ups towards becoming sustainable businesses, we need a better understanding of the dynamics of the development of their initial business relationships.

Focusing on business relationships in the initial phases of starting up also reflects findings from the IMP stream of research, which views industrial markets as networks of business relationships between organisations, in which every business is a unique nexus of business relationships with customers and suppliers (e.g. Håkansson & Snehota, 1995). Research in the IMP tradition has been concerned with the interaction processes in business relationships between customers and suppliers and has found that interaction determines the development of business relationships and the dynamics of business networks (Håkansson, Ford, Gadde, Snehota & Waluszewski, 2009). Following these findings, we take a process view on the development of the initial business relationships of a start up developing into a sustainable fledging, and (eventually) a sustainable business.

Our analytical focus on the process of developing the initial business relationships of start ups is different from that of most published studies of start ups. Most of these studies appear to focus on either the individual entrepreneurs (e.g. Løwe Nielsen et al. 2012; Read, Sarasvathy, Dew, Wittbank & Ohlsson, 2011), the institutional structures (e.g. Shane, 2003), the firm (e.g. Clarysse, Wright & Van de Velde, 2011; Mustar et al., 2006; Wright, Clarysse, Mustar & Lockett, 2007), the use of a business model and plan as necessary tools for new venture creation (Meyer & Crane, 2014) or 'business strategy' as a key facilitator of start up development (Stevenson, Roberts, Bhide & Sahlman, 1999). Against this background, we add to the existing entrepreneurship research as we explore starting up as a process of embedding the new business venture in a business landscape characterised by existing resource constellations, activity patterns and actors' interdependencies. In this perspective, the initial phases of the start up journey are about relating to an existing landscape of business organisations, customers, suppliers and other institutions in order to become a node in the business network. For the start up this implies developing the initial customer and supplier relationships to access from others the resources needed to operate the new business. Hence, establishing the initial business relationships, including handling the interaction processes, is a condition for the very survival of the start up.

In this book we emphasise the verb 'starting up' to mark a turn of attention to the dynamic nature of the phenomenon examined. As a start up is in many ways its relationships, starting up is primarily a relational act. Developing the initial customer relationships is only one side of the start up's relational effort; the other is to develop equally important supplier relationships. Relationships with customers and suppliers have a different nature and content, and need to be 'handled' differently.

Developing the initial relationships with customers and suppliers is not an easy or simple affair. It is demanding and involves developing the offering and its various components, which goes far beyond the core product. Solutions must be found for how to deliver and deploy the offering, how to handle commercialisation and how to secure further development of the business. An array of technical, commercial and administrative issues has to be addressed and solutions to these have to be found. At the same time, developing the initial relationships requires that customers and suppliers acknowledge the existence of the start up and admit it as a member of their mental map and context.

The complexity of the task of developing the initial business relationships is compounded by the fact that it is taking place in a context that is in continuous transformation and subject to relentless change. Business networks that the start ups relate to experience ongoing changes as new actors enter and some exit the network, and the relationships between actors change and evolve continuously. That concerns all businesses, but for start ups dynamic networks are more common because the context is one of newly emergent businesses. These conditions have also resulted in extensive policy support of new venture creation and development.

All actors involved in starting up a new business would benefit from understanding the process of developing the first business relationships. All the players in the start up regardless of whether they are entrepreneurs, start up managers or policy actors must understand the process in order to cope with it more effectively. Yet, while it is widely recognised that starting up a new business venture is a challenging practice for all the actors involved (entrepreneurs, managers, technology transfer officers and investors), there is limited knowledge and understanding of the process of starting up in business networks. In this gap lies the contribution of our book, which attempts to shed more light on different facets of the process of developing the initial business relationships of a start up.

This book offers a novel perspective on starting up, espousing a shift in attention in research from structural explanations to process explanations, from an internal perspective (within the company) to an external perspective (inter-organisational relationships and business networks) and from social networks (the individuals) to business networks (including individuals and organisational and technological aspects). Several studies have proposed that connecting to an existing business network and acquiring a position in the network is a necessary condition for the survival, development and ultimate success of a business (Aaboen, Dubois & Lind, 2011, 2013; Aaboen, Laage-Hellman, Lind, Öberg & Shih, 2016; Gadde, Hjelmgren & Skarp, 2012; La Rocca, Ford & Snehota, 2013; La Rocca & Perna, 2014; La Rocca & Snehota, 2014; Snehota, 2011).

Each chapter in this volume explores a facet of the development of the initial business relationships when starting up a new business venture. We look at special situations of starting up with scarce resources, lack of legitimacy and products based on novel technologies. From empirical examples we develop concepts for capturing the intricate processes of connecting to the established (but evolving) institutions and structures. Several of our start ups are science based and emerge in a context very different from the structures of an established use and production setting, which makes the process of relating and connecting challenging, with far-reaching consequences for the network. This volume has five parts, each consisting of two chapters focusing on a specific theme in starting up in business networks. Part I explores the initiation of business relationships; Part II deals with the dynamics of relationships and networks examining the implications for a start up of operating in a context of continuous motion; Part III addresses the issue of the technological collaboration of start ups in industrial networks; Part IV presents cases of academic spin-offs coping with commercialisation; Part V focuses on the role of policy actors in stimulating entrepreneurship and supporting start ups.

Part I: Starting Up Business Relationships

The first part of the book (Chaps. 1 and 2) explores the initiation of business relationships. The authors investigate both the processes that can be identified within the relationship that is developing and the processes needed for the relationship initiation to take place. Unlike all other chapters in this volume, this section focuses only on dyadic or possibly triadic relationships start ups initiate and develop. The aim is to shed light on the process of initiating and developing the initial relationships when starting up.

In Chap. 1, Aaboen, Holmen and Pedersen identify six different facets of the relationship initiation process in order to make its otherwise ambiguous nature more accessible to researchers and start up managers seeking to initiate business relationships. The six facets identified are as follows: (1) the initiation of business relationships as the first state in the business relationship development process, (2) the initiation of business relationships as a process of its own, (3) focal relationships instead of focal actors, (4) third actors playing an active role in the initiation of business relationships, (5) one of the focal actors' portfolio of other relationships and (6) the initiation of business relationships as an interaction between resource entities. Notwithstanding the importance of initiating business relationships for start ups, most literature on relationship initiation has dealt with it in the context of established firms. This literature developed for mature firms does not take into account the special conditions of start ups that have less resources, and therefore cannot devote much time and resources to each relationship and at the same time depend heavily on very few relationships for taking off. Furthermore, the product of the start up tends to be under development when the first relationships are being initiated and the start up has little choice but to interact with the business partners that are willing and ready to interact with them. The authors argue that we need more research on business relationship initiation in start ups and we need to develop theory that is closer to the reality of entrepreneurs. In terms of a future research agenda, the authors therefore suggest that the extant literature on relationship development processes should be cross-fertilised with the literature on interactions between resource entities, which is a more common perspective when investigating start ups. Finally, the authors call for more studies attending to the activities taking place during business relationship initiations among start ups.

In Chap. 2 Oukes and von Raesfeld investigate how third actors influence a start up's business relationship initiation and subsequent embedding in the network, as well as the start up's development. The chapter elaborates on facet number four discussed in Chap. 1. An in-depth case study of the relationship initiation processes of a Dutch medical device start up is presented. The development of the start up is traced chronologically from its establishment in 2008 until 2015, and each relationship that the start up initiated is described in detail. Drawing on the case, the authors conclude that the start up tended to rely on well-embedded partners who, however, rarely were able to act as third actors facilitating other relationships. This case shows that some third actors were able to perform their role as facilitators without forming a triad with the start up and business partner. Finally, the authors found that the venture creation process is both affected by and affects the third actor's initiation of relationships and that the roles of third actors, as well as who the third actor is, will vary according to the start up's development stage.

Part II: Relationships Dynamics in New Business Development

Chapters 3 and 4 start from the consideration that a condition for the start up becoming a new venture is that it develops business relationships through which it becomes embedded in a pre-existing business network. The initial business relationships, particularly with customers and suppliers, are crucial to access and obtain the resources required. Developing the initial business relationships is complicated by the fact that business networks are always in motion. These two chapters provide a new lens through which to examine the critical issues relevant to the successful development of start ups.

In Chap. 3 La Rocca, Snehota and Harrison address the question 'How does a would-be new business venture become embedded in a context in motion?' The authors frame the issue as a process of relating to the (interactive) business landscape. This involves developing a set of business relationships with particular actors with their specific resource constellations and activity patterns. Exploring the process of relating, the authors stress the effects of the indeterminateness of connections and the ambiguity of the economic consequences for the parties. Looking at how the network position of the new venture affects its development path, the authors argue that (1) the position acquired by a single business in the network implies a particular horizon that affects the perceptions and interpretations of possibilities and liabilities; (2) the position acquired within the network determines the resources and competences that can be mobilised through the set of customers, suppliers and other parties; (3) the position in the business network is a valuable asset but also a liability that enables certain development paths but inhibits others. The authors conclude that network positions of the individual businesses are interdependent and that the individual businesses keep the network 'in motion' as they mutually adjust. Opportunities emerge from the motion in the network. The implications of coping with a business network in motion are discussed, and draw on an empirical illustration. The authors conclude that, on the one hand, relating to the context in motion involves connecting the emergent venture to the resources, activities and thought worlds of different actors in the network, and on the other hand, involves acquiring face and meaning for the relational partners.

In Chap. 4 La Rocca, Öberg and Hoholm explore the process of the start ups shifting from the developing setting (university incubators and other similar 'hosting environments') in which they are born, to producing and using settings of business. The issue is that the developing setting is subject to a knowledge development logic, which is different from the economic logic that prevails in the producing and using setting. Two cases of technology-based start ups in a Swedish university context are used to show the entwinement between innovation and start ups journey. The cases illustrate how shifting the settings is a complex iterative progressive and regressive process: the development of a start up depends on changes in the relevant business networks and on how the newcomer is perceived by the other parties. In particular, start ups appear constrained in choosing their path because external factors push them into new arenas and sometimes back to the developing setting. The authors discuss how developing settings, driven by curiosity, academic recognition and scientific methods, contrast with the common drivers of mutual adaptation and value creation in the producing and using settings of industrial networks. The 'epistemic cultures' (Knorr Cetina, 1999) of the developing settings, passionate about exploring epistemic objects (research objects), often lead to divergence, expansion, multiplication of problems and solution pathways, which is in contrast to the need to find convergence and diminish uncertainty by a closure that is required for commercialisation. Reflections on how to cope with 'diverging logics' and the 'network impact' are presented in the final part of the chapter, where the authors point to the need for 'improvisation' and 'reliance on action' rather than planning (Leybourne & Kennedy, 2015). They discuss the role of 'reactive rules' (Guercini, La Rocca, Runfola & Snehota, 2015) as a key ability to acquire in the early stages of start up development.

Part III: Start ups and Technological Collaboration in Industrial Networks

The chapters in this part (Chaps. 5 and 6) focus on technological collaboration, given that start up firms initially lack business relationships but depend on interacting with others in order to develop their technologies and products. Start up companies often aim at commercialising a science-based discovery or invention that needs to be transformed into a commercial product. The start up's own research and development (R&D) activities need to be linked to those of other actors, and in this process the use of different kinds of external resources may be necessary. To manage this process with limited resources, collaborating with various external partners in technological development becomes a necessary condition. In addition to making the product function in a developing setting, the discovery or invention needs to fit into using and producing settings. In Chap. 5 Laage-Hellman, Landqvist and Lind focus on R&D collaboration forms, while in Chap. 6 Havenvid focuses on collaboration between researchers and business actors in a university-organised commercialisation project.

In Chap. 5 Laage-Hellman, Landqvist and Lind describe and analyse the ways in which start ups collaborate in R&D. The theoretical frame of reference relies on the industrial network approach and five key questions related to R&D collaboration: When, How, Why, Who and What. The chapter builds on four case studies of start ups from different industrial contexts. What distinguishes all the cases is the importance of external R&D collaboration, especially with potential customers and with suppliers and research organisations. Based on a discussion of the cases in light of the key questions, five forms of R&D collaboration for start ups are identified. Two forms of collaboration with potential customers are identified: one displays a pattern of working with parallel tracks, in terms of testing applications with several customers at the same time; the other shows a pattern of focusing on collaborative projects with one potential customer in a certain application area. Third, a specific form of R&D collaboration is observed—that concerns the solving of specific technical problems in collaboration with suppliers or universities. The fourth form is an open form of collaboration with research organisations. It is open and it may be difficult to foresee what will come out, but it always has a direction. The fifth form regards the special situation of collaboration with founding institutions, which initially is very important for spin-offs. The authors conclude that given the scarce resources of start ups, R&D collaboration is a balancing act: between parallel tracks and open collaboration on the one hand, and focused and specific collaborations on the other.

In Chap. 6 Havenvid discusses the pressure on universities to supply the business community with scientific knowledge that can lead to new ventures, products or services. It is common to assume that there is a direct link between scientific advancement and innovation, and consequently the main barrier to achieving greater innovation is that this type of knowledge remains purely ‘scientific’ and is not related to business needs in an effective way. From an industrial network perspective, the challenge is interpreted quite differently. The chapter is based on a case study of a university-organised commercialisation project involving both researchers and business actors. The case shows that while business actors were involved in the project, the way their knowledge could be applied depended largely on how they could engage their existing resources in the project and what benefits could be created from doing so. Therefore, 'general' business knowledge was insufficient, and even when specific actors interested in commercialisation were involved, the main challenge that remained was how to engage in the innovation process in a beneficial way. In the chapter the author suggests that in order to become an innovation any new product or service needs to fit into the settings of development, production and use. The author concludes that from a business network perspective the challenge of bringing science-based ventures to commercialisation requires combining the new with existing resource structures within these settings.

Part IV: Academic Spin-Offs and the Issue of Commercialising Science. Some Empirical Experiences

This section (Chaps. 7 and 8) explores how academic spin-offs deal with the issue of commercialising science. It is generally accepted that it is a tricky and unpredictable process because financial, technical and organisational barriers can emerge and need to be overcome as quickly as possible. Moreover, in the case of academic spin-offs, one main issue relates to how to connect science to industrial needs when there is the big risk that the technology has to be transformed into 'something else' in order to fit with other existing structures. Turning science into a viable solution to be commercialised involves very complex structures, and it is not always easy to transform an idea generated within a university setting into a product to be commercialised. For instance, many heterogeneous actors are involved; these include scientists and researchers from academia, producers who have to manufacture the new technology and users who are not always ready to adopt it. Therefore, how to fit science into the established structures of producers and users constitutes a real challenge.

The authors propose that interpreting such a phenomenon requires adopting an inter-organisational perspective and focusing on the roles specific business relationships play. Both cases illustrate how the commercialisation of science is a process that creates several tensions and frictions due to the different agendas of the actors involved. The two chapters are based on a case study of two academic spin-offs—one Italian and one Swedish—which have been struggling to commercialise their technology.

Chapter 7 by Baraldi, Perna, Fraticelli and Gregori illustrates how initial key relationships influence the commercialisation of science. Using the case of an Italian academic spin-off—the company Nautes—the authors emphasise that business ventures are strongly affected by their initial and key business relationships, which can play the role of facilitators or inhibitors of the commercialisation process. As a consequence, the theoretical background deals with both the positive and negative sides of building business relationships from the new business venture's point of view.

The authors investigate the complex nature of relationships between new and established companies, focusing on the embedding process of science over time. The case describes several adaptations between the new solution and the surrounding context, starting from the first customer and continuing with the subsequent customer relationships. Particular attention is paid to the importance of the first customer relationships in 'shaping' the development of the start up. The chapter highlights the effects of the imprinting derived from the initial relationships with the independence that seems necessary to let the company embrace 'others' within the business network. Therefore, the results suggest that the power-dependence imbalance, which characterises the relationship between a small new firm and an established large customer, leads to a burden as well as opening up new opportunities to connect to new actors.

In Chap. 8 Baraldi, Lindahl and Perna analyse how the commercialisation of science unfolds over time by adopting the concept of vessels. The starting point is the non-linearity of innovation journeys due to the complex embedding of a technology in the developing, producing and using setting. Vessel is a metaphor for identifying any kind of organisational arrangement, such as start ups, project units and established companies, which carry technologies throughout the innovation journey. In the theoretical part, it is emphasised how start up firms can be viewed as the primary vessel that propels technologies on their journey; however, they need to relate to other actors to find broader support in order for science to be transformed into a viable product to be commercialised.

By taking the case of the innovation journey of an infrared technology, the authors show how different resources and competences have been transferred, combined and transformed by specific vessels in relation to other vessels. Thus, the process of transforming science into solutions for users does not necessarily take place within the same organisation, but it happens within the business relationships formed between the different vessels.

Part V: Start ups and the Role of Policy Actors

The chapters in this section (Chaps. 9 and 10) focus on the role of policy actors and the effects of policy support of start up companies. Start ups generally lack resources, legitimacy and relationships with established market actors. Hence, policy, both the institutional structures and actors, can be important in supporting the start ups in their endeavours to develop and commercialise their ideas and products. The chapters highlight the supportive functions policy can serve but also identify and discuss the potential deleterious effects of policies.

In Chap. 9 Shih and Waluszewski discuss different views of value creation in a policy setting compared to a business setting and what kind of challenges this poses to university start ups. The chapter illustrates that through relationships with policy actors, the start up company is often encouraged to follow a certain development path, such as promoting interactions with actors on the basis that they are local, and on the creation of assets such as patents. In order to establish and develop a university start up, the start up company is more or less pushed to become an integral part of a policy-supported network. Hence, the environment composed of the actors in the support structure can limit the university start up's ability to combine resources and solicit opportunities from a broader business network. The authors suggest that in a policy setting what appears as a valuable research result, suitable for commercialisation through a start up company, does not necessarily appear as valuable from a business producer and user perspective. The policy implications that are derived from this chapter include the suggestion that there should be a deeper understanding of the effects of institutional start up support and how this can actually help companies become embedded in these institutional structures. The cases also illustrate the deleterious effects of being 'too' embedded in the policy setting. For example, relating to a set of policy directives can thwart the pursuit of business development. This, in turn, will affect the start up, especially a university start up, when transforming combined resources into value-producing innovations in a business setting.

In Chap. 10 Linné and Shih look at another kind of policy actors, namely Chinese state actors and how they support start up companies' innovative activities. Empirical cases from the Chinese biotechnology industry show how policy actors indirectly and directly steer the start up networks; in some cases the policy actors are counterparts in relationships, while in other cases policy actors affect critical relationships indirectly through various regulatory and support measures. Thus, in establishing and developing the 'value net' or 'network position' of the start ups, policy actors play a crucial role. By taking on a variety of roles, policy actors try to reduce the uncertainty and risks associated with business activities related to production structures in the Chinese biotechnology industry. These activities provide support to some start ups and contribute to industrial development in a prioritised industry in China. The focus of the chapter on the role of Chinese policy actors directs attention to the power of policy actors in steering business networks in certain directions.

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Part I

Starting Up Business Relationships

1

Initiation of Business Relationships in Start Ups

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1.1 Introduction

During the last few years, several authors have recognised the need for more research into how start ups or new business ventures initiate new relationships. Aaboen, Dubois and Lind (2011) studied how start up firms develop their initial customer relationships and resource base in close interaction with customers. Furthermore, La Rocca, Ford and Snehota (2013) argued that even though developing new business relationships is demanding for all types of firms, it is particularly critical for start ups because their offerings are likely to be less developed than the offerings of established firms. Thus, it is a newly developed interest to study, understand and manage the process of initiating business relationships for start ups.

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In this chapter we rely heavily on contributions from the field of relationship initiation and development within the industrial network perspective (e.g., Aarikka-Stenroos, 2008; Edvardsson, Holmlund & Strandvik, 2008; Ford, 1980; Wilson, 1995), which have argued that more research is needed on the beginnings of business relationships. There are a number of reasons why this particular topic has been given less attention than other business relationship-related topics. For example, Aarikka-Stenroos (2008) argued that relationship initiation is a blurred phase involving many actors, thus making it a particularly difficult phase to study. On the other hand, Holmen et al. (2005) maintained that because economic value is often seen as being generated only after the business relationship has become more fully developed, its initiation is overlooked. Another reason could be that, at the beginning of the 'relationship paradigm', explaining long-lasting relationships was deemed more important.

In the present conceptual chapter we combine literature that focuses on business relationship initiation and development for all types of firms and situations with literature that specifically addresses the relationship-initiation process and resource-based development for start ups. Thus, the aim of this chapter is to identify different facets of the relationship-initiation process in order to make its otherwise ambiguous nature more accessible to researchers, students and start up managers seeking to initiate business relationships. Further, we present the different facets alongside suggestions for future research on business relationship initiation in order to depict the reality of start ups in a more nuanced way.

The structure of the chapter is as follows. First, we discuss the methodology used for selecting relevant articles and papers for the literature review and for identifying different facets from the literature on business relationship initiation. Second, we present the six identified facets of business relationship initiation. While doing so, we pay particular attention to whether start up companies are directly considered in an article or in combination with other types of businesses, such as established companies. Finally, we offer conclusions and suggestions for further research into business relationship initiation in general and start up companies in particular.

1.2 Note on Methods

In order to identify articles that focus on the initiation of business relationships, we first made structured keyword searches in a literature database. Key articles identified in these searches formed the basis for a cited reference search and examination of relevant references, through which additional articles and papers were identified. For the main literature database, we chose ProQuest ABI-Inform, which is widely recognised within the fields of economics and business administration and contains approximately 3000 scholarly journals. We made several searches for keywords in abstracts in this database. The first search was for the words 'initiation' and 'relationship' combined with the words 'business' or 'customer'. The rationale for such search criteria was that it would locate articles central to the field of business relationship initiation. The search resulted in 50 articles. Not surprisingly, however, many of the identified articles focused more on relationship initiation in general than on relationship initiation in start ups in particular. In order to identify articles specifically focused on start ups, the words 'customer relationship' and 'entrepreneur*' were combined in the next keyword search. This search generated 180 articles. However, even though this new search generated more articles focusing on start ups than the first search, these articles tended to focus more on how entrepreneurs utilise customer relationships for resource acquisition and product development than on the initiation of such relationships per se. In the 'traditional' entrepreneurship literature (e.g., Anderson, Dodd & Jack, 2010; Slotte-Kock & Coviello, 2010), the focus of business relationship studies tends to be on the resources and capabilities that such relationships and associated networks can provide access to. Examples include the relationship between early network development, knowledge creation and technology transfer (Pérez & Sánchez, 2003), and social capital and knowledge acquisition (Yli-Renko, Autio & Sapienza, 2001). A related branch of literature (also focusing on entrepreneurs and customers) is the study of entrepreneurial marketing (cf. Eggers, Hansen & Davis, 2012; Mort, Weerawardena & Liesch, 2012). However, this type of literature is more of a subsection of traditional market literature that explores strategies applicable for a start up in the context of an anonymous market.

In the third search, we looked for the keywords ‘selling’ and ‘entrepreneur*’ in abstracts in order to get closer to the moment of customer acquisition. This search resulted in 162 articles. In addition to articles within our field of interest, the search also returned articles about salespeople in large organisations who act as entrepreneurs when selling. Such articles were not included in the literature review. In each of the three searches, we found relatively few articles that fell within our field of interest, which is not surprising since this is an emerging field. However, through combined searches, we identified articles that we knew of beforehand as well as articles, which were relevant but unknown to us previously. Since relationship initiation in the context of start up business networks is particularly interesting from a research point of view in the Industrial Marketing and Purchasing (IMP) tradition, we complemented our searches in the ProQuest ABI-Inform database with searches for the same keywords in the IMP database. This database contains all conference papers from IMP conferences. As expected, we recognised many of the papers in the IMP database as conference versions of the articles we had selected from the ProQuest ABI-Inform database. In the IMP database, we also found many papers dealing with other issues, since the word ‘relationship’ is central in IMP literature and is therefore used in many different contexts. Following the selection of relevant key articles, the next steps were to examine their reference lists and search for articles that referred back to the key articles. When the articles to be reviewed had been selected, we carefully read through them with the aim of identifying facets that characterise the literature on business relationship initiation. While doing so, we also paid attention to whether or not the literature covered relationship initiation in start up companies specifically.

1.3 The Six Facets of Initiating Business Relationships in Start Ups

From the investigation process described above, we identified six facets of business relationship initiation literature. Related to the issue of relationship *dynamics* over time, two facets of the *process* of relationship initiation were identified:

– Initiation of business relationships as *constituting the first states* in the business relationship development process
– Initiation of business relationships as *a process on its own*, separate from subsequent states of the business relationship development process

Concentrating on whose *perspective* is taken in business relationship initiation, one facet was identified:
– Two possibly *different perspectives* on the initiation of business relationships

Focusing on the *network context* of business relationship initiation, two facets were identified:

– Categories of *third actors* who play an active role in business relationship initiation
– One of the involved actors' *portfolio of other relationships* surrounding the focal business relationship being initiated

Related to the *resources* involved in business relationship initiation, one facet was identified:
– Initiation of business relationships as an *interaction between resource entities*

While most of the articles and papers in this review mainly address one of these six facets, some of them cover more than one. We view the fact that some articles include several overlapping facets as a positive aspect for this area of research. The overlaps indicate that the facets are actually facets of *one* potential literature stream rather than fragmented groups of articles. As mentioned in the introduction, the aim of this chapter is to identify these facets at the intersection of business relationship literature and start up literature, not to summarise all articles found in the search for each facet individually. In the description of each facet, only the articles that we need to refer to in order to describe the facet are included, even though we needed to examine additional articles to identify the facets. In a few instances, we also used contributions that were not from the initial search in the descriptions. These contributions enabled us to use empirical examples to illustrate the facets in order to make the nature of the chapter clearer to readers.

1.3.1 Initiation of Business Relationships as Constituting the First States in the Business Relationship Development Process

As mentioned in the introduction, business relationships are vital for start ups. Business relationships enable start ups to combine resources and become embedded in a network. We found that the articles, which discussed the business relationship development process, only used mature firms as empirical examples. In this chapter, we first present the main issues in the business relationship development process literature and then discuss these issues in connection with start ups. Exactly when the relationship initiation starts and ends has been a subject of scholarly debate, but most agree that relationship initiation consists of a pre-relationship state, followed by an early-relationship state, and then culminating with the signing of a contract. Therefore, in this section, we discuss these relationship development states, as well as factors that influence the transition between them including the influence of previous relationship histories. According to more recent relationship development models, the initiation of new business relationships can both include and be influenced by the reactivation of dormant or previously terminated relationships.

The most well-known and cited stage model is the one presented by Ford (1980). The model has five stages: (1) the pre-relationship stage, (2) the early stage, (3) the development stage, (4) the long-term stage and (5) the final stage. Moreover, each of these stages is characterised by five important variables: experience, uncertainty, distance, commitment and adaptation. Similar stage models have been developed by Dwyer, Schurr and Oh (1987) and Wilson (1995), among others. An important assumption of the model is that a business relationship consists of two active parties who interact in episodes where adaptations take place. These adaptations lead to increased investment by both parties, which in turn leads to increased commitment. During the different stages, distances and uncertainty between the parties decrease as experience increases. The distances referred to here can be broken down into five elements: social distance, cultural distance, technological distance, time distance and geographical distance (Ford, 1980).

A recent contribution to the stream of literature focusing on initiation as the first part of relationship development was a study conducted by

Mandják, Szalkai, Neumann-Bòdi, Magyar and Simon (2015). In their study, the authors created an empirical framework by merging the first stages of five previous stage models and then focusing specifically on the trust-building process that takes place during them. They found that the trust-building process occurs at both the personal and organisational level.

Several authors have criticised the stage theory for not taking into account the complexity of relationships and for being deterministic. In response to these criticisms, the states theory (Batonda & Perry, 2003) was developed, which posits an evolution of unpredictable states—in other words, the relationship initiation process can move between states in any sequence or order. According to the states model, the process can also move into a dormant state, becoming inactive for a period of time. Polonsky, Gupta, Beldona and Hyman (2010) contributed to the model by adding a de-actualisation phase that the relationship can move into and out of from any other phase. This addition enables the investigation of both active and inactive relationships simultaneously and emphasises the important influence of previous interactions on current developments, since many new relationships may in essence be reactivated forms of older relationships.

The business relationship development models only deal with mature firms. It may be possible to argue that the long-term aspect is less relevant for start ups and more difficult to study in connection to start ups since both the firm and their relationships are new. However, it is important for start ups to strategise in the early stages of business relationship development in order to ensure that it will be less problematic later on (cf. Aaboen & Lind, 2016). It is therefore relevant for start ups to not only know the intended future of their business relationships but also be able to analyse present events in light of theoretically possible futures.

1.3.2 Initiation of Business Relationships as a Process of its Own, Separate from Subsequent States of the Business Relationship Development Process

The process of initiating business relationships is important for start ups to master quickly since customers are necessary for revenue and resources tend to be scarce at first. Start ups may save a lot of time if they are able to learn from early attempts to initiate business relationships. The process models of business relationship initiation would therefore be more practically applicable for start ups if they were less ambiguous than they are currently. Based on a literature review and inductive investigation of a Dutch company, Holmen et al. (2005) claimed that there are at least 11 different types of business relationship initiations, including counterparts who initiate contact, meetings at trade shows and third parties known by both initiates and contacts. Edvardsson et al. (2008) introduced a model of the seller's position during business relationship initiation from the buyer's perspective, consisting of three statuses: unrecognised, recognised and considered, leading to a business agreement. The process may move between the different statuses at any pace and in any order. The model also includes converters and inhibitors. The converters contribute to forward or backward movement, while the inhibitors cause the business relationship initiation process to linger. Several different converters and inhibitors may contribute simultaneously. Examples of converters are time, trust and service offerings; examples of inhibitors are image, risk and bonds (Edvardsson et al., 2008).

Whereas Edvardsson et al. (2008) focused on the business relationship initiation process between the seller and buyer in moving towards the signing of a contract, Cooper and Budd (2007) put more emphasis on the part of the process whereby customer is selected or found. Cooper and Budd (2007) referred to this part of the process as the *sales funnel:* where the pool of candidates becomes increasingly smaller at every stage. The stages to which they referred are right-size market, right-size lead pool, qualified prospects pool, bidding pool, contracted and scheduled projects pool, and project release. Their model is even more one-sided than that proposed by Edvardsson et al. (2008) in the sense that the focal firm is assumed to be the one that decides which potential customers move on to the next stage of the process. Cespedes, Dougherty and Skinner (2013) placed even greater emphasis on selection by suggesting that the customer selection process takes place as an internal exercise in a firm through which the stages are assembled, customer data are analysed, preliminary hypotheses are developed, refined and modified, and the ideal client profile and implications are communicated. According to

Cespedes et al. (2013), this exercise is closely linked to opportunity management and improves the sales productivity of new ventures. In the pure sales literature, the precise role of a salesperson when utilising specific elements of this type of selling is explained, such as opportunity recognition (cf. Bonney & Williams, 2009) and customer preferences in regard to selling strategies (cf. Sharma & Pillai, 1996); this degree of detail in selling techniques, however, is outside the scope of this chapter.

Companies that have been involved in several business relationship initiation processes may be well acquainted with their intricacies. However, to enhance our understanding of them, a more systematic reflection by means of detailed models may be beneficial. For start ups, a systematic reflection on business relationship initiation processes may enable them to become better at initiating relationships more quickly. Both Edvardsson et al. (2008) and more sales-related literature focus on the process of getting to a sale. How to get to a sale is described as a process whereby the focal firm remains the same throughout the process. However, this is not necessarily true for start ups, which may change their products over the course of the business relationship initiation process. This also happens in mature firms, but it is a larger factor for start ups.

1.3.3 Two Possibly Different Perspectives on the Initiation of Business Relationships

In the discussion of the facet of initiation as a process of its own, it was mentioned that product changes are an important component for start ups in the initiation of business relationships. However, it is also important to take into consideration that there are two active actors in a business relationship. Although this is one of the fundamental components of IMP (cf. Ford, 1980), it tends to be at least partially overlooked when dealing with business relationship initiation. There seems to be a propensity for using a focal firm rather than a focal relationship or two focal actors as a starting point for models and studies. As argued by Mandják et al. (2015), the initiation of a business relationship is a result of the decisions and actions of the actors involved. Hence, there are at least *two* actors that should be taken into consideration: the focal firm and the customer. However, several of the initiation models within business network studies tend to use only the viewpoint of one of the two actors. These studies thereby fail to take into account the interactive dimension of the initiation. However, previously proposed models may be used in a more dyadic and interactive manner. For example, Edvardsson et al.'s (2008) initiation model could be used for a two-sided study if the framework is applied to both actors in the dyad instead of only one. This possibility was explored by Østensen (2013) with a framework based on Edvardsson et al. (2008). In the extended two-sided framework, both a firm and a customer may enter the business relationship initiation phases unrecognised, recognised and considered; both a firm and a customer can also be affected by converters and inhibitors when moving between phases. It is not until both firms arrive at a business agreement that the relationship initiation is complete. Østensen's (2013) framework also uses the third-actor concept from Aarikka-Stenroos (2011) to argue that third actors may influence the process from either the firm's point of view, the customer's, or both. Furthermore, Østensen (2013) argued that Edvardsson et al.'s (2008) business relationship initiation process was not sufficiently detailed and therefore divided the unrecognised phase into unawareness, general awareness and specific awareness. Using a framework that integrates the perspectives of firms and customers (i.e., a focal relationship initiation rather than a focal firm) opens up the possibility of more carefully analysing whether the two actors in a business relationship consider it to be in the same phase, as well as the actions taken based on their assumptions. Consequently, it would be easier to define relational factors acting as converters and inhibitors in the relationship. Furthermore, it would enable a more careful analysis of how intentional movements between different phases appear from the perspective of both parties.

Considering both sides of the business relationship is important for established businesses as well as start ups: it reminds all companies that there are two active parties in the relationship, and that each may have different perspectives on both the relationship and its development trajectory. For start ups, it is important to realise that their counterparts have their own perspectives, and that their interest in initiating a relationship with them likely depends on self-interest. In practice, it would be difficult for a start up to fully understand the other actor or everything taking place in the business relationship since it is, of course, seen from the viewpoint of the start up itself. However, research studies that concentrate on focal interactions may provide a more accurate account of what is actually taking place.

1.3.4 Categories of Third Actors Who Play an Active Role in the Initiation of a Business Relationship

Several branches of literature have argued that business relationship initiation is complex and does not take place in a vacuum. Aarikka-Stenroos and Halinen (2007) examined the personal and organisational actors who influence business relationship initiation, and other studies have also mentioned mediators who either facilitate the initiation or contribute to it (e.g., Aarikka-Stenroos, Aaboen & Rolfsen, 2015; Mainela, 2007; Ring & Van de Ven, 1994; Ritter, 2000). Also, in the literature on social networks, authors such as Jack (2005) and Hite (2005) have focused on how start ups access resources and important partners by being embedded in a social network wherein their current relationships stimulate new relationships via mediation; that said, among business network articles focusing on start ups, this type of study is less prevalent. However, most business relationship initiation studies focus on the two parties between whom a relationship is being initiated. An exception is Aarikka-Stenroos and Halinen's (2007) exploration of third parties (or third actors) who promote business relationship initiation through their actions during the initiation process. A third actor could be either a person or an organisation. Based on 20 interviews with buyers and sellers, Aarikka-Stenroos and Halinen (2007) also defined 12 different roles that third actors can have during the initiation: scouter, awareness builder, need creator, access provider, accelerator, advocate seller, matchmaker, trust builder, evaluation assistant, expectations builder, risk reducer and concrete evidence provider. These roles can be performed passively, where third parties allow the use of their names; reactively, by answering questions; or actively, by making introductions. One application of this model is the initiation of business relationships across geographical boundaries. Other

IMP researchers also take third actors into account, but do not focus on them with the same level of detail. For instance, Henneberg, Mouzas and Naudé (2009), p. 109 noted 'the relationship between buyer and seller is often dictated, at least to some degree, by other actors beyond this immediate dyad' as a complication to their conclusions on customer segmentation in B2B markets. The notion of third actors has also been considered in studies of entrepreneurial relationships that do not apply the IMP approach. Venkataraman and Van de Ven (1998) discussed environmental instabilities as an important factor that could cause entrepreneurs to lose some relationships and add new ones. In other words, their study addressed the fact that business relationship initiation does not occur in a vacuum.

Among the previous studies that have explored business relationship initiation processes, some have concentrated on particular aspects of these business relationship initiation process in terms of content and applications. For example, Leek and Canning (2011) examined the role of social capital during the initiation of business relationships; they found that the networking performed by the involved parties was of more importance for initiating business relationships than the existing social capital they had at their disposal. Types of networking differed in terms of the amount of time invested and the frequency of communication, as well as in terms of being either deliberate or unplanned, or direct or indirect. By contrast, De Clercq and Rangarajan (2008) focused on the relational support that the entrepreneur perceives from the customer as a factor that influences the outcome of the relationship. This type of study tends to ignore the internal workings of the business relationship initiation and development process to a large extent by only measuring the input and output.

However, there is still a dearth of studies that focus on third actors in detail. Concentrating on third actors in studies of start up business relationship initiation would be particularly timely at present, since the entrepreneurship literature is attempting to understand the growth of two-sided platforms following the emergence of a large number of Internet-based platforms, which connect different types of users and customers (cf. Caillaud & Julien, 2003; Eisenmann, Parker & van Alstyne, 2006; Osterwalder & Pigneur, 2010). One famous example of such a platform is Uber, which connects people willing to work as taxi drivers with people in need of taxis. In the context of two-sided platforms, each business relationship initiation depends on the existence of many customers or important customers on either one side or both sides of the platform. Due to resource constraints, start ups need to carefully strategise about how to quickly reach a critical mass of customers on both sides of the platform in order to benefit from the network effects of existing customers. Dyvik and Wærness-Vold (2015) explored this phenomenon using an in-depth case study of the student start up Dirtybit, which managed to reach over 60 million global users, became number one on the Apple App Store in 10 different countries, and generated $3 million (USD) within one year of launching their app game *Fun Run*. In their study, Dyvik and Wærness-Vold (2015) found that Dirtybit initially devoted most of their attention to the consumer side of the platform, returning to the B2B side after they had a network of consumers and users large enough to negotiate better agreements with more valuable business partners. On the consumer side of the platform, Dyvik and Wærness-Vold (2015) identified a particularly important group of third actors called *ambassadors*. Ambassadors can be either consumers who make in-game purchases, users who play without making purchases, or neither. The important contribution of ambassadors is that they talk about the game with their friends and on social media such as Twitter, thus generating more consumers. Therefore, an important way of attracting consumers to an app game organised as a two-sided platform is to encourage ambassadors to talk about the company and its games via contests, famous players, game-specific news and other potential talking points.

That third actors can influence business relationship initiation is important to consider for both established businesses and start up companies. Attending to this issue reminds a company that third actors can enable as well as hamper the initiation of a relationship. For start ups that have a limited set of diverse relationships, it is particularly important that they scrutinise how their current relationships could facilitate the initiation of new business relationships. The importance of appropriate responses to introductions to potential customers enabled by third actors may also become clearer in light of the importance of third actors for business relationship initiation. The third actor influence will be further discussed and empirically illustrated in Chap. 2 of this book.

1.3.5 One of the Involved Actors' Portfolio of Other Relationships Surrounding the Focal Business Relationship Being Initiated

To gain a more holistic view of the portfolio of relationships in a start up, it is important to know which relationships should be prioritised and developed further. The strategising in the portfolio is connected to what patterns of relationship development states in the portfolio that will bring a start up to its goals (cf. Aaboen, Holmen & Pedersen, 2014). In this section, we encourage firms to take a holistic view of their complete portfolio of business relationships when initiating and developing new relationships. In the sales literature, there is a stream of studies that argue that sales and product development should be integrated rather than separated. Pitkänen, Parvinen and Töytäri (2014), for example, are proponents of value-based selling and proactive sales orientation, where the value of the product rather than the product itself is identified, quantified, communicated and verified through contact with potential customers. This orientation would solve the problem of not knowing what the final product of the start up will be at the time the customer relationship is initiated. However, sales-funnel theories also seem to assume the possibility of 'choosing' a customer. By combining the sales-funnel model with the business relationship initiation models from IMP, it is possible to create a framework that allows us to identify a selection process driven by the need to initiate contact with many potential customers and to analyse interactions after contact has been made. The goal of many sales models is only to sell a product, but since start ups need to continuously interact with customers in order to develop their products and businesses, ongoing relationships are at least as important as their initiation. In their exploration of how to reach an agreement with pilot customers, Hetzel, Neergård and Sørensen (2015) constructed a framework consisting of the following phases: search and select, contact, get to know, negotiations and agreement. The phases are illustrated as a funnel in order to emphasise that the start up may need to engage in early interactions with several different potential pilot customers in order to be able to identify those with whom to interact more intensively. Early interactions with multiple potential pilot customers may need to take place simultaneously since the success of the start up is time-sensitive. Between all phases, there are also potential influences from third actors and potential iterations since the start up may learn how next to proceed in their business relationship initiation during their interactions. Due to the nascency of a start up firm's development and product(s), the type of pilot customer needed may change. This may cause the relationship to move backward during the relationship initiation as well as after an initial agreement is reached.

The business relationship portfolio is important to consider for both established businesses and start ups. From a relationship dynamics perspective, the portfolio may consist of relationships in different stages or states. For established businesses, it is crucial to take into account whether a favourable balance exists between new relationships, early-stage relationships and mature relationships. For a start up, however, most of its relationships will be in an initiatory state. As a result of resource constraints, a start up should consider its prioritising and allocating of resources to different business relationship initiations and development processes when establishing a productive set of initiation processes that will stimulate its development. In other words, a start up may need to use a portfolio approach for simultaneously commencing initiation processes with several actors so that it will have several options to develop further, depending on how the interactions and the start up develop. The start up may also need to use a portfolio approach in terms of initiating many different kinds of relationships simultaneously rather than sequentially. Even though a relationship with, for instance, a potential future customer or a buyer of the entire start up may not need to be fully developed, it may still provide a sense of direction with regard to which relationships and products should be further developed, as well as for the start up as a whole.

1.3.6 Initiation of Business Relationships as an Interaction Between Resource Entities

Start ups often develop their firms, products and strategies simultaneously while initiating their first business relationships. Start ups will often make adjustments in order to be compatible with the structures of their potential business partner(s). Early business relationships will therefore inform the development of the start up itself. Several of the studies that investigated adjustments made to enhance compatibility with potential business partners are based on the four resource entities model (Håkansson & Waluszewski, 2002). The model is used for identifying changes in the relationships, business units, products and facilities of start ups. Examples of studies that have applied this model include Aaboen et al.'s (2011) examination of the initiation of first-customer relationships and Oukes and von Raesfeld's (2014) research on the initiation of business relationships between start ups and more powerful counterparts. In general, the four resource entities model is common in studies of start ups and new ventures in a network context, although many of these studies focused on the connection between start ups and networks (c.f. La Rocca et al., 2013) rather than the relationship initiation process itself. Mainela, Pernu and Puhakka (2011) viewed the venture creation process as consisting of three interrelated processes: business opportunity-centred processes, where the start up becomes embedded in a social network; technology-centred processes, where the start up becomes embedded in a technological network; and internationalisation-centred processes, where the start up becomes embedded in an inter-firm network. Compared to the articles applying the four entities model, the venture creation process approach is similar in that it considers interrelated processes whereby several aspects of the start up develop simultaneously as part of interactions with customers and other actors.

Managers may benefit from considering how their companies and resources can change as a result of new business relationships being initiated. For established companies, the initiation of a new business relationship may not lead to major changes for the company. However, the initiation of a new business relationship can also create friction when faced with inertia in a company's established resources, activities, business models, offerings and value propositions. By contrast, a start up company is just beginning to gather its resources and may be heavily influenced by resource interactions in the business relationship initiations it engages in. To properly shape a start up, some plasticity in terms of its resources will likely be necessary and also beneficial in resource interactions. However, a start up should also consider limiting its plasticity and balancing between resource plasticity and resource rigidity, at least initially, to avoid wasting time in the start up development process (cf. La Rocca et al., 2013).

1.4 Conclusion and Implications for Future Studies on the Six Facets

The present chapter was written based on the assumption that relationships matter. In this chapter, we presented six facets from the literature on start up business relationship initiation: (1) the initiation of business relationships as constituting the first states in the business relationship development process, (2) the initiation of business relationships as a process of its own, (3) focal relationships instead of focal actors, (4) third actors playing an active role in the initiation of business relationships, (5) one of the focal actors' portfolio of other relationships and (6) the initiation of business relationships as an interaction between resource entities. When presenting these facets, we made some observations: (1) the present literature on business relationship development is primarily focused on mature firms even though it is important for start ups to be able to analyse their present relationships as well; (2) the present business relationship initiation literature does not take into account that products may be developed as part of the business relationship initiation process; (3) it is important to define both sides of the business relationship, not just the perspective of one of the actors. We should therefore focus on focal relationships rather than focal actors; (4) third actors are particularly important for start ups in initiating business relationships; (5) since start ups have limited resources, they should take their entire portfolio of business relationships into account when deciding how to strategise and prioritise. Due to the lack of knowledge about how a start up will develop, it is also important to initiate business relationships with several different actors simultaneously and decide which to develop later on; (6) it has become popular to view business relationship initiation as an interaction between resource entities, and it is important for start ups to consider which resources to keep constant and which to change when necessary. Determining the right balance between resource rigidity and plasticity will help a start up develop products that will be bought by customers without having to adapt it for each customer.

From our review of the literature, it is evident that in articles dealing with the structure and process of interactions between actors, there were few references that focused specifically on start ups. Instead, most of the literature on start ups was found in articles that viewed the initiation of business relationships as an interaction between resource entities. Based on these findings, we suggest that the understanding of the start up phenomenon would benefit from cross-fertilisation of articles focusing on business relationship development processes and articles focusing on interactions between resource entities. We also posit that the resource entities interaction component should be given more weight in future research on business relationship development models in order to make them more relevant for start ups. In most models, the initiation process is usually assumed to have taken place when the interaction between resource entities occurs. For start ups, however, it may be particularly important to understand the interplay between the business relationship initiation and the interaction between resource entities. Finally, the articles focusing on business relationship development processes and the articles focusing on interactions between resource entities mainly take only *actors* and *resources* into account. There is still a dearth of studies that attend to the *activities* that take place during business relationship initiations among start ups. Holmen et al. (2005) stressed the importance of activities by focusing on the places where business relationship initiations begin as well as the activities actors engage in at these places. Hence, in addition to merging the branches of research that focus on actors and resources, an activity component should also be added in future studies of the initiation of business relationships among start up companies.

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2

Third Actors Initiating Business Relationships for a Medical Device Start Up: Effect on Network Embedding and Venture Creation Processes

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2.1 Introduction

It is widely recognised that it is essential to the survival and growth of start ups to initiate, develop and maintain business relationships (e.g. Aaboen, Dubois & Lind, 2011; La Rocca, Ford & Snehota, 2013). Only through establishing business relationships can start ups embed themselves in the pre-existing developing, producing and using setting (Håkansson, Ford, Gadde, Snehota & Waluszewski, 2009). However, start ups often experience difficulties in initiating the necessary business relationships (Prashantham & Birkinshaw, 2008). To cope with this challenge, Oukes and Raesfeld (2014) found that a start up used the mediating function of its partners to initiate new relationships. They showed that after it was made aware of, introduced to or referred to a potential partner by one of its existing partners, the start up could mobilise valuable resources from new partners.

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Other researchers (e.g. Aarikka-Stenroos, 2011; Aarikka-Stenroos & Halinen, 2007; Kirkels & Duysters, 2010; Yin, Wu & Tsai, 2012) have also highlighted the important role of 'third actors' in initiating relationships. Nevertheless, these studies focused on the perspective of the third actor—the one who connects—rather than the actors that are connected. Yet, the connection function of a start up itself is usually limited due to a lack of power, influence, information and control benefits, as well as the constraints on network activities with which it is confronted (Shipilov, Li & Greve, 2011; Yin et al., 2012). Nonetheless, the connection function of its partners can support the initiation of a start up's business relationships in two ways. First, third actors reduce the uncertainty associated with the competencies and resources of a start up's potential partners by connecting complementary partners in a way that is beneficial to all parties (Howells, 2006). Second, a start up can mitigate the possible detrimental effects of its limited network by relying on its partners to connect some of their existing relationships to the start up (Holmen & Pedersen, 2003).

In addition, research has shown that the initiation of business relationships will affect the extent to which the start up embeds itself in the pre-existing network and develops its business (Lamine, Jack, Fayolle & Chabaud, 2015). For example, Mainela, Pernu and Puhakka (2011) define four specific behaviours—internal problem-solving, external solution creation, opportunity selling and opportunity organising—as the primary drivers of the development of start ups and embedding them in networks. Although these studies have given us a valuable understanding of the network-embedding process and start up business development, this type of study usually looks at the initiation of several dyads, that is, the relation between two organisations (e.g. Aaboen et al., 2011; La Rocca et al., 2013), or the initiation of a portfolio, that is, the relations of a single organisation (e.g. Anderson, Dodd & Jack, 2010; Huggins, Izushi, Prokop & Thompson, 2015; Mainela et al., 2011). However, relatively little research has investigated the effect of third actors on the network embeddedness and business creation processes.

In summary, only limited research has been undertaken into how third actors influence the process of start up relationship initiation and how this in turn affects the process by which they embed themselves in the pre-existing network and develop their business. Therefore, our aim is to investigate *how third actors influence a start up's business relationship initiation and subsequent network embedding, as well as its business development.* This research's aim is addressed in a case study of a start up. The company involved is developing a medical device for the treatment of persons with diabetes. In the medical device industry, innovation is located within networks in which universities, start ups, established firms, venture capitalists and professional service firms collaborate. Especially in such a network-based structure, centrally positioned third actors can support the emergence of resource constellations and activity patterns between start ups and other members of the network (Styhre & Remneland-Wikhamn, 2016). This chapter starts by sketching a framework of the relevant theory. After that, the method used to address the research aim is briefly discussed. The 'Results' and 'Discussion' sections describe the findings of the case study, analysing the key findings in light of the theory. The chapter ends with our conclusion, discusses the limitations and avenues for future research.

2.2 Theory

2.2.1 Third Actors and a Start Up's Relationship Initiation

Edvardsson, Holmlund and Strandvik (2008) showed that the process of relationship initiation consists of three statuses, with increasing likelihood that a business agreement will be achieved: (1) unrecognised, that is, the parties do not know each other; (2) recognised, that is, there is an awareness of the parties of mutual business opportunities; and (3) considered, that is, companies negotiate the objective, scope and terms of the business relationship. The relationship initiation process ends and the relationship begins with the closing of a business agreement. Although the authors developed a conceptualisation of the dynamics in the business relationship initiation process, they did not consider the role and function of third actors in this process. Yet, business relationships—especially those of start ups—seldom start from direct approaches, such as cold calls, but often come about with the support of third actors, which introduce two or more matching business partners (Aarikka-Stenroos, 2009).

In particular, third actors are considered to have three functions and four roles in relationship initiation within the Industrial Marketing and Purchasing (IMP) tradition. Holmen and Pedersen (2003) discern three mediating functions of three actors: joining, relating and insulating. *Joining* enables direct coordination on some aspects between the firm of interest and the firm's counterparty. *Relating* facilitates coordination between the firm and a third party via the counterparty, with both parties having knowledge of each other. *Insulating* permits coordination between the firm and the third party without the parties having any knowledge of each other. In addition, Aarikka-Stenroos and Halinen (2007) classify 12 roles in four main categories: awareness, access, matching and specifying the deal. *Awareness* involves identifying potential partners, building awareness among suitable partners and creating a need for a specific partner. *Access* refers to establishing contact between partners, speeding up the initiation process and delivering marketing information. *Matching* includes evaluating the fit between partners, offering information about the trustworthiness of a partner and assessing the quality of a partner. *Specifying the deal* involves providing prospects of the relationship outcome, offering risk-reducing information and making intangible services tangible.

Both Holmen and Pedersen (2003) and Aarikka-Stenroos and Halinen (2007) emphasise the facilitating role of third actors in fostering relationship initiation. However, outside the IMP tradition, scholars have identified two main types of third actors based on the seminal work of Simmel and Wolff (1950): *tertius gaudens* and *tertius iungens*. *Tertius gaudens*, or 'the third who enjoys', benefits of a position between two disconnected actors by their active separation (Burt, 1992, 2000). *Tertius iungens*, or 'the third who connects', connects actors in a network by either introducing disconnected actors or facilitating new coordination between connected actors (Obstfeld, 2005). Thus, we argue that third actors may be capable of stimulating advancement and removing blocks that inhibit progress in a start up's relationship initiation. By contrast, they may also be capable of strengthening blocks against moving forward and provoking backwards conversion. However, it remains unsettled how the functions and roles of third actors drive or inhibit relationship initiation from unrecognised, recognised to considered statuses. Therefore, the first research question of this chapter is: *How do the roles and functions of third actors drive or inhibit a start up's relationship initiation?*

2.2.2 Third Actors and a Start up's Network Embedding

Network embeddedness is 'the dependency of a firm on its links with other actors in an industrial network' (Yli-Renko & Autio, 1998, p. 256). Embeddedness can be divided into three settings (Håkansson et al., 2009), based on the dominant type of activities connecting an organisation to a network (Yli-Renko & Autio, 1998): the developing, producing and using setting. In the developing setting, new ideas are developed; in the producing setting, the developed ideas are produced, and in the using setting, the ideas produced are used commercially (Håkansson et al., 2009). Start ups are usually not yet embedded in the pre-existing networks within these settings (Oukes & Raesfeld, 2016). Yet, becoming embedded is crucial to a start up's survival and growth (Bliemel & Maine, 2008) because it always builds on the resource constellations, activity patterns and a web of actors in the pre-existing network (Snehota, 2011). Moreover, the value of a start up's resources depends on its connections to the resources of others, and the outcome of its activities is interdependent with its counterparts' activities (Håkansson et al., 2009). Although it is widely recognised that becoming embedded in the pre-existing network is essential to start ups (e.g. Bliemel & Maine, 2008; Yli-Renko & Autio, 1998), so far we have no in-depth understanding of how start ups establish themselves therein. To shed new light onto how this process unfolds, we aim to explore the role of the third actor.

To embed themselves in the developing, producing and using setting, start ups have to initiate business relationships (Yli-Renko & Autio, 1998). Yet, the limited resources and scanning abilities of start ups make it difficult to find competent partners with valuable resources (Kirkels

& Duysters, 2010). Furthermore, a start up cannot always be directly involved in making new connections among relationships of its partners because of its limited network horizon (Holmen & Pedersen, 2003). We therefore argue that third actors can stimulate a start up's network embeddedness by facilitating the initiation of business relationships. The research of Styhre and Remneland-Wikhamn (2016) supports this argument. They investigated how a large pharmaceutical company connected small companies with public organisations, venture capital investors, universities and equipment providers to support innovation in life science. In this way, the pharmaceutical company presumably supported the embedding of the smaller companies in the developing, producing and using setting. However, their study adopted the perspective of the large pharmaceutical company, so it remains unclear how third actors stimulate network embedding from the perspective of the start ups. As a result, the second research question of this chapter is: *How do third actors facilitate the embedding of a start up in the pre-existing developing, producing and using setting?*

Business relationships are usually studied as if they were dyadic, even if they are affected by various actors and business in a larger network (Aarikka-Stenroos, 2011). However, when a third actor participates in the initiation of a business relationship, a dyadic relationship becomes a triad. A triad exists '*when relationships between three directly or indirectly associated actors are connected*' (Vedel, Holma & Havila, 2016, p. 4). A triad can be open or closed: in an open triad, three organisations are indirectly linked to each other through a third actor, while in a closed triad all three actors are linked directly (Vedel et al., 2016). It is often assumed that if those connected can communicate directly with each other, the importance of the third actor decreases because it is no longer necessary (Yin et al., 2012). However, Yin et al. (2012) show, inter alia, that if the organisations are dissimilar in size, the role of the third actor remains important. As start ups often (have to) collaborate with large, established organisations, they may form a triad with the third actor who introduced them, instead of their relationship with it ceasing to exist. Although this may influence a start up's level of network embeddedness, this has so far remained unexplored. Therefore, the third research question of this chapter is: *What is the effect of the type of triad—open versus closed—that is formed with the third actor and its level of importance on the embedding of a start up in the pre-existing network?*

2.2.3 Third Actors and a Start up's Venture Creation

A start up's business development refers to the entrepreneurial process of discovering, creating and exploiting opportunities (Shane & Venkataraman, 2000). Mainela et al. (2011) combined these phases of business development with research on technological networks and network-based internationalisation. Based on these bodies of literature, they showed that three venture creation processes can be distinguished: (1) the opportunity-centred process is focused on building a start up's business concept, (2) the technology-centred process involves connecting the initial ideas for new products to innovative technological solutions and (3) the internationalisation-centred process consists of positioning a start up in relation to actors in the international, inter-organisational network (Mainela et al., 2011). However, these processes are not independent: a start up's business and technology develop simultaneously as part of the interaction with the organisations in its business network.

Raesfeld and Roos (2008) linked the three phases of a small firm's business development to the three functions of third actors defined by Holmen and Pedersen (2003). They argued that during opportunity discovery, third actors *relate* organisations to advance the development of the weak ties necessary for the generation of new business opportunities. During the opportunity creation, third actors *join* organisations to facilitate the formation of strong ties, which are crucial to the sharing of resources and new product creation. During opportunity exploitation, third actors *insulate* organisations to stimulate the generation of loose ties necessary to deliver products efficiently to customers. However, Holmen and Pedersen (2003) focused on the management of business relationships rather than their initiation. Although third actors may facilitate the management of relationships between connected organisations, they also introduce disconnected organisations (Obstfeld, 2005). In addition, they have only captured part of the venture creation process: the opportunity-centred process. Yet, the initiation of relationships by third actors will also influence the other two venture creation processes. As a result, we argue that through initiating business relationships, third actors will affect the venture creation of a start up. Yet, an understanding of how this process unfolds is still unavailable. The fourth research question of this chapter is therefore: *How does a third actor affect the venture creation of a start up through relationship initiation?*

2.3 Methodology

In order to achieve insights into the role of third actors in the relationship initiation of start ups, the data collection must include information about at least three actors: the two, three or more relationships which link them, and how these relationships influence each other (Vedel et al., 2016). Therefore, we have used an in-depth case study to analyse the process by which the start up's key relationships are initiated. The methodology of the case has been reported in detail elsewhere (Oukes & Raesfeld, 2016). Briefly, a retrospective analysis was done from the foundation of the start up in 2008 until April 2013. Thereafter, the start up was followed in real time until the end of November 2015. The longitudinal data were collected by three methods: interviews, observations and archival data. First, nine individuals from both the start up and its key partners were interviewed during spring 2012. These interviews were repeated with five of the interviewees one and a half years later. Interviewing the start up as well as its partners at two different times allowed us to capture the complexities and network characteristics associated with multiplex inter-organisational relationships over time. The interviews centred around (1) how the start up and its artificial pancreas had developed since its foundation, (2) how its network evolved over time and (3) how each of its relationships was initiated and coordinated, as well as how resources were exchanged between partners during the relationship. In addition to these aspects, in the second set of interviews questions were asked about how the partners interacted with each other. Despite the semi-structured nature of the interviews, there was sufficient room for the interviewee to give examples and elaborate on important situations. The selection of interviewees was based on (1) direct interaction with the other partner(s) in the relationship and (2) direct involvement in the development of the start up's artificial pancreas. Secondly, the behaviour of the start up in its relationships was actively and passively observed during the first author's stay at the company from April 2013 until November 2015. Thirdly, archival documents, such as websites, grant proposals, contracts and patents, were collected from the start up's foundation in 2008 until November 2015. The observations and archival data were primarily used to help the researchers improve their understanding of data collected through the interviews. The data collection involved sensitive, confidential and political issues regarding the start up and its partners. As a result, the individuals and organisations are given fictional names to maintain confidentiality. The transcribed interviews, field notes and archival documents were analysed in four consecutive steps. First, we described with whom, when, where and why the start up initiated a relationship. Second, we looked at whether a third actor was involved in the relationship's initiation, and if so what the influence of the third actor was on the process. Third, we assessed how the involvement of the third actor in the relationship initiation affected the network embedding of the start up. Fourth, we explored how the engagement of the third actor in the relationship initiation affected its venture creation.

2.4 Findings

This section describes chronologically how the relationships of the start up were initiated and the influence of third actors on this process. In addition, we describe how the third actor subsequently affected the network embedding and the venture creation processes. Table 2.1 provides the key findings regarding the role and function of the third actors within the relationship initiation process. Table 2.2 presents the main results regarding (1) the setting in which the start up can embed itself through the initiation of the relationship with the specific

Table 2.1 The key findings regarding the third actors' function and role in the relationship initiation process

	Year	Third actor	Function	Role of third	Statuses of process
Teaching hospital	2008	The physician	Joining	Scouter; awareness builder; access provider	Unrecognised; Recognised; Considered; Agreement
Health fund	2009	–	–	–	Unrecognised; Recognised; Considered
Research institute	2012	Health fund	Joining	Scouter; awareness builder; access provider	Unrecognised; Recognised; Considered; Agreement
European project	2012	Teaching hospital	Joining; relating	Scouter; awareness builder; access provider; matchmaker	Unrecognised; Recognised; Considered; Agreement
Market leader	2012	Health fund	Joining	Advocate seller	Unrecognised; Recognised; Considered; Agreement
Regional hospital	2013	Teach hospital	Joining	Awareness builder; access provider	Unrecognised; Recognised; Considered; Agreement
Design studio	2014	Health fund Regional hospital	Joining	Advocate seller	Unrecognised; Recognised; Considered; Agreement
Glucagon company	2014	Health foundation Investment company	Joining	Scouter; awareness builder; access provider	Unrecognised; Recognised; Considered

Table 2.2 The key findings regarding the setting and level of network embedding of the start up's relationships as well as the effect on its business development

	Setting of partner	Source	Open/ closed	Importance of third actor	Venture creation process
Teaching hospital	Developing Using	Relation	Open	Decreased	Technology Improve the size and function of Artificial Pancreas (AP)
Health fund	Developing Using	–	–	–	Internationalisation Access to diabetes-related network
Research institute	Developing	Relation	Closed	Increased	Technology Cheaper and more accurate sensor
European project	Developing	Relation	Closed	Decreased	Technology Develop various aspects of the AP Opportunity Develop the business case of the AP
Market leader	Producing	Publicity	–	–	Opportunity Ensure that the AP is commercialised
Regional hospital	Developing Using	Relation	Closed	Stable	Technology Improve the size and function of AP
Design studio	Developing Developing	Publicity Publicity	– –	– –	Technology Improve the usability of the AP
Glucagon company	Developing Developing	Relation Relation	Open Closed	Decreased Stable	Technology Development of liquid glucagon

partner, whether or not facilitated by a third actor; (2) three indicators of the level of network embedding: source, type of triad and third actor importance; and (3) the start up's venture creation process in which the partner is primarily involved, whether or not the relationship was initiated by a third actor. Figures 2.1, 2.2 and 2.3 show the network development of the start up over time (2007–2009, 2010–2012 and 2013–2015), as well as the influence of third actors on initiating relationships. In addition, the figures show the strength of the ties between the organisations in the start up's network. Strong ties have a higher level of resource commitment, continue to exist over a longer period

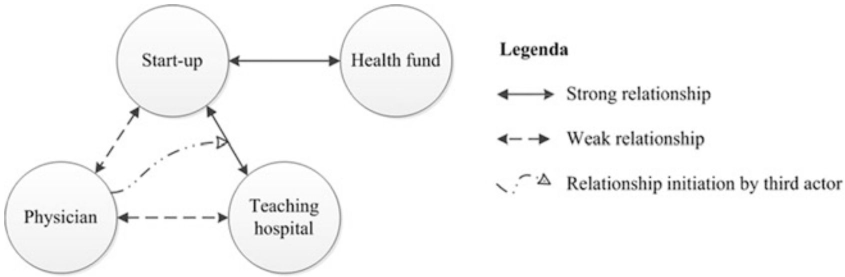

Fig. 2.1 Network of the start up between 2007 and 2009

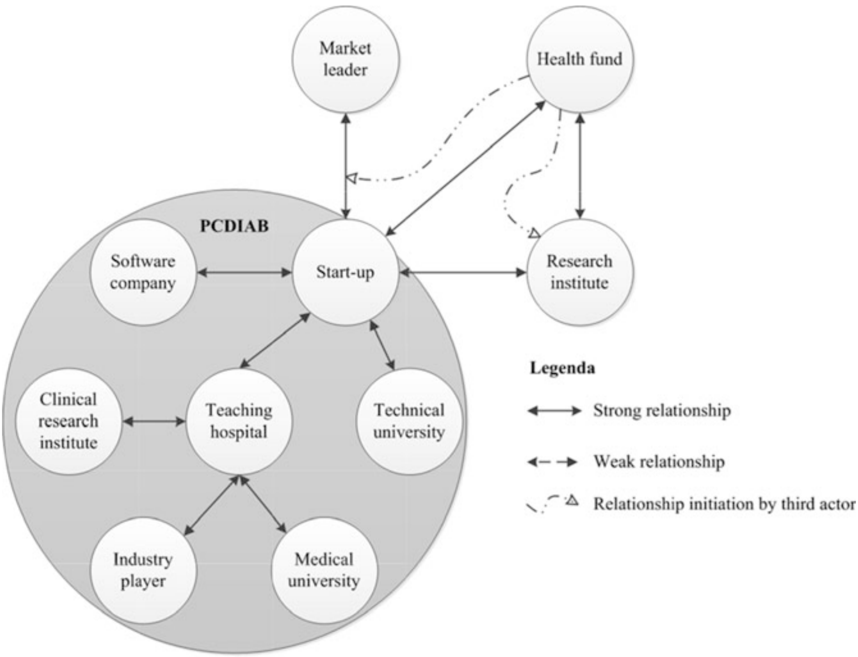

Fig. 2.2 Network of the start up between 2010 and 2012

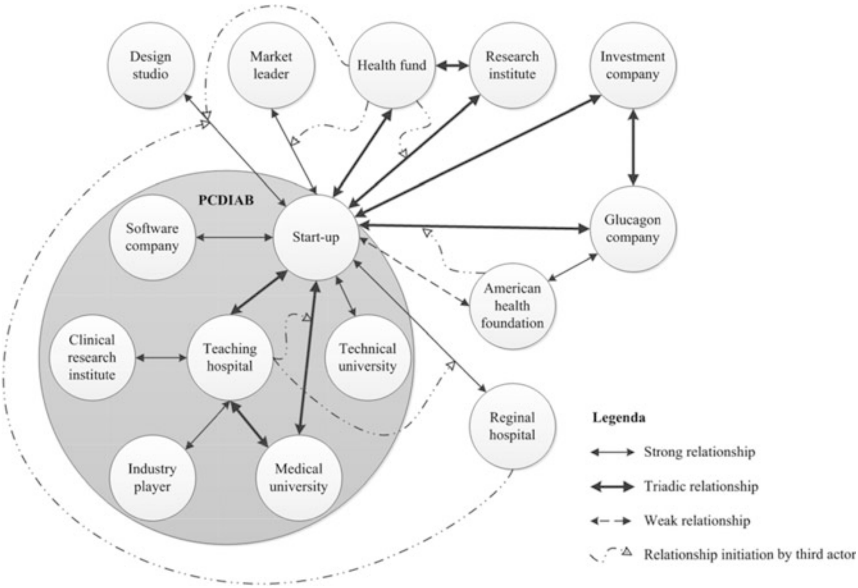

Fig. 2.3 Network of the start up between 2013 and 2015

of time and have more social content at the inter-personal and inter-organisational level than weak ones.

2.4.1 Brief Description of the Start up and its Product

The start up was established in 2008 by the inventor of the product and an angel investor. The start up is creating a bi-hormonal artificial pancreas for the treatment of persons with type 1 diabetes mellitus (T1DM). A bi-hormonal artificial pancreas (artificial pancreas below) connects an insulin/glucagon pump with a continuous glucose monitor by means of an algorithm. The algorithm calculates the correct amount of insulin (decreases blood glucose levels) or glucagon (increases blood glucose levels) to be injected based on the current blood glucose level. In turn, the pump automatically delivers that specific amount of insulin/glucagon to the body. Currently, the treatment of diabetes is a major burden to those who suffer from it. Persons with T1DM must regularly measure their blood glucose level with a finger prick and test strip, calculate their carbohydrate intake, take account of exercise, determine the required amount of insulin and inject themselves. The start up's artificial pancreas will give them complete freedom of diet and exercise flexibility combined with fewer finger pricks and insulin injections. The expectation is that the device will considerably improve the quality of life of persons with T1DM because their disease becomes less of a burden during the day. Despite the fact that the start up has been in existence for some time, the artificial system is not yet ready for production, let alone use by persons with T1DM. Consequently, the start up can still be considered to be in the start up phase (Oukes & Raesfeld, 2016). In order to mobilise and leverage the resources necessary to develop the artificial pancreas, such as intellectual property, distribution networks and production facilities, the start up needed to initiate relationships with other organisations. As we explain in the remainder of this section, the start up would not have been able to initiate all the necessary relationships without the support of third actors.

2.4.2 Initiating the Relationship with the Teaching Hospital

As shown in Table 2.1, the start up's first relationship was established with the teaching hospital in 2008. It was made aware of the existence of the Diabetology Research Group of this centre by a physician from another hospital. He contacted the start up after he had read an article about the artificial pancreas in a magazine. The start up anticipated that he would be able to run clinical trials. It was necessary to run these trials since the efficiency, effectiveness and safety of the artificial pancreas had to be evaluated. Yet, the start up lacked the required knowledge, financial resources and facilities to run the trials itself. However, the physician was unable to run clinical trials because he lacked the appropriate resources. Nevertheless, the physician referred the start up to the head of the teaching hospital's Diabetology Research Group. The aim of this group is to conduct medical-scientific research in the field of insulin delivery and continuous glucose monitoring. Therefore, the physician identified the Diabetology Research Group as a suitable partner for the start up. After he established the first contact between the two potential partners, the start up was invited to give a presentation to the group's members. During the presentation, the owners of the start up presented the results of the early tests that were run with a first prototype of the artificial pancreas. According to the head of the teaching hospital's Diabetology Research Group, the results were promising. This convinced him that it would be worth the effort to evaluate the start up's idea in clinical trials. A series of meetings followed in which the Diabetology Research Group and the start up negotiated the details of their potential relationship. In the end, they agreed that the teaching hospital would run three clinical trials in exchange for 10 % of the start up's shares. The outcomes of these trials could be used to create a second, and eventually a third, prototype of their technology: the artificial pancreas. These outcomes would not only be related to technical aspects, such as the performance of the algorithm and the product's reliability, but also involve feedback from users regarding the user-friendliness of the device (see Table 2.2). As presented in Table 2.2, after the agreement between the start up and the teaching hospital was effected, the physician withdrew from both relationships due to lack of interest in the artificial pancreas as a research topic.

2.4.3 Initiating the Relationship with the Health Fund

Shortly after the relationship with the teaching hospital was initiated, the inventor was at a beneficiary meeting of the health fund. The aim of this foundation is to cure diabetes and ensure a healthy life for diabetes patients without the daily concerns about diabetes and its complications by facilitating scientific research and providing education. At the meeting, the inventor had a conversation with the health fund's head of research. The two discovered that they had a mutual interest: improving the quality of life of diabetes patients. The mutual interest between the partners marked the start of several meetings to discuss what they might mean for each other. Thus, neither during these negotiations nor during the remainder of the relationship initiation process was a third actor involved (see Table 2.1). As the health fund was known as the largest financer of diabetes-related research, the start up requested financial support for the development of a second artificial pancreas prototype. However, this request was rejected by the foundation's internal audit committee. According to its policies, every funding proposal had to be approved by this committee to justify the choice for specific projects to their accountants, beneficiaries and the wider public. Therefore, the health fund was not permitted to financially support the development of the start up's device. In turn, the two partners were unable to reach an agreement about financial support of the artificial pancreas development. However, the health fund also appeared to support diabetes-related research with its huge network of nurses, physicians, research institutes and pharmaceutical companies. In addition, the foundation promoted new diabetes-related development among its members, such as diabetes patients and their families. As shown in Table 2.2, the health fund could consequently not only support the start up financially but also help them to position in the diabetes-related research network. In this way, the health fund could function as a third actor in joining the start up with valuable partners to advance the development of their artificial pancreas.

2.4.4 Initiating the Relationship with the Research Institute

The health fund organised meetings to connect industry and research institutes to advance new product development in the field of diabetes. Before these meetings, the foundation identifies potential partners and during the meeting it establishes contacts between the partners to build awareness among suitable partners (see Table 2.1). In 2012, the health fund organised such a meeting to discuss the latest developments regarding glucose sensors. The start up was invited to the meeting because the existing glucose sensors were not accurate and reliable enough to calculate the correct amount of insulin or glucagon. The meeting was also attended by the research institute—a well-known, independent research institute—since it was developing a glucose sensor based on novel technology. It expected that this sensor would not only be more accurate but also be cheaper than existing ones (see Table 2.2). Yet, the research institute needed an industry partner to determine whether there was an actual market application for its sensor and to finance its continued development. The clear complementarities between the start up and the research institute resulted shortly after the meeting in an agreement to collaborate. They agreed to start a 'co-financing' project. In this type of project, the development trajectory is divided into four phases: from scientific research to market authorisation. The start up had to finance, respectively, 10, 25, 50 and 100 % of the sensor development itself, while the remainder was funded by local government. Completing the four phases would result in a patented sensor which the start up could exclusively licence from the research institute.

As shown in Table 2.2, the importance of the health fund did not decrease when the relationship between the start up and the research institute was established. By contrast, the health fund became essential in resolving a conflict between the two partners. In the first year, the joint project of the start up and the research institute made rapid progress. Then, the research institute started a multi-partner research project with similar objectives. Consequently, the research institute requested the start up to join and end the co-financing project. This, however, meant that the start up would have to share the right to licence the patented sensor with several other companies. This was not considered beneficial by the start up and it consequently turned down the request. This brought the research institute into a difficult position because it required the start up's patented sensor to make progress in the multi-partner research project. As a consequence, the research institute began to obstruct the development of the sensor, so attempting to force the start up to join the multi-partner project. This attempt was unsuccessful and the conflict seemed to end in an impasse. In 2014, the health fund—one of the partners in the multi-partner research project of the research institute—proposed a creative solution to resolve these issues. In essence, the foundation's proposition involved its providing the necessary financial resources to complete the development of the new sensor. In turn, the start up would get the exclusive right to licence the patent on this sensor. Thereafter, it would join the multi-partner project. This solution appears to have turned out favourably for all three parties.

2.4.5 Initiating the Relationship with the Market Leader

Besides the sensor meeting for research institutes and industry, the health fund also organised a contest for innovative research projects. In this way, it aimed to deliver information to the public about the progress of research in the field of diabetes (Table 2.1). In 2012, the start up participated and won the audience award. Winning this award attracted nationwide attention in the media for the development of its device. In this way, a department of the market leader became aware of the start up's artificial pancreas. The market leader is a frontrunner in personalised health care, a global leader in cancer treatment and the leading provider of in vitro diagnostics. In the diabetes market, the firm is the leader in glucose monitoring. When the business director of the glucose-monitoring department heard about the start up, he invited it to give a presentation. During the presentation, the technicians of the market leader discovered that the artificial pancreas was further developed than they had expected. Nevertheless, the development of the artificial pancreas was not yet sufficiently mature to invest in; the risk that it would fail was viewed as too high. However, the market leader wanted to keep abreast of developments at the start up, to which end they signed a non-disclosure agreement. This agreement enabled the partners to share confidential knowledge and information, but restricts the counterparty from sharing it with third parties. Additionally, they signed a right of first refusal, which gives the market leader the option to enter a business transaction with the start up before it can enter into such a transaction with a third party.

The agreements between the market leader and the start up provided the partners the chance to build a trusting relationship and opened up opportunities for future collaboration. As a small, young company the start up had the required flexibility to develop the artificial pancreas, but was expected to lack the resources to produce, market, sell and distribute it. By contrast, the market leader—as a large, established firm—is less well equipped to invent new diabetes devices, but it possesses the production facilities, marketing experience, sales agents and distribution network to commercialise them. Consequently, both partners saw the advantages of long-term collaboration to exploit the device developed by the start up (see Table 2.2).

2.4.6 Initiating the European-Funded Project

In 2012, the start up not only initiated a relationship with the research institute and the market leader, it also started a European project together with the teaching hospital. When the head of the teaching hospital's Diabetology Research Group came across an interesting call for projects grants under the Seventh Framework Programme for Research and Technological Development (FP7) of the European Commission, he invited the start up to join the application. The partners could use the grant to build a fourth prototype of the artificial pancreas and evaluate it in additional clinical trials. The teaching hospital introduced the start up to three organisations with which it had good experience in another ongoing project. As shown in Table 2.1, this project focused on the development of another type of artificial pancreas and they were identified as relevant, suitable and valuable partners. Specifically, the medical university, the established industry player and the clinical research institute joined the project team. Within the European project, the medical university will examine the interactions between insulin and glucagon administration and continuous glucose monitoring at the same site. In addition, clinical research institute will conduct and coordinate the clinical trials. Furthermore, the established industry player will be responsible for the development of a new glucagon formulation. Also, the start up's angel investor asked two organisations to join the project: the software firm and the technical university. Within the European project, the software company will be responsible for developing the presentation and reporting software for various stakeholders, such as physicians, researchers and patients. Additionally, the technical university will focus on the business development of the artificial pancreas and support the innovation network of the companies involved. Thus, the respective responsibilities of the partners were mainly focused on the technological development of the artificial pancreas. Yet with the inclusion of the technical university, the project partners also aimed to develop the business concept of the start up to find opportunities to exploit the technology (see Table 2.2). After the project team was formed, the potential partners wrote a project proposal that suited their own interests as well as fulfilled the specifications of the European Commission. The result was a proposal that was granted more than four million Euros in funding. In September 2012, the three-year European project was launched and the partners started working on their respective responsibilities.

In 2015, the European project should have been finalised, but the development of the artificial pancreas progressed more slowly than expected. The partners therefore applied for and were granted a nine-month extension of the project. Nevertheless, the start up had to find new sources of financing to be able to continue developing its device. To that end, the start up wrote several new project applications. In almost all of these applications, the medical university was one of the project partners while the teaching hospital was involved only in some of them. As Figs. 2.2 and 2.3 show, the teaching hospital first related the start up and the medical university, while over time it joined the partners: a direct relationship between the partners emerged in which the teaching hospital was only sometimes involved.

2.4.7 Initiating the Relationship with the Regional Hospital

At the start of 2013, it appeared that the teaching hospital, responsible for conducting clinical trials within the European project, would have insufficient capacity to do so. Running the additional clinical trials was essential to demonstrate the efficiency, effectiveness and safety of the new technical features of the artificial pancreas the start up had created, as well as give patients the opportunity to test the usability of the device's interface (see Table 2.2). A former employee of the teaching hospital, who had run the first three clinical trials, heard about this problem. At that time, she worked at the regional hospital, but was still indirectly involved with the start up project. Finally, the teaching hospital's former employee ensured that the regional hospital would provide the capacity to run the clinical trials. As shown in Table 2.2, a close relationship was developed between the regional hospital, which provided the necessary capacity, the teaching hospital, which designed, ran and analysed the clinical trials, and the start up, which provided technical support. The emergence of this triadic relationship was facilitated by the teaching hospital which, although through a former employee, made the regional hospital and the start up aware of each other and introduced them to each other. In response to the initiation of this relationship, the regional hospital wrote a press release about the development of the artificial pancreas and its role in this development at the end of 2013. Soon thereafter, the health fund also issued a press release about the start up's development project. These press releases were picked up by some local newspapers and from there by the national press, magazines, news broadcasts and talk shows. In this way, the regional hospital and health fund spread information about the start up that was picked up by potential partners (see Table 2.1).

2.4.8 Initiating the Relationship with the Design Studio

It was during the intense media attention to the start up's artificial pancreas in 2013 that the design studio learned about the start up. The design studio is an institute for art, science and technology in the fields of digital media, biotechnology and cognitive sciences. Recently, the design studio had developed an application that showed the blood glucose level of diabetes patients using colours (indicating a good, neutral or bad blood glucose level) instead of the hard numbers. In this way, blood glucose level measurement was perceived to be more user-friendly. Although designers developed a good-looking design, it was not used in an actual product. So, when one of the employees saw the artificial pancreas on television, she thought that the studio's design could be applied to this device and contacted the start up. The start up was previously more focused on getting the artificial pancreas to work properly. However, it was also starting to consider the design of its artificial pancreas market model at that time. As the start up lacked the required design expertise, it was interested in collaboration. Therefore, the partners started a one-year project to implement the design studio's design in the start up's artificial pancreas (see Table 2.2).

2.4.9 Initiating the Relationship with the Glucagon Company

In 2014, the established industry player decided to leave the European project because it had shut down its research project to develop stable, soluble glucagon. As a result of the need for stable, soluble glucagon for the bi-hormonal artificial pancreas' commercial success, the start up urgently had to search for a new partner. The American Health Foundation is a global organisation that aims to find a cure for diabetes type 1 and its complications. As shown in Table 2.1, the foundation identified the glucagon company as a suitable partner and established the first contact between the potential partners. The glucagon company is a small, American start up founded in 2005 that is dedicated to the development of stable, soluble glucagon for the treatment of low blood sugar levels. The company was an interesting partner for the start up as its glucagon was expected to be the first available on the market. The potential partners met a few times and held several transatlantic phone calls. In the end, they agreed it would use the glucagon of the glucagon company in the following clinical trials. In this way, the start up did not have to use the unstable, powder glucagon currently available, while the glucagon company could test the performance of its glucagon solution in a clinical setting (see Table 2.2). However, a problem occurred: neither the glucagon company nor the start up had the resources to finance the production of a batch of glucagon for use in the clinical trial. Previously, the start up had had contact with an American investment company which invests in innovative research in the USA looking for a cure for type 1 diabetes. Eventually, it appeared that the investment company did not want to invest in the development of the artificial pancreas because it was a European initiative. Yet the start up supposed that it might be willing to support the glucagon provider, an American start up. Indeed, the investment company was prepared to invest in the batch of glucagon. In this way, a close relationship emerged between the glucagon company, the investment company and the start up. In this collaboration, the glucagon company was responsible for supplying the glucagon, the start up delivered the artificial pancreas and the investment company provided the necessary financial resources (see Table 2.2).

2.5 Discussion

2.5.1 How Do the Roles and Functions of Third Actors Drive or Inhibit a Start up's Relationship Initiation?

The case study shows that third actors were involved in the initiation of seven out of eight of the start up's business relationships. These third actors drove the initiation of its relationships from the unrecognised to the recognised and the considered statuses. For example, the health fund brought the start up and the research institute together at a research meeting so that they would recognise their complementarities and consider collaboration. This implies that, as suggested in the literature (Holmen & Pedersen, 2003; Kirkels & Duysters, 2010), the start up experienced difficulties in recognising partners with the necessary characteristics due to its limited network horizon. In fact, it was almost exclusively dependent on the third actors to develop its portfolio of relationships. However, the third actors did not play an active role in the consideration status. For example, the health fund was not involved in the negotiations between the start up and the research institute.

This lack of involvement of the third actors in the consideration status can be explained by their role in the initiation process. Table 2.1 shows that the role of the third actors in the relationship initiation process was generally either a combination of scout, awareness builder and access provider or an advocate seller. The case provided no examples of third actors that specified the deal: three roles which are usually performed in the consideration status (Aarikka-Stenroos & Halinen, 2007).

This may be because Aarikka-Stenroos and Halinen (2007) investigated buyer-supplier relationships while the start up had not yet established any relationships with suppliers or customers. The third actors in the start up's portfolio were not 'traditional' intermediaries present in 'classical' value chains (Rose, 2012). Moreover, they were not 'traditional' organisations that provide support to young, small firms, such as incubators or venture capitalists. Therefore, the teaching hospital and health fund had neither the expertise nor the motivation to provide concrete evidence, build expectations, reduce risk and function as an evaluation assistant for the start up and its partners. Thus, the third actors were not involved in the consideration status because they were not skilled and motivated to do so.

In addition, the third actors mainly joined potential partners, as shown in Table 2.1. The other two functions of Holmen and Pedersen (2003) were either not (insulating) or less (relating) evident. This is in line with the findings of Raesfeld and Roos (2008), who argued that in the opportunity discovering, creating and exploiting phases, the third actor would relate, join and insulate, respectively. The start up was clearly focused on creating the artificial pancreas: it had passed beyond discovering the need for it, while it paid only limited attention to its commercialisation. As this phase requires the start up to develop strong ties with other organisations to develop its device, it could be expected that 'joining' third actors would facilitate such close collaboration. Indeed, Figs. 2.1, 2.2 and 2.3 show that the majority of the relationships being formed, except for the relationship with the physician and the American health foundation, are strong ties.

From the discussions of these functions and roles of the third actors involved in the start up's relationship initiation, it becomes clear that they acted with a *tertius iungens* orientation. The third actors acted less as an intermediary that controls inter-organisational relationships and more as a facilitator that fosters them (Styhre & Remneland-Wikhamn, 2016). This is in line with the findings of Obstfeld (2005) who showed that while the *tertius gaudens* is important for generating new, good ideas, the *tertius iungens* is crucial in developing these ideas because it requires more explicitly coordinative action. Although it is crucial for the start up's invention that its third actors act with a *tertius iungens* orientation, this does not mean they actually have the motivation to do so. For example, the teaching hospital explained that they also participated in a project in which they deliberately linked up two competitors in order to identify the best potential technology.

2.5.2 How Do Third Actors Facilitate the Embedding of a Start up in the Pre-Existing Developing, Producing and Using Setting?

Third actors facilitated the embedding of the start up in the pre-existing developing, producing and using setting through the initiation of its relationships. Indeed, Yli-Renko and Autio (1998) showed that in becoming embedded in a setting, the crucial step seems to be establishing initial, intense relationships with other organisations in the network. As shown in Table 2.1, there were two principal third actors—the health fund and the teaching hospital—that facilitated the embedding of the start up. In total, the health fund connected the start up three times to potential partners, while the teaching hospital introduced it to four new partners. Figures 2.1, 2.2 and 2.3 reveal that tie strength affects the number of relationships that were initiated by a third partner. Whereas the teaching hospital and health fund both had a strong relationship, the physician and the American Health Foundation had a weak tie with the start up. This implies that start ups can continue to benefit from the third actor role as a partner when they have a strong relationship.

Furthermore, Table 2.2 shows that both the health fund and the teaching hospital were both well embedded in one or more of the pre-existing settings. This is in line with the findings of Ahuja, Polidoro and Mitchell (2009), who found that poorly embedded firms are more likely to form relationships with well-embedded firms because, among others, of their access to other potential partners. However, being well embedded in one or multiple pre-existing settings was a necessary, but insufficient condition for the third actors to connect the start up to other potential partners: they should also be motivated to do so (Aarikka-Stenroos, 2009).

For example, the health fund was motivated to introduce the start up to other partners since it was unable to provide direct financial support for the development of the artificial pancreas. Yet, it believed in the device as a potential solution to diminish the burden of diabetes. This implies that a start up can benefit from the third actor's functions and roles of well-embedded organisations as long as they are motivated to connect it to partners in its own developing, producing and using setting.

2.5.3 What is the Effect of the Type of Triad that is Formed with the Third Actor and its Level of Importance on the Embedding of a Start Up in the Pre-Existing Network?

When addressing this question, the first thing to notice is that a triad was not necessarily formed when a third actor connected the start up to a new partner. The case shows that the third actor could take either an active position in the relationship initiation process or a passive one. In the former instance, a triad is (temporarily) formed between the start up, third actor and a potential partner; that is, the third actor is directly involved in initiating the relationship. For example, the American Health Foundation connected the start up and the glucagon company by contacting both organisations. In the latter instance, a triad is not formed between the three actors; that is, the third actor is only facilitating the initiation of new relationships through the generation of media attention for the start up. For example, the regional hospital and the health fund attracted a lot of media attention to the start up in 2013. In reaction to this, the start up was able to initiate a relationship with the design studio. However, neither the regional hospital nor the health fund was in direct contact with this new partner. This is in contrast with the arguments of Aarikka-Stenroos (2011), who suggest that when a third actor participates in the initiation of a business relationship, a dyadic relationship becomes a triad. It is more in line with Vedel et al. (2016, p. 3), who argue that '*it is not enough that a third actor exists for triad to form. The third actor must be associated to the other two for a triad to form.'* Although a third actor is not directly connected to both organisations in the second position, it still facilitates the relationship's initiation: without the media attention that the third actor generated, some of the start up's relationships would not have been established. Therefore, the 'third actor' can still be considered a third actor, even though no triadic relationship is being formed.

A start up is embedded in a pre-existing network when it is dependent on the resources of other organisations in that network (Wedin, 2001). These resources are bound together by activities, which form the links between the start up and the other organisations in the network (Yli-Renko & Autio, 1998). The case shows that the level of mutual dependency between the partners is the lowest in dyadic relationships (with a passive position of the third actor), moderate in open triads and highest in closed triads. For example, the start up is greatly dependent on both organisations to successfully develop a new sensor in the closed triad with the research institute and the health fund. Therefore, the degree of network embedding is higher in a closed triadic relationship than in an open triadic and dyadic relationship, respectively. Thus, the third actor can increase the level of a start up's embeddedness by forming a triadic relationship after initiating the relationship.

Additionally, the case shows that within a triad the importance of the third actor can either increase or decrease or remain stable. The importance of the third actor is closely related to the dependencies between the partners: when the importance of the third actors increases the dependencies also increase, and vice versa. For example, a triadic relationship was formed between the start up, the teaching hospital and the medical university. Over time, the start up and the medical university wrote a joint grant application without the involvement of the teaching hospital. The partners became less dependent on the teaching hospital because it was not necessary to run clinical trials in these applications. In addition, the case shows that the strength of a tie plays a role in the importance of the third actor: in two out of three instances in which the importance of the third actor decreases, the start up had a weak tie with the third actor. The importance of the physician and the American Health Foundation decreased once the initial contact with the potential partners had been made. Both these actors had a weak relationship with the start up. Embedding is associated with the level of dependency (Wedin, 2001) as well as tie strength (Moran, 2005). Therefore, the more important a third actor becomes during the relationship with another partner, the higher the level of embeddedness.

2.5.4 How Does a Third Actor Affect the Venture Creation of a Start up Through Relationship Initiation?

As shown in Table 2.2, the third actors involved in the relationship initiation of the start up stimulated its venture creation. If third actors had not established the relationships with the respective partners, the start up would have been unable to develop its technology, nor its business and network. For example, the relationships with the research institute for the sensor and the glucagon company were initiated by the third actors to ensure that the artificial pancreas could function properly. Thus, this case shows that third actors can play an important role in a start up's business development through the initiation of relationships. However, the third actor is also influenced by the business development phase of the start up (see Fig. 2.4). As explained in Sect. 2.5.1, depending on the phase of development, a third actor usually performs a different function. The case reveals that the focus of the start up's relationships is on the technological development of the artificial pancreas, that is, the development of new technological innovations as described by Mainela et al. (2011). By contrast, the development of the business concept and the organisation of the market through its relationships have received far less attention. Only upon initiating the relationship with the market leader did the start up take the first steps in bringing the artificial pancreas to market (Oukes & Raesfeld, 2016). As soon as the start up's focus comes increasingly to lie on the commercialisation of its artificial pancreas, it can be expected that the role, function and type of the third actor will change (Raesfeld & Roos, 2008). For example, the market leader may start to insulate the start up and the distributors or sale agencies in its network. In this way, it can facilitate the development of the weak ties necessary to deliver products efficiently to customers (Raesfeld & Roos, 2008).

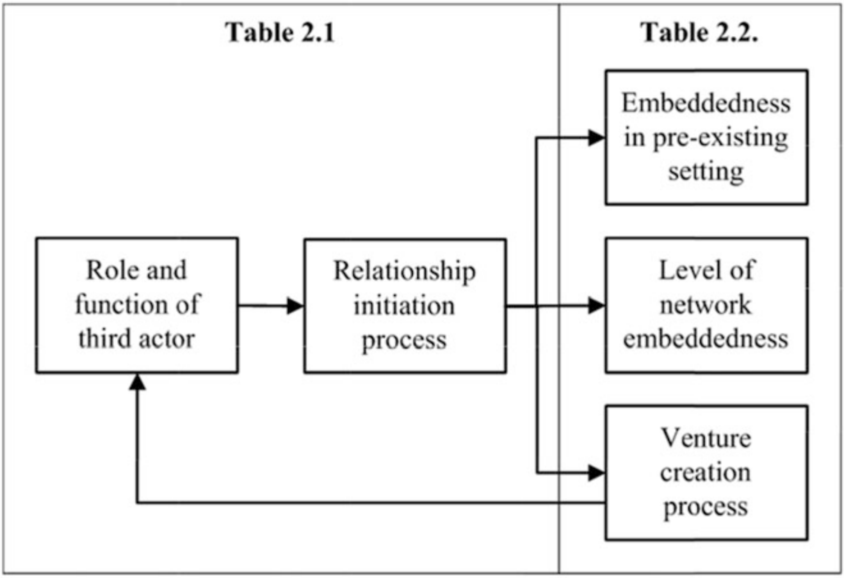

Fig. 2.4 Overview of key findings

2.6 Conclusion

The first conclusion that can be drawn from this case is that the start up relied heavily on well-embedded partners with which it had a strong relationship and which functioned as a *tertius iungens*. This type of third actor joined the start up with potential partners with the resources and activities necessary to advance its product development. However, the relationships with well-embedded partners do not have to result in new ones because they do not always have the necessary skills or the motivation to perform the roles and functions of a third actor. This implies that start ups should aim to closely connect not only with well-embedded partners but partners with the necessary abilities and interests. However, how start ups may select capable partners and motivate them to become involved in the relationship initiation process has so far remained under-explored. Therefore, two questions for future research are (1) how can start ups select well-embedded partners that have the skills to act as a third actor throughout the relationship initiation process? and (2) how can they motivate these partners to perform their role as third actors for a start up?

Secondly, the case shows that a third actor does not necessarily have to form a triad with the start up and a potential partner to facilitate the initiation of the relationship. This has important implications for future studies aiming to investigate the role of third actors in the relationship initiation process. To gain a complete understanding of the third actor's role in this process, both the active and passive positions of third actors should be investigated. If research only looks at third actors with a direct relationship to both sides of the new relationship, it may miss important facilitators of the relationship initiation process. Although it is not necessary for an inter-organisational triad to form, the embeddedness of the start up in the pre-existing network is higher when a triad is formed, especially when the importance of the third actor increases during the remainder of the relationship. Thus, a start up can increase its embedding in the developing, producing and using setting by forming a triad with the potential partner and the third actor. The case shows that third actors are willing to form a triad when there is a close dependency between the three actors and a strong tie with the start up and the third actor. Therefore, a start up may stimulate the formation of a triad by (1) attempting to increase the dependency between the three potential partners and (2) trying to develop an intense, durable and frequent relationship with the third actor.

Thirdly, the case shows that the venture creation process is both affected by and affects the third actor's initiation of relationships. Third actors clearly facilitated the start up's business development. However, they also performed a joining function just because the start up was in the opportunity creation phase. This may imply that different third actors may become involved according to the stage of the start up's development. Accordingly, a start up does have to select and motivate different types of partners depending on the stage of its venture creation. Therefore, it may be interesting to investigate the two questions raised above for each stage of a start up's life cycle. This was not possible within the research reported here, because only the opportunity creation phase of the start up was covered.

In summary, the case presented in this chapter shows that most of the start up's relationships are initiated by a third actor. This makes third actors not only crucial to its network embedding in the developing, using and producing setting but also essential to its venture creation.

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Part II

Relationships Dynamics in New Business Development

3

Starting Up: Relating to a Context in Motion

Antonella La Rocca, Ivan Snehota, and Debbie Harrison

3.1 Introduction

The odds that a start up succeeds are low. The risk of failure during the first three years is estimated at 85 %; statistics show that only a few newly started businesses survive more than a handful of years (Short, McKelvie, Ketchen, & Chandler, 2009). Despite these odds, the number

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of entrepreneurs who want to start their own business continues to grow, and the interest among policy makers and investors remains. Since such unfavourable statistics persist, despite research on entrepreneurship and the support which start ups receive, our understanding and knowledge about the process of establishing and developing a new business venture is apparently rather limited or not fully relevant. Following a certain tradition in new venturing studies (Gartner, 1985), in this chapter we use the notion of 'start up' when we refer to the pre-organizational stage, and that of 'new business venture' when the enterprise acquires the features of an organized activity system (drawing a clear line is of course arbitrary but this is not really central to our purpose in this chapter).

It is common for a start up to be launched in contexts where customers of the would-be new business venture are other businesses and organizations; in other words, in business-to-business markets. Even when a new business venture is focused on individual consumers, it always depends on business-to-business markets on the supply side. Business markets are thus a highly relevant context of new ventures. Research highlights that business markets demonstrate particular features: continuity in customer–supplier relationships, substantive interdependences between businesses and the centrality of interaction processes (Håkansson, Ford, Gadde, Snehota, & Waluszewski, 2009). As such, business markets can be characterized as 'business networks', in which businesses are nodes of business relationships.

Considering the start up from a business networks perspective, if it is to develop into a viable new business venture, it has to be embedded in the existing business network context (Snehota, 2011). Embedding the new business venture implies that it has to develop the initial business relationships to customers and suppliers through which it can access and obtain the resources necessary to sustain its operations (Aaboen, Dubois, & Lind, 2011). Developing the initial business relationships means connecting various facets of at least two businesses, their resources, activities, and the individual actors involved. Furthermore, the initial relationships only develop if the would-be new business venture has a meaning and role for others in the network (Håkansson & Snehota, 1989). As the start up develops these initial business relationships, it becomes a 'node' in a business network (cf. Gadde & Mattsson, 1987; La Rocca & Perna, 2014; La Rocca & Snehota, 2014; Mattsson, 1989). Becoming a node is difficult, not only because of the complexity of developing the connections and the need to acquiring a meaning but also because this has to be done in a context characterized by ambiguity among the actors and which is continuously changing.

In this chapter, we will approach 'starting up' as a process of embedding the would-be new business venture in a relevant business network. We focus on the processes underlying the formation of the initial relationships (Aaboen et al., 2011; La Rocca, Ford, & Snehota, 2013) and frame the embedding issue as one of 'relating to a context in motion'. We attempt to identify the criticalities in how a start up develops into an ongoing business enterprise and approach the 'process of relating' as one that underlies the formation of business relationships. We will argue that 'relating' requires connecting resources, activities and thought worlds of some of the actors in the relevant business network and coping with the resulting interdependences. The 'process of relating' is conditional on acquiring a face and meaning for relational counterparts in a single business relationship, but also on acquiring a position and identity in the relevant business network (cf. Håkansson & Snehota, 1989).

The chapter proceeds in six sections. In Sect. 3.2, we discuss how the characteristics of the business network affect the process of turning the start up into an embedded node in a business network. In the next section, we discuss the notion of relating as the process of mutual construction of meanings among the actors. Then, in Sect. 3.4 we examine the 'in motion' in networks and the process of relating to a 'context in motion'. We discuss the meaning of position and status for new ventures in business networks in Sect. 3.5. In Sect. 3.6 we report a case of a start up in the advertising industry. The case exemplifies the key issues in the embedding process of a start up. Lastly, in Sect. 3.7 we present our conclusions and suggest some implications.

3.2 Developing a New Venture in a Business Network Context

How a problem is framed has implications for acting, as the framing reflects one's assumptions about the working of things (e.g. Reger & Palmer, 1996; Tolman, 1952). This consideration is highly relevant in the context of a start up, because it is common, in particular within academic circles, to assume that start ups face a level (market) playing field. That is, a 'market playing field' populated by knowledgeable, informed, autonomous and focused business actors that are fully attentive to all the new opportunities and solutions they can benefit from. Knowledgeable customers identify those who offer the best deals (products, services, prices) and then carry out the transaction, therefore getting what they want. Framing the start up situation based on these assumptions brings to the fore the technological content of the product/service proposed, along with the cost of the offering to the potential users, as the key factors that will determine the success of a would-be new business venture.

Past and current research on business markets, in particular studies within the Industrial Marketing and Purchasing (IMP) research tradition (e.g. Håkansson et al., 2009), has shown that such assumptions do not hold for business markets, in which the customers are businesses and other organizations. An extensive body of research has highlighted several features of business markets that directly contrast the above assumptions. These features, which we briefly review in the following paragraphs, are argued to have considerable bearing on what is critical in converting a start up into a new business venture.

First, businesses tend to conduct most of their activity within continuous complex and interactive buyer–seller relationships (Håkansson & Snehota, 1995). There are various reasons for the continuity of customer–supplier relationships. The most obvious is that in order to sustain ongoing operations, customer organizations require continuous supplies of various resources. When purchasing, they do not 'go shopping'; rather, they are securing the supplies necessary for their businesses. When a company commits to 'do business' with a certain counterpart on a continuous basis, they stabilize to some extent the context in which they operate. Since businesses act on only partial knowledge and face considerable uncertainties that cannot be resolved (e.g. Knight, 1922), stabilizing the context is beneficial both for planning future operations and for protecting the necessary investments.

However, this apparent stability of the ongoing does not mean that the business relationship has stable content or is unchanging. It is more accurate to say that long-lasting customer–supplier relationships are continuous while the content and various solutions within a particular relationship are continuously changing. Such changes take place for various reasons and are to be expected. For example, the features of the products, logistical and administrative solutions are continuously adjusted for reasons internal to the two organizations involved but also external to their relationship, with triggers from other parties (Hallén, Johanson, & Seyed-Mohamed, 1991). Whatever the origin, problems and opportunities arising between the parties must be addressed and solutions must be found if the relationship is to continue.

Striving for relatively stabilized (not stable) relationships thus involves ongoing development of new solutions and the consequent changes and adjustments just to keep the relationships operational. Typically, solutions to the problems or challenges arising within the relationship are not available 'off the shelf'. Instead, they need to be conceived, developed and implemented within the ongoing relational interaction. Applying new solutions obviously involves both the supplier and the customer, but also this development and the necessary adaptations tends to be undertaken jointly (Brennan & Turnbull, 1999). Neither the form nor the content of a business relationship between the customer and supplier is unilaterally defined. The development and deployment of new solutions require extensive interaction between those involved. Interaction is needed both to create the solutions and to cope with the consequences. Extensive interaction in customer–supplier relationships is the second distinctive feature of business markets.

The interaction processes of devising and implementing relational solutions require adaptations, large or small, in both the supplier and the customer sides. Because interaction is both demanding and costly, companies in business-to-business markets tend to do business with only a limited number of customers and suppliers that are of central importance for the economic performance and development of the firm (Håkansson & Snehota, 1995). The key customers and suppliers typically represent a significant volume of business for an organization.

The adaptations in resources, activities and behaviours of actors made when searching for workable solutions in a relationship lead to the creation of specific interdependences between the two organizations. These adaptations also affect the other relationships in which both supplier and customer are a part. Furthermore, the key business relationships of a company are not of the same kind; that is, they are not homogeneous. Instead, they are always an assortment of complementary relationships linked to the nature of operations being carried out. This means that there are interdependences not only between the two organizations in a relationship but also between the relationships the two partners are involved in. Such interdependences underpin the third characteristic of business markets; the relatively limited number of important complementary business partners and the emerging interdependences between different relationships confer to business markets the features of a network structure.

The idea of the market as a network-like structure implies that every business firm stands as a node in a set of complementary and interdependent business relationships (Easton & Araujo, 1989; Easton & Lundgren, 1992). This perspective on the context of the start up firm as a relatively tightly connected business network with few suitable potential suppliers and customers has consequences for how we frame the critical processes in starting up a new business venture. Such a perspective suggests that developing a new business venture is akin to creating a new node in the relevant existing business network. Creating a new node implies developing business relationships with a certain number of different existing business entities. The process of developing and handling business relationships is therefore critical in new venture development. In this chapter, we refer to developing and handling business relationships as the process of 'relating' (Håkansson & Snehota, 2006) which stands out as the central process with which the start up has to cope.

The existence of continuous business relationships, ubiquitous interaction processes and interdependent network structures means that business networks have particular dynamics that have considerable bearing on the process of a start up becoming a new business venture. Contrary to the basic assumption in traditional economics, the single discrete transactions lose their importance for linking buyers and sellers. Other factors will determine who will be doing business with whom. Expected future performance in various aspects appears to be the main rationale for relating with other businesses. Time matters as such expectations are based on direct and indirect past experience (Mattson, 1989).

There is continuity in the sense that the individual positions of the single businesses are always a result of past interactions (which is true even for the newcomers) and the current network positions are a base for a future development (ibid.). However, in spite of the continuity in relationships between customers and suppliers, business networks change rather rapidly. The profound changes in industries such as computing, cellular phones, cars, banks, steel production or shipping over the past decades evidence this. Business networks are always 'in motion' because existing relationships are continuously modified, some cease to exist and new relationships keep emerging.

3.3 Relating When Developing the Initial Relationships

To develop a new business relationship is anything but simple. The network view of the start up context implies that there are no 'free-floating' business partners eagerly awaiting a newcomer. At any given moment, the businesses in the network operate and perform by making use of the existing relationships and existing solutions. A newcomer has to be 'admitted' into the business network. Developing new relationships involves two aspects: it requires on the one hand connecting activities and resources of different businesses, and on the other hand, the newcomer has to acquire a meaning for the other actors within the network that are likely to benefit or suffer as new relationships develop.

The content of business relationships tends to be rather complex because constructing a new business relationship typically requires developing solutions for how to connect two businesses which in turn entails interfacing their resources, configuring their activities and linking various actors in the two organizations. Ongoing business relationships build on mutual experience and a considerable amount of experiential knowledge. Such knowledge is absent in the case of would-be new business ventures. Therefore, developing the initial relationships of a start up is partly different from developing and coping with business relationships in an ongoing business.

Establishing the initial relationships for the would-be new business venture has elements of innovation, as it means to put into being solutions that are novel, and in some sense 'better', for those involved. New business venturing is entwined with innovation as the new entity means new business relationships and that involves new solutions. The new solutions are always novel resource combinations, and combining different resource elements into a new solution tends to be onerous because it requires creating workable interfaces among various resource elements (Baraldi, 2003).

Establishing a new business relationship also requires that the activities undertaken by the new business venture are interlinked and configured with the broader network activity pattern. Reconfiguring the existing activity links typically involves extensive interaction to handle interdependencies in activity patterns internal and external to a business (Araujo, Dubois, & Gadde, 2003; Dubois, 1998). Introducing new solutions requires a series of mutual adaptations of resources used, of activities undertaken and of actors involved in the relationship (Gadde, Hjelmgren, & Skarp, 2012; La Rocca & Snehota, 2014; Tuli, Kohli, & Bharadwaj, 2007). It also entails confronting different business logics and thought worlds (Håkansson & Waluszewski, 2007).

The problem in developing business relationships and thereby entering a pre-existing network is that it is only partly in the hand of the newcomer; some others have to 'admit' the newcomer. In order to be 'allowed in' to an existing network, the would-be new business venture has to acquire a 'face' (Axelsson, 1992). In other words, it has to become an entity with an identity, and it has to acquire a meaning for at least some of the incumbents in the business network. In principle, developing new relationships is conditional on the acceptance by the incumbents, which have to accommodate the new entity and adapt to it becoming part of the network. It is therefore not a one-sided affair. A new entrant will be 'admitted' depending on whether it is perceived to solve the problems of some of the incumbents, or to benefit them in some way, for example, by positively affecting their assets (existing resource–activity–actor connections).

The combining and interfacing of resources, connecting and reconfiguring of activities, and confronting and integrating logics and interpretations of actors in a business relationship is a mutual process. It cannot be achieved unilaterally. Given the complexity of the solutions required for a workable business relationship, these are never fully known in advance. There is no way to make a blueprint of the arrangements required. Because of this uncertainty and need to involve others, the only way a relationship can be developed is through 'enacting' this via interaction among the parties (Read, Dew, Sarasvathy, Song, & Wiltbank, 2009).

The need to enact the solution (rather than to design it and implement it unilaterally) makes the arrangements in any major business relationship fluid, which is evident from the continuous adjustments brought to any business relationship (Hallén et al., 1991). Enactment is mutual, which makes it necessary to proceed by trial and error and experimenting with alternative solutions. As we argued earlier, considerable efforts are needed to adjust and change the arrangements to keep the relationship 'working'. Somewhat paradoxically, the development of relationships is never over, it is never accomplished.

The need to devise new solutions and to acquire meaning makes interacting into the critical process in the development of the initial business relationships of the would-be new business venture. Extensive interaction is required to turn a new solution idea (often technological) into an effective solution in a business relationship, because it can never be fully anticipated what it takes to graft a new business relationship on the preexisting context (Onyemah, Rivera Pesquera, & Ali, 2013). The adaptations necessary can only be carried out as actors confront each other and conform, concede or impose on others (Håkansson & Ford, 2002). Interaction in business relationships is much more than communication. It encompasses the cognitive elaboration, learning and teaching, and mutual construction of meanings that directs interaction behaviours. The new venture has to become intelligible to the relevant incumbents and this, in turn, requires mutually constructing new meanings between actors (Baron & Ward, 2004; Cornelissen & Clarke, 2010) and acquiring an identity (Kragh & Houman Andersen, 2009).

In sum, we have now 'set the scene' for what is involved in developing the initial business relationship of the would-be new business venture. Developing the initial relationships requires that a start up acquires 'a face' and identity both in relation to single partners and in the network in general. It also requires the new entity to produce, jointly with partners, workable solutions within a relationship, but also across different relationships.

3.4 Relating to the Network in Motion

We have now established that any would-be business venture needs to connect to the activities being performed by network incumbents. This requires the new entity to simultaneously develop several business relationships to different parties—customers, suppliers and various other stakeholders, while taking into account interdependences among these various relationships.

The 'process of relating' thus has two levels; the single relationship and the network level. On the relationship level, as we argued earlier, no business relationship is ever fully 'developed' and accomplished. Business relationships can be temporarily stabilized but an equilibrium state is not conceivable. Business relationships are all the time exposed to demands for change that come from within the relationship (e.g. striving to improve) or follow changes in the network context of that specific relationship. Business relationships and networks can be mature but they are never 'finished'—they are always within 'processes of becoming apparent' (Tsoukas & Chia, 2002).

If a start up is to become a viable new business venture, it has to develop an assortment of new business relationships. This assorted set of relationships to customers, suppliers and other stakeholders is an integral part of the new business venture as businesses are defined by their relationships. Moreover, when a new node has been interacted/embedded within the existing network, that network does not maintain the same configuration; it has changed. Successful new business venturing therefore brings about change to the business network. The process of relating for the would-be new business venture is about coping with change, but at the same time it produces change. While the new business is a product of its business relationships, it is also an active partner in shaping the form of the network.

Relating is thereby an organizing force at the network level. It shapes the structuring of the network, but it is also disruptive because 'as soon as two companies adapt in relation to each other by changing a product, a process or an organizational routine then the effects are distributed to other related solutions of other producers, users and complementary firms' (Håkansson et al., 2009, pp. 19–20). New business venture development fuels thus change in business networks as it involves the co-evolution of businesses and business solutions (Håkansson & Waluszewski, 2002) in a network that is always changing—'in a perpetual motion'.

While the network position concept can evoke stability and endurance, it is a rather inaccurate impression. The need for continuous adjustment within existing relationships and development of new relationships drives the changes in the business network and fuels its 'motion'. What characterizes business networks is an absence of equilibria. The network positions of the single individual businesses are interdependent and acting of the individual businesses and the mutual adjustments keep the network 'in motion'. Coping with motion is demanding but at the same time it is important to acknowledge that this motion in the business network opens for new entrants and permits development of new nodes (cf. Johanson & Mattson, 1992).

The motion in the relevant business network applies both to the actual solutions and the content of the relationship, plus the mutually attributed meanings and the face that a new business venture acquires dealing with others. That makes continuous 'relating' to the critical strategic process (Johanson & Vahlne, 2011). Framing the start up process as relating to an existing business network landscape and creating a new node (and hence position) in a business market has consequences for what we identify as the necessary criticalities. Taking a network perspective on the start up process tends to lessen the importance of technology factors and 'superior' offering as conditions for success. Instead, it brings to the fore the importance of the process of relating that unfolds over time—relationship building, solution finding and deployment, teaching and learning through interaction, and coping with change.

Taking the business network perspective implies that the new business venture always exploits and impacts the existing network rather than emerging in isolation as an autonomous entity entering 'from outside'. The new entity is not formed outside the network; instead, it is formed within and is endogenous to it. Several studies of new venturing have emphasized that developing new business ventures amounts to constructing and reshaping market structures (Sarasvathy, Dew, & Ventresca, 2009). Consequently, the new business venture becomes an element of a collective, not least because its development path will reflect how the wider constellations of related businesses evolve (Ciabuschi, Perna, & Snehota, 2012). Since relating is not a one-sided affair but result of joint action, it can never be fully controlled by one party. The relating process is always to some extent collective and implies that a start up has limited autonomy (as do the other businesses operating in such a network context).

3.5 Why Network Position Matters

We established above that for a start up to become a node requires it to be embedded as a new venture in the business network context. Such embeddedness is not to be understood in some general sense. Mattsson (1989) makes a distinction between micro and macro network positions, though these are interrelated. The development of a macro-position may involve an actor attempting to increase the number of customers or to outsource some activities to new suppliers. The development of micro-positions is about the development of a single relationship and how this occurs over time.

The network position of a business is therefore a composite set of 'micro-positions' in relationships to single specific partners who hold different pictures of the focal business. Adding up the 'micro-positions' is not straight forward as the micro-positions vis-à-vis its business partners can be very different and any actor's pictures of the focal business tend to be unique. The overall macro-position of a business in a business network is therefore characterized by a combination of heterogeneous micro-positions. Micro-positions mutually perceived by the counterparts are the platform for mutual interaction behaviours (La Rocca & Snehota, 2016).

There are two main reasons why a network position matters. One reason is that the position is related to the resources that a business can make use of (Mattson, 1989). The position that a business has developed within the network consists of a specific set of relationships to customers, suppliers and other parties; this set of relationships determines which resources and competences of others the business can mobilize, access and make use. Second, the position acquired by a single business in the network implies a particular horizon and visibility, and is important for the perceptions and interpretations of possibilities and liabilities that the business faces (Holmen & Pedersen, 2003).

The position that a start up is likely to acquire in a business network depends on the effects of the new business venture on the existing network as perceived and anticipated by the various actors involved. The impact of the new business venture is not neutral; any emergent venture will affect the assets of some actors positively and of some other actors negatively. Whether and how the new entity will be admitted to the existing network depends on the balance of the effects it has throughout the relevant network (Ingemansson & Waluszewski, 2009; Snehota, 2011).

It could be appropriate to use a concept of *status* rather than position to capture how others perceive a business (La Rocca & Snehota, 2016). Since partners in business relationship are mostly concerned with what the counterpart business can do for them, the judgment of a counterpart always has a dimension of 'future potential'. The concept of perceived and attributed status tends to be associated with potential future action more than the concept of position (Jensen, Kim, & Kim, 2011). Moreover, status is related to the issues of concern and preferences of the counterparts. A new venture faces the problem of acquiring a local status in the single relationships and an overall status in the existing network. The network status of a business is important because the economic and financial outcomes of that business and its development possibilities and potential depend on it.

In a business network in motion, the positions of all firms are subject to continuous evolution, and the would-be new business venture is no exception here. This implies that acquiring a position is not a one-off event, but rather a process continuously built on past and present achievements. The position that a single business acquires in the business network is a valuable asset but also a liability. It represents the base on which the future development of a business rests; it enables certain development paths and inhibits other paths (Mattson, 1989). Relating to a network in motion, creating specific connections and identities in the single relationships, produces uniqueness of business positions which is a distinctive feature of business networks. As a consequence, a business network is always an evolving set of unique positions and relationships without any conceivable state of equilibrium.

3.6 The Story of C&L: A Start up Acquiring a Position in a Network in Motion[1]

In order to illustrate the process of relating of the new venture in becoming a node in the relevant business network, we report here a story of C&L, an Italian start up in advertising industry that has been relatively successful in acquiring a position in a context in motion. The case is based on repeated interviews with key informants in the advertising industry, a series of in depth semi-structured interviews with the managers/founders of the C&L, and secondary material (industry reports, press articles). The case has 'revelatory' potential (Coviello & Joseph, 2012) in relation to our topic of developing the initial business relationships of a start up in order to become a fully fledged new business venture.

3.6.1 Advertising Industry in Motion

The advertising industry has undergone profound changes over the last decade. Technologies have changed and has the structure of the industry as a consequence of the diffusion of social and digital technologies, but also of the financial crisis of 2008. The use of new digital media (apps, wikis, blogs, social networks, online video and many others) has fundamentally changed communication patterns in media business. As in most countries in continental Europe, the digital media spend in Italy is growing and has reached 25–30 % of the total in 2014. The traditional media—TV, radio, newspapers, and magazines—have been challenged in their role in spreading news and advertising.

[1] An earlier version of this case has been presented in a paper for the 30th IMP Conference in Bordeaux 2014 co-authored by the first and second author (Cfr. Højbjerg Clarke, Freytag, La Rocca, & Snehota, 2014).

New media development is technology enabled and driven foremost by large advertisers, in particular the large global corporations. New technology platforms for communication keep emerging and challenge many established firms which find it difficult to decide what media to apply and how to orchestrate the content of the new media. The content of the new media is created by the use of the individual actor and information spreads faster than with many old media types. Seen as a communication channel, the 'old media' were more controllable by publishers and firms than the new media, because a considerable amount of communication on the Internet is generated by the users.

A few figures from Aegis Media Global Advertising Expenditure Report (Aegis Media, 2013) illustrate the trends and the pressure on the agency businesses. Between 2008 and 2014, the total media spending in Italy decreased by about 15–20 %. TV, press and digital media in 2013 accounted for 85–90 % of the overall media spending. While TV share of the total changed slightly from 52 % to 51 % between 2009 and 2013, there has been a dramatic fall in the share of press media (newspapers and periodicals) from 25 % to 16 % and the spending on digital media more than doubled, growing from 10 % to 23 %.

These figures, however, only hint other deep changes within each media in the advertising formats and technologies in use. The market is in motion: there have been notable changes in the top advertisers as new client sectors (e.g. banking, tourism services and non-profit institutions) keep emerging and others withered away even if more systematic data on that are not available on aggregated level. Increases or decreases in advertising spending of a certain client sector (e.g. transport, banking, etc.) on a year-on-year basis in order of 15–20 % is not exceptional.

New media has become the new means of communication and understanding how the new media works and the ability to integrate these in companies' communication efforts has become essential.

Since the new media communication seems to build on a much more interactive logic than the traditional media, many existing agencies have found it difficult to handle. So the new logics of communication pose a number of challenges both for companies in communicating with their customers and for advertising agencies in providing services to such companies—their customers. Most industry actors (customers, agencies and media companies) share the view that the new media will bring about new communication patterns but are uncertain about how the industry will look in five years.

The content of communication campaigns has been traditionally created in a dialogue between agency and customer, with the aim to deliver a certain message for a particular audience, and then delivered through a number of different media mostly suggested by media agencies. In reality the target audience has never 'just received the message', and always attached a particular meaning to a message, but in the traditional media setting the audience had more limited possibilities to argue and discuss a certain message. With the new media, this has changed, as, at least in principle, the receiver of information has also become a creator of information and different 'target audiences' (and other actors) can at any time discuss among themselves the content of any messages and campaigns. On the whole, advertising becomes thus much more a dialogue where no one is in full control of the communication process.

Changes in communication patterns bring up the question of how the main players adapt to the changing business network and relationships in the industry. Agencies and the related businesses (PR agencies, media agencies, and design and graphics production) are all struggling to cope with the motion in their business networks. Numerous newcomers in the industry, in particular specialized 'online' agencies offering services and competences of the new 'digital media' and some unlikely actors, like Google or Microsoft, are actually becoming media companies.

There has also been a wave of mergers and acquisitions, largely generated by traditional agencies that have been buying some of the emerging new media agencies in order to acquire 'digital competences'. Numerous acquisitions have been made in reaction to large fast-moving consumer goods companies pioneering the use of digital media in their marketing and looking for new media competences among the agencies. The industry is in motion as new media technologies, emerging new players and the wave of acquisitions are profoundly changing business networks of the industry. Against this background, we will examine how a start up is building up its position in this network in motion.

3.6.2 C&L

C&L is a small agency with eight employees which has operated as an independent company in Milan since the beginning of 2013. It doubled in turnover and size in 2014. The two founders expect considerable growth in the years to come, even though both founders are convinced that it is wise not to forecast what will happen but to act on emerging opportunities. While C&L is a legal entity only since the beginning of 2013, its origins go back to 2010 when two Master graduates started working as an independent unit within a mid-sized traditional advertising agency in central Italy—AdAg with staff of 30. Working mainly for mid-sized traditional industrial and commercial businesses with rather limited communication and advertising budgets, AdAg contracted the two future founders to become able to offer their traditional customers some basic 'digital competences'. AdAg agreed that what would later become the C&L could start as a team (the two founders plus a couple of employees and occasional freelance as sub-suppliers) offering consulting services on digital communication solutions to some of the AdAg clients.

Despite the initial enthusiasm, the 'digital communication' team in the AdAg did not work well and various tensions led the two founders to negotiate a management buy-out in January 2013. One of the problems was that the AdAg customers mostly asked for assistance in planning and executing traditional offline campaigns and the online solutions have been perceived in AdAg as interesting, but only as an add-on in traditional marketing communication campaigns. When the online solutions were successfully accepted by some of the clients it caused resentments among the AdAg staff because it meant re-allocating the customer spend from the traditional offline to the new online solutions and was perceived as cannibalizing the existing revenues. Apart from contracting the C&L for the online solutions AdAg had no interest to make significant investments to develop the digital online business.

The two future C&L founders were not particularly keen to be perceived as 'suppliers of online solutions' having developed a conviction, not shared within AdAg, that the main need of clients was support in how to design their communication strategies using and integrating both traditional and new media and solutions. The need for a new approach to market communication strategies integrating the mix of traditional and emerging media led to the management buyout and the foundation of the C&L at the beginning of 2013.

After becoming independent, C&L started to work on developing the profile of ‘contemporary communication strategy consulting’. While competent on digital media, the new venture has consciously tried to avoid being linked to and dependent on some of the digital competences requested, reflecting the conviction (and evidence) that many of the specialized digital agencies (web design, blogging, etc.) had a rather short life cycle as numerous new agencies emerged in this field. Rather than offering specific competences for online solutions, the C&L presented itself as ‘management consultants that understand communication issues’ who, when needed, would enlist a pool of specific competencies available in the industry on various communication technologies, including the online media. Literally hundreds of such companies exist in Milan area where C&L is based.

The strategic orientation of C&L is based on the founders’ conviction that most business clients today understand that there is potential in the new media for their business but have only limited understanding of the deployment of different digital solutions and look for advice on this. At the same time, several clients have acquired, or developed in-house, some of the basic digital communication competences (e.g. blogging, web design, etc.). C&L founders also believe that several larger client companies experience difficulties in working with the large traditional advertising or media agencies that, because of their specialized competences, have limited understanding of the business fundamentals of the client companies and seldom offer integrated solutions that fit the client’s business.

C&L perceives the potential clients in the industry falling in three segments: the first consists of clients competent and knowledgeable about the market communication process and requirements. These tend to have the competence to develop communication strategies and campaigns, and it is often the marketing department that defines what services to buy and the suitable suppliers. Such clients know what they want (or believe to know) and are willing and able to shop among the service suppliers to satisfy the need of specific competences (design, web design, graphics, media planning, etc.). They tend to enlist suppliers for specific campaigns and with time-limited project mandates. Large, fast-moving branded consumer goods companies are prime customers of this kind.

The second segment consists of companies that are less confident in their capabilities to manage market communication strategically and have only limited understanding of both new and old media. A typical client in this category is a mid-sized industrial or commercial business. These vary in their perception of need to strengthen marketing communication, but tend to be aware of the potential of the digital media. The main influencer and actual buyer of advertising consultancy and services in these companies tend to be the general management, often top management and owners, assisted by various functions within the companies that can be sales, marketing or else.

The third segment, which is growing fast, consists of different companies and institutions that perceive the potential of digital communication solutions not only in market communication but also internally in various parts of their business. These clients are looking for both competent counterparts whom to engage in ‘co-development’ of various communication solutions (both internal and external communication) and also specialized service providers. The buying in these companies is mainly done by the general management but is typically initiated, guided and assisted by different functions, for example, IT, HR, sales or finance.

C&L has been working mainly with clients in the second and third segments. It has a portfolio of 30–40 customers, most of which are on a single project basis. Three major customers represent about 80 % of the turnover, and C&L works with these more or less continuously. In all three relationships, C&L not only acts as strategic communication consultant but also as ‘general contractor’ for services required to ‘organize and execute’ strategic communication projects. C&L is actively trying to develop another dozen of such customers. Developing a continuous business with a client has a lead time of up to 12 months also because in the client organization such decisions tend to follow yearly planning (and budgeting) cycle.

Even though the three main clients are rather different—a medium-sized bank, a large non-profit organization and a financial services company, the development of the business relationships has followed a similar pattern. All three clients had a substantial budget for internal and external communication activities and issued request for quotation on minor communication projects of no more than some 20–30,000 euro (e.g. outlining a social media strategy, designing an internal communication platform). These requests for quotation were brought to the knowledge of C&L through their social network.

Once acquired, such projects were used by C&L to present themselves as communication consultants with strategic business perspective, focusing on business consequences of the communication solutions. In one case, C&L even advised the client not to go ahead with the initiative the client was about to undertake! C&L has in these relationships acquired the image of a competent strategy consultant (proud when one of the clients called them 'little McKinsey') knowledgeable about digital communication. Having gained the credibility through the initial project, C&L was asked to continue to assist the client with development of other internal and external communication projects of varying size and complexity. Several of these follow-up projects entail service delivery and executing parts of the projects. Half a dozen of such projects (of the duration of 6–12 months) are ongoing for the three clients. C&L estimates that about half of the business with the three customers is consulting and another half is delivery of different services.

For service delivery, but also to some extent for consulting, C&L works with about 15 partners that range from freelance to mid-sized agencies offering various on and offline services that embrace all kind of specializations not only digital (can be event management, point of sales design, etc.). In a relationship to one of the major clients, C&L has the role of coordinating a pool of these partners as co-suppliers because the client organization has capacity and competences to supervise the execution of projects. In the relationships with the other two clients who have less capacity to monitor and coordinate the projects, C&L acts as general contractor supervising and coordinating a pool of partners as 'sub-suppliers'. In these cases, the sub-suppliers account for around 60 % of the project value. This networked way of operating is facilitated by the high-density of different advertising and communication related businesses in the Milan area.

The initial projects with the key clients have been about minor external communication campaigns but then branched into different communication projects. In two client organizations, C&L is engaged in rather complex restructuring of client's business model and organization (e.g. the project with the bank client is related to change from banking through territorial agencies to e-banking; the project for the non-profit organization client is related to promoting creation of a partner network). C&L is convinced that relying on external partners facilitates the focus on client business. The absence of own structure permits to avoid the pressure to saturate own resources and means being more flexible to follow the actual needs of the client organization.

C&L is consciously pursuing the strategy of acquiring customers one by one to grow the related business. The remaining 20 % of the turnover are today (2015) generated from about two dozen relatively small, short-time projects, typically assisting and supporting time-limited market communication campaigns. C&L considers these as spear-heads for future major customer relationships (continuous contracts). The founders see the acquisition cycle as relatively long and gradual process but are confident to have no less than 30 sales leads with high probability of landing a substantial contract. Some of these are with foreign companies and the ambition of the company is to work internationally. In the judgement of the founders more than a third of their time (and attention) today is investments to develop future customer relationships while less than two-thirds are on 'delivery on current projects'. On the whole, C&L is convinced that the ongoing changes in the advertising and communication services industry at large means that various new opportunities can be pursued.

3.7 Conclusion: Coping with Motion

In this chapter, we have argued that turning a start up into a viable new business venture in a business network context means to acquire a position in an existing business network in continuous motion, and thus to develop relationships with a few key actors. We also stressed that developing a would-be new business venture is demanding because the context is continuously changing and developing the new business venture means also that the existing network will change.

We identified two processes as critical for a start up when developing the initial business relationships and the C&L case nicely illustrates both. The first process is acquiring a face and identity—becoming a node in the business network that some incumbents can interpret and make sense of. Developing a new relationship requires becoming intelligible to the counterpart so that a counterpart can form some expectations—regardless of how vague or well founded these might be. In the case, the C&L partners appear very aware of the need to 'acquire a face' when approaching a customer. They try to avoid to be perceived as purely digital communication experts with technical competences; instead, they make huge efforts to be seen as 'business consultants'.

The second critical process is developing solutions for the clients which involves connecting resources, activities and actors of the supplier and customer organizations. Developing a business relationship is contingent on connecting two businesses with complementarities (existing or potential) in their operations and in the resources, activities and individual actors on which the operations depend. This requires that a number of different arrangements have to be put in place, and maintained to adjust these to changes required. In C&L (service business), these arrangements become manifest in arrangements to integrate a set of different skills and resources of sub-suppliers and partners in carrying out projects for C&L customers.

Motion in the relevant network of the advertising industry is making things difficult, especially for incumbents, but it also opens opportunities, in particular for newcomers like C&L. Motion is at the origin of customers' need for new solutions. At the same time, changes in the industry produced a number of specialized newcomers that C&L can mobilize to offer novel solutions.

New ventures have several important features that distinguish them from established firms. Two obvious features that are always associated with a new business venture are fewer resources and less structure (Ambos & Birkinshaw, 2010). Developing initial relationships is costly and requires considerable effort on the part of 'management' of the new business venture that is often not yet formalized.

Furthermore, the development of the initial relationships has to be done in parallel with the development of the technological and organizational solutions that make it possible to 'produce' the offering of the would-be new business venture. Both relationship management, and also the development of the technological system, and organizing internally the new venture take time and require considerable efforts. Indeed, in the C&L case, heavy investments are made in relating. The founders estimated that they dedicate no less than one-third of their time (attention and efforts) to developing new customer relationships, but also their efforts to mobilize the partner and supplier network can be seen as investments in relating.

We emphasized that 'relating' requires more than developing a new and 'better' offering. Of course, technology is important for a start up and the venture-in-progress, but relating is more than that. It is about expectations of mutual benefits and mutual conditioning that can have positive or negative consequences for the parties involved. Mutual expectations of benefits, and the perception of the costs involved, depend on how the parties can make sense of each other and of the actual arrangements put in place between the two organizations. In business networks, the 'business' aspect of relating is dominant and is largely about the short- and longer-term economic and monetary consequences of the relationship.

For C&L, the 'online media competence' is not a core technology or competence of the new venture. Rather, the core skill and competence are understanding communication processes (digital and non-digital) in business. Indeed, the development of customer relationships (but also of the supplier relationships) depends on customers' (suppliers') expectations of positive effects on their respective businesses; effective relationship development is about business consequences and not simply about the features of products and services offered by the new venture.

In the C&L case, the customer pull is not about technologies but about economically convenient communication solutions that may and may not use the new technology. More than 100 years ago, Veblen (1904) in his 'Theory of business enterprise' famously argued that 'industry is carried out for the sake of business and not conversely.' This appears clearly relevant to starting up a new business venture like C&L, intent on coordinating and integrating various competences in communication projects to help clients with their businesses.

We have been stressing the need to acquire a face and identity if the new venture is to be admitted and co-opted as a trusted and reliable business partner. The need to be intelligible for the relationship partners requires attention to the construction of meaning and communication processes (La Rocca, Snehota, & Trabattoni, 2015). Since the successful development of relationships depends on actual behaviours in interaction and reflects the mutually attributed associations between parties, communication processes and in particular the narratives emerging among the actors in business networks play an important role for new venture development (La Rocca, 2011). C&L founders are attentive to crafting the narrative in relation to customers, building up an image of 'business competence' rather than of specialist competence in IT-based communication. They also put a lot of care to being intelligible to the partners they work with on the supply side. Word-of-mouth, reputation and references are particularly important for acquiring a meaning for new ventures that have few 'history' elements to build on.

The task to develop new business relationships strains both the resources available and the capacity of attending to various issues in organizing. Relative scarcity of resources and limited managerial capacity has an important implication (cf. Penrose, 1959); there is a need to balance the investments of resources and management efforts in R&D and in commercial relationship development. In the early phases of development of a new venture, the problem of allocating the limited resources and management capacity is further compounded by the need to develop several new business relationships in parallel—customers, suppliers, other business partners.

Relating to a 'context in motion' implies the need to invest in developing the initial relationships but also need for more or less continuous and costly maintenance. The lack of continuous maintenance of relationships can put at risk the value of the investments made in relating. That strains the limited managerial resources of the would-be new business venture. This predicament has no evident solution, except for mobilizing and making use of the resources and managerial capacity of (the relational) partners as much as possible. A common mistake in new business venture creation is to allocate more attention and resources to technology-related issues and less to relating (Onyemah et al., 2013). Awareness of this dilemma can help to balance the allocation of efforts and resources available between the different uses. C&L appears clearly aware of the problem to strike a right balance between investments in developing new relationships and technical competence development.

Coping with motion in the business network implies more or less continuously adapting the solutions on which relationships are constructed. Continuity in interaction and commitment to relentless development and maintenance of the initial relationships is critical as the new business venture develops. Failure to acknowledge the need for, more or less continuous, adaptations in business relationships over time, leads to underestimating the resources and capacity needed, and can put at risk the very survival of the new business venture. At the same time, relationships that at one point in time have been beneficial for development within the network can become a straightjacket that burdens the further development of the business in a network in motion. It can also mean, however, that problematic relationships may become valuable assets. Mindful monitoring and maintenance of the network and keeping the horizon of the new venture broad is likely to benefit the start up's development. Like every new venture, C&L's story is too short to tell how it will address the consequences of motion in the network. Time will tell. Limited managerial resources and capacity for coping with contingencies of new business ventures can lead to neglect the need to adjust to the motion in the network.

The task of managing the new business venture development is very demanding as both acquiring an identity for partners and constructing the solutions underlying the offering in a changing context require extensive interaction with customers and other constituencies to cope with the uncertainties of the motion. In such a context, identity and solution offerings cannot be blueprinted first and then executed; they can only be enacted in interaction and the logic is one of effectuation (Read et al., 2009; Sarasvathy, 2008). In a business landscape in motion, the critical capacity on which the development of the new business venture depends is the capacity to interact. However, the capacity to interact is not limited to the interaction capacity of the individual entrepreneur or manager of the new venture (Asanuma, 1989). Rather, it is a systemic feature of the new business venture—the capacity of the business as a whole, its resources, activities and individual actors to relate to a context in continuous development. A capacity to relate to the context in motion depends on individual interaction skills but also on organizing, in particular at the boundaries of the new business venture.

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4

When Start Ups Shift Network: Notes on Start Up Journey

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4.1 Introduction

Start ups are often born in some kind of 'hosting' environment such as business and university incubators or science technology parks. For decades, this has been considered an important measure of enhancing academic entrepreneurship (Grimaldi, Kenney, Siegel, & Wright, 2011) and the beginning of

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a start up's journey towards becoming a full-grown business. In this chapter, we aim to examine the challenges that start ups meet when they begin to acquire the shape of a business venture and attempt to develop commercially viable business relationships with customers and suppliers.

While some attention has been paid to the early stage of development of start ups in the Industrial Marketing and Purchasing (IMP) research (Aaboen, Dubois, & Lind, 2011; 2013; Ciabuschi, Perna, & Snehota, 2012; La Rocca & Snehota, 2014) as well as in entrepreneurship research (Elfring & Hulsink, 2003; Fernández-Alles, Camelo-Ordaz, & Franco-Leal, 2015; Perez & Sánchez, 2003), the process of shifting from the early university/incubator/science park environments to a network of business relationships with customers and suppliers has received limited attention. Indeed, early literature on entrepreneurship has been criticized for inadequately dealing with the dynamics of new venturing and for being mostly concerned with identifying the stages of development (Kaulio, 2003). Additionally, Ambos and Birkinshaw (2010) found that literature offers "little insight into the detailed process—the dynamics of constituent elements and the sequences of events—through which new ventures evolve" (p. 1125).

In their first steps in becoming business ventures, start ups meet several obstacles related to 'liability of newness' (Stinchcombe, 1965) or 'liability of smallness' (Freeman, Carroll, & Hannan, 1983). Early on, lack of management skills and access to venture capital have been found a typical difficulty of the new and small businesses (Allen & Rahman, 1985). Other barriers have been identified in the absence of administrative support and operational costs, such as rents and fees for services needed (Bøllingtoft & Ulhøi, 2005), which led to providing public support in these areas through various forms of incubators and the like. Etzkowitz and Leydesdorff (2000) referred to science parks, incubators, and technology transfer offices as 'hybrid organizations', arguing that they can have a more important role in innovation and new business development compared to more 'static' industrial and public laboratories.

Regarding newness, start ups obviously lack visibility and connections to a network of resources; therefore, the inclusion in such institutionalized supportive environments is in itself a benefit, as it enhances credibility of the start up to have potential to become economically sustainable. Unlike older and larger firms, most start ups do not possess a base level of legitimacy, defined as "a social judgment of acceptance, appropriateness, and desirability" that "enables organizations to access other resources needed to survive and grow" (Zimmerman & Zeitz, 2002, p. 114).

In hosting environments, start ups will eventually come to a point where they face the shift from a friendly, often supportive research-intensive environment to a (less friendly) network of business relationships among companies as customers and suppliers in the industry of reference. Thus, they will have to establish business relationships in the new context. Yet, it has recently been observed that "the development of relationships over time and coordination and management of relationships has not been systematically addressed in the university–industry relations literature" (Thune & Gulbrandsen, 2014, p. 978).

In this chapter, we focus on the shift from a phase of a start up to that of a business venture and explore how start ups try to develop new relationships in an attempt to become viable businesses. We will examine the shifting of two technology start ups from the environment in which they are born (universities or like that we will call developing settings) to the network of supplier and customer relationships (to which we refer also as producing and using settings). In doing so, we aim to broaden the debate on technology entrepreneurship, including some particular challenges of the shift from the developing setting to the producing and using settings. These challenges concern the need for focused learning with business partners, letting go of the logic of the developing setting, and coping with the effects of the business network on the fate of the new venture. Our conclusions will be in line with and expanding current entrepreneurship debates regarding opportunity creation, improvisation, effectuation, and networking. Before empirically exploring the shifting process of two start ups born in a Swedish university context, we examine findings of earlier research on the contexts in which a start up has to navigate to become commercially operative.

4.2 Start up and Innovation Journey

Even though research on entrepreneurship and new business venturing is rapidly expanding, the phenomenon of starting up business is still in need of a more systematic theory elaboration. Much of the research refers to technology-based start ups, the phenomenon that we also have in mind in this chapter. Two ideas underlie much of the current research:

one is that new business venturing is entwined with innovation, the second is that start ups go through a journey that gradually brings a start up (an idea of business) to become an economically viable (and successful) business organization.

Studies on innovation in the business network context highlight that innovations, both as a process and outcome, build on the pre-existing network structure and show that numerous practical hurdles and hindrances must be overcome and unpredicted and unpredictable technical, commercial and institutional issues must be solved to put innovation in use (Håkansson & Waluszewski, 2007; Hoholm & Olsen, 2012; Van de Ven, Polley, Garud, & Venkataraman, 1999). Several studies of innovation processes have also shown that much technical development and innovation in general takes place between rather than within companies (e.g., Chesbrough, 2003; Håkansson, 1989; Lechner & Dowling, 2003; von Hippel, 1988). Various accounts of the development of solutions in the business network context have shown that new solutions often arise concurrently with problem and solution identification during interactions and confrontations between the producer and user (Baraldi, 2008; Harrison & Finch, 2009; Johnsen & Ford, 2007). The innovation process in business context does not appear to be linear; rather, it appears to be a recurrent process of trial and error from which workable and satisfying solutions may arise (Ingemansson & Waluszewski, 2009; Tuli, Kohli, & Bharadwaj, 2007). These studies also suggest that innovation is an outcome of joint action, regardless of whether it is intended (Dhanaraj & Parkhe, 2006).

Business relationships are important milieus of innovation because they connect the user and producer, and the new solutions emerge through customer supplier relationships. Novel solutions entail building on and using resources, activities, and actors that exist in the context. Assembling the resources and configuring the activities required for a new solution (product or service) entails selectively connecting actors in their capacity of resource and activity providers. Grafting the innovation into the pre-existing context may take place within existing customer supplier relationships, but later, it involves change in the content and form of such relationships. Innovation entails a substantial re-combining of resources, activities, and actors across pre-existing business network relationships and therefore typically involves development of new user/producer relationships (Araujo, Dubois, & Gadde, 2003). This need to recombine resources, activities, and actors opens opportunities for new businesses that will organize the new combinations.

Development of business relationships and of new businesses in general is entwined with the innovation process because innovations will only take place when a novel solution is being put into use, which involves establishing and developing business relationships between the producer and the user. The economy of innovation projects and processes is entwined with that of business relationships, and it becomes a critical factor in outcomes of the innovation process (La Rocca & Snehota, 2014). Studies of innovation processes have highlighted particularly three features of the innovation process that have clear bearing on our topic of start ups. They have shown that innovation processes involve multiple actors, that the process of innovation unfolds in a non-linear way, and that innovation artefacts (solutions) tend to become transformed along the process (Hoholm, 2011; Van de Ven et al., 1999). Indeed, some contiguities exist between the innovation journey, that is how innovations travel through existing systems, and the start up journey to become a viable business organization.

When dealing with the development of new business ventures, literature on entrepreneurship generally assumes that (technology-based) businesses follow the path of innovations. Innovations and start ups are assumed to originate in (scientific) research carried out in a certain kind of context (developing setting), to eventually turn into a solution that is produced in another setting (producing setting) in line with the application(s) that emerge in the using setting (Håkansson & Waluszewski, 2007). Studies of the innovation journey have shown that because of the multiple interests involved and the need to 'recombine' different innovation elements that are spread in the relevant network, the innovation process is non-linear and often regressive. The term 'journey' reflects the (often tortuous) path of innovations to be put into actual use. Indeed, if the innovation is to be accomplished, new solutions of start ups that often originate in the developing setting (typically including actors such as universities, incubators, R&D labs or science and technology parks) need to be embedded in two complementary settings—the producing and using settings

(Håkansson & Waluszewski, 2007; Ingemansson, 2010). While all shifts across networks have their peculiarities, statistics on the rate of failure of start ups suggest that the shift from the developing setting to producing and using settings is particularly demanding and difficult to master.

The developing setting is assumed to be the context where the knowledge on which the innovation and the start up can build is developed. The developing setting is particularly relevant when the innovation builds on new scientific knowledge or scientific discovery. The logic of the developing setting is the one of research—relative openness, long-term orientation, and limited use of economic criteria. This logic is related to the dynamics of the development setting, specifically the aims, performance criteria, and resource conditions, among others. Scientific discovery in itself does not necessarily lead to economic revenues, and university research has indeed been exposed to growing pressures to make academic research more "accountable and to demonstrate more clearly its potential practical usefulness" (Pavitt, 2004, p. 119). However, Jensen and Thursby (2001) observed that "most university inventions are at such an early stage of development that no one knows if they will eventually result in a commercially successful innovation or not" (p. 240). The embryonic state of the inventions facilitates further development required for any chance of commercialization (ibid.), and this development is supposed to move forward through research–industry collaborations (George, Zahra, & Wood, 2002) as well as by early involvement of customers in solutions development (Da Mota Pedrosa, 2012; Fang, 2008; Laage-Hellman, Lind, & Perna, 2014).

From our perspective, we would like to add two common features of development settings, contributing to the troublesome shifting to producing and using settings. First, the development setting is often characterized by its unrelatedness to industrial networks (Håkansson & Waluszewski, 2007), as academic environments are driven and governed by different logics and powers compared to industry. Second, developing settings typically consist of what has been called 'epistemic cultures' or knowledge cultures (Knorr Cetina, 1999), meaning that developing settings are driven by curiosity, academic recognition, and scientific methods, as opposed to the common drivers of mutual adaptation and value creation in industrial networks. Such epistemic cultures are passionate about exploring their epistemic objects (research objects), more often leading to divergence, expansion, and multiplication of problems and alternative solution pathways rather than to the kind of convergence and diminishing uncertainty needed for commercialization (Hoholm, 2011; Knorr Cetina, 2001).

The more the developing setting is distant from the producing and using settings, the more difficult it is to "think of what interfaces with what facility systems, represented by what suppliers, and what product systems, represented by what users, the new solution has to interface with in order to gain widespread commercial use" (Baraldi & Waluszewski, 2011, p. 175). This is certainly one of the reasons why university–industry collaborations are anything but smooth. It has been observed that "incompatibility between cultures, such as secrecy vs. free dissemination of knowledge," can be a "stumbling block to university-industry alliances" (George et al., 2002, p. 582).

This suggests that the challenges of 'shifting' from developing setting to the producing and using settings can be related to different underlying logics, networks, and dynamics of the different settings. In producing and using settings, the logic of business appears to prevail. The logic of business is based on economic criteria and related to achieving results within a relatively limited time frame and exploiting proprietary knowledge. In addition, the networks of the developing setting and of the producing and using settings are different. Therefore, the shift from the initial knowledge-based developing setting to the producing and using settings and related business networks is likely to be challenging.

It is likely that for an undefined period, the new venture continues to be embedded in the developing setting while attempting to develop (new) business relationships in the producing and using settings. It means that when the start up is becoming a new business venture, it is likely to be engaged in different types of relationships that follow different logics and need to be handled differently. Accordingly, this chapter focuses on the following questions: why is the shift from developing setting to the business context of the producing and using settings challenging? How do start ups cope with the shift? Through the two cases reported and discussed in the following sections, we aim to explore the shifting process of start ups from the developing setting in which they are born to producing and using settings in which start ups have to build relationships in order to survive and eventually become a viable business. The cases illustrate the interplay between network dynamics and start ups evolution (progressive and regressive) and the entwinement of start ups journey and innovation journey.

4.3 Method

The empirical part of this chapter is based on case study research (Welch, Piekkari, Plakoyiannaki, & Paavilainen-Mäntymäki, 2011). Two cases were selected from a previous data collection focused on ownership changes and network development (cf. Öberg, 2012). The two cases were purposefully selected because the two start ups have their origins in a science park and because of their attempts to develop business relationships with customers and suppliers. Furthermore, the two cases vary in the way in which the two start ups developed, as one mainly follows a progressive path while the other shows a progressive–regressive path. The two cases thus potentially offer different insights on how a research-based start up may move from its original (developing) setting towards business settings.

The data were collected from 16 interviews complemented with secondary data. The data collection started in 2003 for the first case and in 2008 for the second case. Most interviews were conducted between 2008 and 2010, with a follow-up interview in 2013 for the first case. Interviewees included representatives of the start ups, venture companies supporting their development, and early business connections. Questions, which were informal and open ended (McCracken, 1988), aimed to capture the development of the start up from early days onwards and various parties' roles related to the start up. Based on the size of the start ups and limitations in their connections to others, the total number of interviews amounted to the mentioned 16, which included repeated interviews with the same interviewees over several years. The author conducting the data collection was also employed (between 2002 and 2010) at the same university in which the start ups originated, and she worked between 2011 and 2012 for the university incubator hosting the start ups object of the two case studies in this chapter. This all provides a contextual understanding (Lincoln & Guba, 1985) for the start ups and their development while not having an effect on research results, as the researcher did not act as a consultant for the two studied start ups. To analyse the data, interview transcripts and notes were used to create timelines of events and draft early case descriptions. These have also been compared with previous case descriptions of the data collected. Comparisons between the cases are reported in the discussion section but since this was not the primary reason for including two cases, we have instead focused on tracing the dynamics that have influenced their development.

4.4 Case Studies

4.4.1 Case I: ImageTech; Starting and Re-starting a Research-Initiated Business

The first case reports on a university start up from a Swedish technological university founded in 1984 by a group of researchers interested in imaging technology. The main feature of this technology, based on sensor solutions, was 'reading' electronically pictures and other materials. Once developed, it would allow for the detection of variance in the material that was read and, when used for reading pictures, it would permit the interpretation of photographed objects. The researchers' key interest from start was to develop the technology, while the practical application of the idea was yet to be defined when the start up was founded.

As the emphasis was on developing the technology, the first step of the start up's development consisted of ad hoc investigations of the various application areas for the technology that they were committed to develop. At that time, the start up moved from the university premises and became part of a newly established science park. The science park, which functioned as an early version of the incubator, provided office space. Additionally, as the science park started to grow, other services were provided through a university-owned organization to help companies in their early phase develop their commercial side. The incubator of which

ImageTech was a part was supportive in terms of R&D activities (improving functionality of technologies) but did not provide any specific support for creating contacts and connections with the business context. In practice, it functioned as a provider of office spaces where various ideas from the university could meet.

Looking for possible applications of the technology, ImageTech decided early to hire an external CEO. While the arrival of the CEO in the start up brought more attention to the need to attract paying customers, research continued to be at centre of attention in the company since complete functionality of the technology was still to be figured out. Since researchers focused mostly on the technology features, their main relationships/interactions continued to be with other researchers and more generally with the university.

Two years after ImageTech was founded, the researchers have got contacts with a manufacturer of wooden doors in Norway. These contacts came about quite unpredictably and without the help of the science park. The contact with the Norwegian company was the result of the researchers' attempt to apply their technology to imaging of organic materials. The idea was that the technology could be used to sort wood based on its quality. Furthermore, through 'reading' the quality structure of the wood and based on certain metrics of the wood, the technology could calculate how to cut the wood to increase its utilization. The relationship between the start up and the door manufacturer meant that the start up could test its technology on the manufacturer's site and learn to apply it to wood. However, this relationship did not entail any joint development of the technology, nor did the door manufacturer become a customer of ImageTech.

Parallel to the relationship with the Norwegian company, the search for other application areas continued, mainly led by the start up's CEO. With the help of the science park, the start up found financial support from a venture capital company. Besides the financial support and general business advice, this venture capital company did not provide any support in the development of the technology nor did it provide relevant knowledge related to the industry of reference. However, the start up managed to identify two additional application areas for its technology: a tool to scan and trace documents to be used in offices and an 'image interpreter' able to read pictures and find details in them. Established connections were of similar type as the door manufacturer, that is, the start up could test its ideas on the site, but no business deals resulted from these collaborations. Thus, at that point in time, ImageTech, although connected with some actors who could potentially enable its transition to business context, remained fundamentally based in the science park, reliant on research related activities to develop other/better functionalities for its technology. Hesitations to start using the applications were massive among the new business connections, as they were dependent on the existing ways of solving application issues. For instance, they followed certain rules in which documents were currently handled and interpreted manually by specialized personnel.

In the mid-1990s, additional funding was perceived to be needed to create a technological breakthrough. As neither business connections nor venture firms were willing to further support the development financially, financial difficulties were preventing a technological advancement. In that situation, an international industrial company related to the defence industry acquired the start up. This acquisition had important effects on ImageTech. The company relocated from the science park and found itself without the connections that it had previously built, as these decided to suspend their relationships with ImageTech. Hence, the new venture lost partners it had relied on for the testing of ideas and development of application areas, and it also lost the proximity to the continued development of the technology. The start up's destiny became dependent on the acquirer's strategies and ways of running business.

The acquirer, whose main business was related to defence solutions, found ImageTech technology potentially useful for interpreting pictures taken in foreign areas to detect defence items of interest. However, as ImageTech became a very small part of the acquirer's business, it did not attract much interest and contacts between the management of the acquirer and the researchers were rather limited. The new owner offered financial resources to the start up to advance its technological solution, but this was the only thing he did. The acquirer had a strong focus on technological solutions for the defence industry but its knowledge and interest for other areas of commercialization was limited. Since the new owner was interested only in one of the three applications, the development of the other two applications ceased. In addition, the start up's CEO was absorbed by the management of the acquirer which lead to reduce his engagement in the activities of ImageTech. The start up did not experience the acquisition in a positive way also because these changes were perceived as an obstacle to the technological developments previously achieved through research connections. Over the years that followed, the start up did not generate any sales, did not establish any new business connections, and continued to be seen as a very small part of the acquirer's R&D.

A few years later, the acquirer ran into financial problems and decided to focus on its core business and to divest the ImageTech unit that was divided into three different companies corresponding to different application areas that were sold separately to different buyers. The office documentation technology was sold to an established IT company. The image interpretation technology was bought out by some managers in the acquirer company. Finally, the part that focused on material analysis of wood (that we will follow here) was bought by a company owned by some researchers at the university in which the start up had had its origin.

As the original start up was taken over by the researchers it had to start anew in many ways. It returned to the university and the science park context where it had been hosted previously. The return to the science park did not imply much beyond ImageTech being located close to the university. As the start up started over again, the new management put considerable efforts on re-establishing connections with previous collaboration partners (those who had previously discussed and tested possible applications of ImageTech's solution). The new owners considered important to emphasize that the start up started anew so that the (ex) partners would perceive that they could expect something different from what they had experienced during the past years. Initially, these contacts remained hesitant and were only interested in testing of ideas rather than becoming business connections.

The positive aspect that had come out of the previous ownership (in defence industry) was the technological advancement, as the idea moved to a different platform technology. This development made the solutions more reliable and more user-friendly. However, while the company started to be more attentive to attracting customers, the customers they were meeting at fairs and similar occasions showed certain reluctance to adopt the new solution.

In 2001, the struggling start up experienced some change as some ImageTech's competitors introduced on the market a technology similar to the one developed by ImageTech. Their newly introduced technology solutions were based on the idea of transforming the manual quality judgement of wood into automatized solutions. This in turn was an important breakthrough for the customers. The type of customers was the same as those who had participated in the original development of the application, particularly door manufacturers, although window and floor manufacturers and some saw mills became also interested. ImageTech started then to sell its equipment to these customers and subsequently added support services to the solutions (e.g., programming) to keep a close contact with the customers. Together with researchers at the university, the start up continued to develop the technology to improve its functionality for more high-grained wood materials.

In the mid-2000s, the start up once again found itself struggling financially and new venture capital had to be injected into the start up as the sales revenues were limited. The owners (university researchers) sold then most of their shares to two venture capital companies that came to own 75 per cent of the ImageTech. The CEO and the previous owner owned the rest. In 2013 (end of the data collection), the start up still struggled financially. Subsidiaries that formed in the meantime abroad (in the USA and Germany) have been replaced by distribution deals and agency representation in an attempt to consolidate the business. Research funding has been obtained to develop the technology further. The company remains headquartered in the science park close to the university from which it originated.

4.4.2 Case II: SensorTech; Struggling with the Business Context

The second case refers to a start up that we will call SensorTech, which has its origin in the same university as ImageTech. SensorTech emerged as the result of research on sensor technology. The founders, university researchers, based the start up on a patent obtained for anti-spin software. The researchers, who had previous connections with the automotive industry decided to work with solutions for this specific industry, and they were set to develop the technological functionality of the solution. The anti-spin software was an IT solution to avoid the tyres spinning. While the technology was sensor driven, the application area was set from start and reflected the researchers' connection to one car manufacturer.

The start up was founded in 2000 and was owned by a venture capital company of the car manufacturer and the researchers. The early focus of the start up was to develop the technology in close collaboration with a research group at the university. The involvement of the car manufacturer (situated in a different city) was quite limited and consisted mainly of providing financial support.

In 2001, the same science park as ImageTech in Case I hosted SensorTech. At that time, the science park focused increasingly on business support. A centre for entrepreneurship had been developed, and some organizations that were expected to support development of start ups became part of the science park. SensorTech benefited mainly from accessing financial support while in terms of commercialization activities in the automotive industry, it was relying on its own efforts. The venture capital company functioned as a representative of the industry but not as a representative of the start up. From early on, the start up worked to establish industry connections also beyond the venture company (and its owner, the car manufacturer) with other car manufacturers and suppliers to the automotive.

At that time, the automotive industry was marked by an outsourcing trend among car manufacturers, which has later led to car manufacturers competing with their suppliers to develop new solutions. The car manufacturers realized that they had outsourced too much and started to reacquire some of their lost competence and influence. SensorTech's aim was to find customers in an industry characterized by restructuring and some competition between car manufacturers and their suppliers. In this situation, SensorTech was potentially sub-supplier to both car manufacturers and some of their suppliers. Some companies, trusting the technological expertise of SensorTech, started development projects with the SensorTech. However, these companies mostly perceived SensorTech as a partner in developing ideas rather than considering it a potential business partner. The start up, being small and associated more with the university than with any particular company, was not perceived as a competitor; hence, it experienced a freedom and independence in the sector, moving from one company to the next and engaging in different projects. In addition to some research funding and funding from the venture capital company, such projects provided some income but did not actually help develop the idea further. Rather, the idea development continued to take place at the university involving mainly the researchers who were owners of the start up and these also took charge of the project management and development.

Even though the start up managed to create business connections quite early, it still struggled financially and kept struggling to attract customers. Another venture capital company, with less industry connections compared to the first one, also entered the company as a partial owner, providing financial support and some general business expertise, but without any connections to the automotive sector. However, soon thereafter the parent car company divested the venture capital company that initially founded SensorTech, and both the new and the first original venture capital companies exited the venture.

The start up continued to look for options to finance its further development. Talks were held with several representatives of the car industry as well as with suppliers of the automotive sector about taking over the start up. In parallel, the start up continued to introduce its idea to customers. Contacts were created with individuals who enabled the start up's presentation in an auto fair. However, the solution idea of the start up was met with scepticism, not the least because it would replace mechanical solutions used in the industry. The start up worked to fit its software solution with hardware currently produced by several automotive suppliers but the suppliers showed very limited interest. Thus, while suppliers to the car manufacturing industry were willing to arrange development projects with the start up, they felt that the SensorTech solution was competing with their current solutions.

In 2003, a German car manufacturer that heard about SensorTech at the industry fair decided to acquire SensorTech even if it had no previous contacts. This decision surprised various parties connected to the start up as well as researchers themselves. The car manufacturer acquired the majority of SensorTech's shares, and the researchers remained as minority owners. The new owner was interested in ensuring the further development of the idea and keeping alive the link to the university. The researchers remained based at the university and continued to pursue research while SensorTech's management remained situated in the close-by science park.

Following the acquisition, the researchers and management of SensorTech continued to develop the technology. The new owner was very clear about his intention to let the start up continue its path as a separate company, producing new ideas and income from other companies. The acquisition increased the legitimacy of SensorTech as player in the market, but at the same time, it increased the attention by competitors. Car manufacturers started to be less interested in developing projects with SensorTech, and suppliers increasingly perceived SensorTech as a competitor. They were also hesitating about whether the start up would really be able to deliver to other parties rather than its acquirer. Consequently, SensorTech lost much of its external contacts and sources of idea generation, and it became progressively incorporated in the routines of its acquirer that was modifying the nature itself of the start up with its strategic decisions. The link to the researchers also became increasingly administrative, although the technological development of the idea continued. In parallel to the technical development, the start up also focused on developing the service offering. However, several suppliers also started to develop competing solutions.

In 2008, SensorTech experienced a sharp rise in revenues from customization of solutions and sales to the parent company. What secured a stable income was the introduction of a legal requirement in the USA that made solutions as the one SensorTech developed mandatory in new cars. The owner transformed this new requirement into a standard component in its cars, as the start up's solution was certified by a European control organization to fulfil the requirements of that market. However, while some external customers showed interest, sales largely remained within the group, and the business of SensorTech mainly supplied its German owner.

4.5 Discussion

ImageTech and SensorTech cases illustrate the challenges associated with shifting from the developing setting to producing and using settings (and backward) and the ways to cope with them. A common thread in the two cases is the effects that business network and its dynamics have on the initial phase of the start up journey when the start up is set to move out of the safe harbour of the development setting where it has stayed for some time.

4.5.1 Diverging Logics

When developing the first business relationships, both start ups start from a 'solution concept'. In case of SensorTech, it is related to a given application in automotive industry, and in case of ImageTech to a less defined idea of solutions in three different application fields. The new ventures were looking for application domains for the solution concepts, and they strived to identify producers/users that might be able to use these. Both start ups were ready to work on various different application/solutions, being open to pursue quite different paths. This was rather obvious to ImageTech that was working in parallel on solutions to different customer needs as wood structure analysis, document analysis, and picture analysis. SensorTech, to overcome the lack of customers interested in its core idea, has chosen to become a sub-supplier not only to car manufactures but also to some of their suppliers. Both ventures were committed to develop workable solutions and invested quite heavily in doing that. They were ready, in principle, to adapt to the potential customers and even to change the essence of their business, but they struggled to translate it in practice. When starting to operate in the business context, both ventures appeared to maintain the logic of opening (searching for alternative applications and solutions), which is typical of the developing setting. This has not lead to business deals in the initial relationships with potential customers. In the ImageTech case, the door manufacturer, which has paid attention to the new solution, never became a paying customer and remained involved only in joint testing of the idea of the solution. The two start ups appeared loosely committed to the potential customers with whom they were in touch and kept developing the solution for other applications, showing a 'weak commitment to partnership overtime' (Thune & Gulbrandsen, 2014, p. 977).

Throughout the entire period during which we followed the evolution of the start ups, the opportunities for the two start ups were not abundant nor were waiting to be 'recognized' and exploited (Grégoire, Barr, & Shepherd, 2010). While the application space for the solution concept appears wide from the perspective of the start ups, such space narrows down as the concept is translated into solutions in the existing producing and using settings. This narrowing down solutions with a specific partner seems difficult to accept for the start ups' entrepreneurs (researchers) who continued to develop the solution concept in different directions. It has been suggested that new companies in a complex business environment can act only on a minor portion of the opportunities (Håkansson & Snehota, 1995), but our two start ups were reluctant to focus, and they appeared to be driven primarily by broadening the opportunity space. This logic to large extent prevails in the development settings, and the two ventures appear to bring such logic with them to the new producing and using settings where it appears inappropriate. The producing and using settings are characterized by the logic of closing on a workable solution that fits with the pre-existing context. The two ventures did not seem to realize that economic outcomes in business reflect the economic consequences of embedding the new solutions in the existing producing/using operations.

In our two cases, we see academic entrepreneurs exploring their knowledge object (i.e., technology) and their potential applicability in various contexts. When meeting barriers or dead ends on the commercial side, they tend to slide back to the logic of research of the developing setting instead of intensifying the commercialization efforts. Ultimately, this appears to hinder the necessary focusing of resources and learning towards (and together with) particular business partners and their networks, which is a necessary condition for economically viable solutions.

Both cases also show limited ability of start ups to confront issues in their emerging relationships and their attitude to conform/adapt to their counterparts (La Rocca, Ford, & Snehota, 2013). This did not favour the two ventures in acquiring a reputation as interesting and dependable business partners. The developing setting and its surrounding relationships represented an asset in our cases; a safe harbour for the two start ups, as both return to the science park until new business relationships and opportunities materialize. At the same time, however, the prolonged period in a hosting environment with its developing logic did not favour the start up's process of legitimization. In both cases there are signs of the 'fluidity' of start ups' identities (Lounsbury & Glynn, 2001; Rindova & Kotha, 2001) that from the customers' perspectives on the new venture do not appear to favour the development of business relationships. The identity of start ups in the early phase of the development oscillated between one of 'inventor/innovator' and one of a 'innovative reliable business partner'; the impression is that in both our cases, the inventor identity keeps prevailing while the second is difficult to acquire, which hinders the development of economically viable business relationships.

4.5.2 Network Impact

In spite of all the efforts to develop the initial business relationships, refine the solutions, and construct a certain identity, the actual development is in both cases influenced largely by exogenous factors that come from the actual business networks that the two start ups attempt to enter. The outcomes are thus largely beyond the control of the two ventures' managements. Examples of the positive and negative effects of exogenous factors on the journey of the start up abound in the two cases.

In both cases, indeed, the start ups benefited from and took advantage of changes occurring in the network beyond the horizon of their direct business relationships (Holmen & Pedersen, 2003) and the space of their action, even if only temporarily. For instance, developments in the relevant business network of ImageTech, which paradoxically emerged from what competitors did, made it possible to extend the potential customer base from door manufacturers to floor manufactures and sawmills. In the case of SensorTech, a regulatory change in the USA made the solution provided by the new venture mandatory for cars sold in the USA, leading to consistent business. On the other hand, the effects of development on the relevant business network have not been positive. Both ventures actually appear at mercy of decisions and actions taken elsewhere by other actors. ImageTech was acquired and sold for reasons quite unrelated to its activities. After the acquisition by the German car manufacturer, SensorTech's activity was clearly subordinate to the acquiring company's strategy, and became confined to the role of 'internal component supplier'.

The journey of ImageTech and SensorTech towards becoming a business venture appears thus largely marked by decisions the origin and effects of which were difficult, if not impossible, to anticipate. What happens in the business networks, including the various takeovers and acquisitions, can bring in valuable resources and affect businesses positively (Ahuja & Katila, 2001; Capron, Dussauge, & Mitchell, 1998), but it can also block access to resources and destroy existing resources (Santos & Eisenhardt, 2009). ImageTech acquisition by the defence related company has two important consequences for the development of the start up. The new owner imposed developing only one of the three applications. When it is subsequently divested, the other two applications were entirely disconnected from the original start up and followed different paths. When the defence industry company sold ImageTech to the university researchers, it was pushed back to the developing setting. However, this did not imply a re-starting from scratch, as the start up could use the connections established with previous business partners and benefited from the technological developments of the 'picture interpreting' solution for a highly sophisticated user. In both cases the original innovative solution concepts continued to be transformed following the two start ups' encounters during their journey, and the solution that emerged at a certain point with certain partners eventually could become an asset in other situations that the ventures would meet.

The two cases clearly showed that developing actual business relationships and shifting from developing to producing and using settings is anything but linear. Rather it appears to be a painstaking process that is likely to be regressive mainly due the fact that networks have their own life continuously interfering with start ups' plans, intentions, and actual actions. After 20 years for ImageTech and 15 for the SensorTech, both start ups are still suspended between the developing setting and producing and using settings. Neither of the two is a viable stand-alone businesses, both remaining start ups that are trying to become a full-fledged business venture. ImageTech is back to the start up phase and SensorTech is an R&D and production unit in a larger business organization.

4.6 Conclusions

Shifting from the developing setting to producing and using settings (or in other words closing the distance between the former and the latter) is problematic for a start up for several reasons and is therefore often demanding for the management of the venture in becoming. In the following two sections, we draw conclusions on why this shift is challenging and discuss what it takes for the entrepreneurs/management of the new venture to cope with this process.

4.6.1 Challenges of the Process

The shift in the network context, implied by the first steps in the journey from start up to business venture, presents various challenges. The first challenge reflects the need to relate to the new business context by developing business relationships with customers, suppliers, and other stakeholders that follow logics different from those the start up experienced in the developing setting. Developing the first business relationships require commitment to interaction with a limited number of specific partners. In developing these relationships, there is a need to develop a range of cost-effective and economically viable specific solutions for problems of some specific users that find value in the solutions. It requires logic of narrowing down a workable solution and often entails developing elements of the solution that are peripheral to the core technology solution but important for making the new technology solution adapted to the resources and routines in place. Such logic is distant to the logic of developing setting that puts premium on opening the solutions.

The extent to which it is necessary to commit to single opportunities for resource strained start ups, as compared to keeping more opportunities open, is an interesting question; nevertheless, entrepreneurial ventures often need to focus their resources (Leitch, Hill, & Neergaard, 2010).

They are then expected to move towards diminishing uncertainty by learning over time, as they test and adjust their ideas often in interaction with counterparts (Van de Ven et al., 1999; Wiltbank, Dew, Read, & Sarasvathy, 2006). However, the nature of epistemic cultures in developing settings and universities in particular may be an underlying reason for this not happening and for entrepreneurs to revert to their 'safe' hosting environment. Hoholm (2011), drawing on Knorr Cetina (2001), noticed how experts, when exploring their 'knowledge objects' (objects of inquiry, such as innovations and new products), made the objects multiply into a number of new problems and alternative development pathways due to the experts' passion for knowledge and exploration of interesting problems.

A related (second) challenge is that the new business venture has to engage simultaneously in several business relationships. To develop economically viable solutions in the business context of the producing and using settings requires integrating a number of different elements in a context-specific solution, which in turn requires developing business relationships with several counterparts. To gain paying customers and to generate income sufficient to cover operating costs is conditional on the solution having positive economic consequences in the new business context.

The heterogeneity of relationships matters a great deal. Since technical and commercial knowledge, funding, production capacity, distribution and sales, product combinations, among others, are rarely available within one and the same relationship, the new venture has to engage in 'heterogeneous engineering' (Law, 2004). Through this process the entrepreneur (whether scientist, engineer or business manager) seeks to mobilize and relate necessary resources and actors, while also being influenced by the same resources and actors. In this material semiotic (i.e., relational) process, the meaning and value of a resource (such as a technology or a product) are established as a relational effect of the emergent network within which the process takes place. The 'heterogeneous engineering' cannot be avoided. It is intrinsic to transforming the general solution concept into a specific solution-in-use for solving a specific problem of a specific business partner. It generates the distinct identity of the start up and the new venture that is the product of their relationships.

A third challenge for start ups is the need to interact and act jointly. Relational interdependencies limit the autonomy of the venture and the control it has of its own actions as well as of the outcomes of the own activities. Interaction is the central business process; it is a condition for developing business relationships and related solutions. Any start up and new venture is simultaneously engaged and interacting in several different relationships. Acting jointly with several actors implies that certain activities are carried out between actors rather than within respective actors' organizations. Every form of interaction and joint action with an external actor brings in uncertainty and entails (potentially) unexpected developments and risks. It also means a certain loss of control and autonomy in defining the technical features of the appropriate solutions in different relationships. Joint action results in interdependencies that limit the opportunities for the emerging business venture. As every actor involved in a relationship has its own ideas of goals, alternative courses of action, and expected outcomes, there is no complete consensus among actors about the variables that produce outcomes of the interaction. The new business needs to constantly reassure its counterparts about the expected outcomes in an attempt to find some consensus.

Overall, we are inclined to frame the journey of a technology start up becoming a business venture as a process of fitting solutions to problems; starting from available solutions and then searching for problems that can be solved by the available solution. It is akin to the garbage-can model of organizational choice (Cohen, March, & Olsen, 1972) in one important aspect: the outcomes of the process are largely dependent on interacting context variables rather than on one-sided action of the new venture. The difficulties in shifting from the developing context to a producing/using context thus appear to be related to the interplay of two factors: the diverging logics of the two settings and the different dynamics of the relational networks in the two settings.

4.6.2 How To Cope with It

Our study indicates that the difficulty for new firms to merge into the pre-existing business context lies in the continuous interferences from those with whom they interact and who hold a different logic. However, no business can be generated without relating to others. The need to relate to others implies that the outcomes of a new business will depend on the intentions, perceptions, actions, and reactions of the interacting actors and only to a certain degree on plans and intended strategies of the new venture management. The major difficulty for new ventures in becoming ongoing businesses is conditional on others' influence. The continuous interferences from the context make the process of new business formation a collective phenomenon (Ciabuschi et al., 2012). Therefore, the new venture must, in some way, play collectively with the surrounding context to achieve positive economic outcomes. Opportunities do not wait to be discovered and exploited by an alert entrepreneur (McMullen & Shepherd, 2006); rather, according to the creational view on entrepreneurial opportunities, they emerge from joint action and interaction (Mainela, Puhakka, & Servais, 2014).

The management of the new venture has to espouse a new logic, quite different from the one of the developing setting. The instrumental rationality of the scientific context has to be complemented by an economic and organizational rationality (Thompson, 1967), which is to large extent reflexive (and in a broad sense opportunistic). The passion for exploring knowledge (Knorr Cetina, 2001) needs to give way to focused learning processes with specific business counterparts, even if it is likely to lead to compromises and tough pragmatic choices between equally interesting opportunities (Hoholm, 2011). These two logics are mutually exclusive and are not easy to combine. For the start up journey, it means that if the new venture is to become part of the new setting, the logic of the developing setting at some point has to be downplayed and complemented with a logic of the producing and using settings, which entails giving priority to business interaction. This requires converging and focusing resources towards fewer opportunities with fewer counterparts, which entails tough compromising work. From a research logic, this may be experienced as difficult (to kill your darlings) and risky (to temporally give up other opportunities). The logic of the developing setting is likely to become a burden when developing new relationships in the producing and using settings (Håkansson & Snehota, 1998). The shift to the network of the producing and using settings implies taking on a new identity, which is certainly demanding and one may doubt whether the same individuals can achieve it or whether it requires a substantial change in the human resources of the new venture.

The management of the emergent venture will have to learn and adopt the business logic of the new setting that produces dynamics different from the business setting that is much less stable compared to the developing setting. What characterizes the new setting and its network is continuous unexpected events that make it impossible (and risky) to follow a plan developed ex ante. In an ever-changing producing and using settings, a start up needs to acquire ability similar to what has been called 'improvisation' defined as, "the degree to which composition and execution converge in time" (Moorman & Miner, 1998, p. 698). Improvisation implies a "shift away from planning, and a reliance on action" (Leybourne & Kennedy, 2015) and resonates well with the 'effectuation' logic in entrepreneurship and acting in uncertain contexts (Read, Dew, Sarasvathy, Song, & Wiltbank, 2009; Wiltbank et al., 2006). Recent studies on interaction behaviours in business relationships have suggested that the ability to improvise rests on employing reactive rules, such as readiness 'to improvise and to react to the unexpected' to keep interaction in business relationships smooth and accomplish their tasks (Guercini, La Rocca, Runfola, & Snehota, 2015). What makes the shift from the network of the development setting to the network of producing and using settings so difficult is that the logic of action implies relying on heuristics related to acting rather than scientific rationality of systematic knowledge development. While heuristics in interaction have been explored in a context of ongoing established relationships, we assume that these play an even greater role in circumstances where the uncertainty and ambiguity make decisions based on extensive information unlikely. Overall, we also believe that this study, as well as other studies in this volume, evidences the necessity of adopting the business network perspective to the study of new venture creation, to complement the social network perspective (Elfring & Hulsink, 2003).

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Part III

Start Ups and Technological Collaboration in Industrial Networks

5

R&D Collaboration and Start Ups

Jens Laage-Hellman, Maria Landqvist, and Frida Lind

5.1 Introduction

It is well known from previous studies that R&D collaboration is important to firms' technological development, especially in business-to-business (B2B) markets. This includes empirical studies carried out in the Industrial Marketing and Purchasing (IMP) tradition focusing on the role and importance of interaction, business relationships and industrial networks (e.g. Baraldi, 2003; Baraldi, Gressetvold, & Harrison, 2012; Gressetvold, 2004; Håkansson, 1987; Håkansson & Waluszewski, 2002, 2007; Laage-Hellman, 1997; Wedin, 2001) as well as other types of innovation studies (e.g. McKelvey, Zaring, & Ljungberg, 2015; Melander, 2014; von Hippel, 1988). Innovation thus tends to be the outcome of

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interaction processes between different types of actors including, for example, selling and buying firms.

Drawing on Coviello and Joseph (2012), for example, we would argue that this holds not only for established firms but also for start up companies. Technology-based start ups are typically founded for the purpose of commercialising some new knowledge, scientific discovery or invention. The initial ideas, coming from, for instance, academic research, need to be further developed and transformed into a commercial product (good and/or service) that can be introduced into the market and become an innovation. This usually requires R&D collaboration with external actors. In other words, the success and survival of the start up is dependent on how well it succeeds in establishing fruitful collaboration with other actors in the environment.

As shown by Håkansson (1989, 1990) in his cross-sectional study of 123 Swedish firms, three out of four key collaborative relationships in technological development were established with existing customers and suppliers, that is, in business relationships. The remaining quarter of the collaborations took place in so-called horizontal relationships established with other types of external actors such as competitors, producers of complementary products, universities and research institutes. This forms the background for investigating the situation of start ups. Such firms initially lack business relationships, but at the same time they are very much dependent on interacting with others in order to develop their technologies and products.

Assuming that R&D collaboration in relationships is important to technology-based start ups, this chapter focuses on the different forms of collaboration in which such firms become involved during their early phase of development, that is, before they are fully established in the market and have implemented functioning business ideas and models. The purpose is thus to describe and analyse in what ways start ups collaborate in R&D. The chapter also aims to identify collaborative forms that are typical of such firms and discuss some challenges that start ups have to deal with in their early networking.

The chapter is structured as follows. First, the theoretical background is presented. This is followed by a method section, case descriptions and a discussion. The chapter ends with some concluding remarks.

5.2 Theoretical Background

The industrial network approach (Håkansson, Ford, Gadde, Snehota, & Waluszewski, 2009) and the IMP tradition at large constitute the main theoretical point of departure for this chapter. According to this approach, business relationships are important for the selling and buying of industrial goods and services, but they can also be useful for related R&D purposes. For example, firms may collaborate with specific customers, suppliers and other types of ('horizontal') network actors in their development of new technologies, products and production processes. The collaborative activities enable the company to access new knowledge, mobilise external resources and coordinate activities (Håkansson, 1987).

5.2.1 R&D Collaborations of Start Ups

This research has shown that established firms can be involved in R&D collaboration in a multitude of ways, and we would argue that most of these are relevant also to new firms, including technology-based start ups. When founded, such firms usually do not have a final product to be sold on the market. Establishing relationships with potential business partners is necessary, not only for selling the product but in many cases also for developing it. New firms often lack many of the resources needed for doing this (Baum, Calabrese, & Silverman, 2000). To gain access to tangible and intangible resources available in the network, they therefore need to link up with other actors. However, unlike established firms, new companies lack business relationships with suppliers and customers, for obvious reasons. Collaborative relationships with such counterparts have to be created more or less from scratch. This situation presents challenges for the start up.

The potential partners are basically the same as for established firms, that is, customers, suppliers and horizontal units. Involving customers at an early stage is vital in order to provide an input of valuable resources to the product development. For example, due to the absence of existing customer relationships, the company may not have sufficient knowledge about the requirements of future customers (La Rocca, Ford, & Snehota, 2013). R&D collaboration not only allows start ups to make customers part of their own product development but may also contribute to directing them towards the kind of new relationships that need to be developed (Aaboen, Dubois, & Lind, 2011).

The start up may also need to establish R&D collaboration with various suppliers on the supply side. Effective use of key materials or components that constitute part of the innovation may necessitate adaptation of a potential supplier's product or production process, and this often requires joint R&D activities (e.g. Laage-Hellman & McKelvey, 2015). According to Song and Di Benedetto (2008) the relationship between the start up and its suppliers may not only provide new technologies but also financial support.

Among the horizontal units, research organisations such as universities and research institutes are a particularly important category of partner, especially for those start ups that have spun off from such institutions (Bercovitz & Feldman, 2006). In this case, the firm is established for the purpose of commercialising research findings. The technology that is to be commercialised by transforming it into an innovation has to be transferred to the company (in the form of knowledge and property rights). This usually requires some kind of collaboration or agreement with the inventors and other patent owners. Besides this type of initial transfer, research-based start ups may need to involve external researchers in the subsequent product development in order to gain access, if necessary, to complementary technologies and competencies. The partner can be the founding institution, which may continue to develop the original technology, or other research environments developing potentially interesting technologies of a different kind.

Nowadays, most universities have some sort of innovation support system, including, for example, a technology transfer office, an incubator and financing bodies. Such actors can help the start ups in their business development by providing various types of services (Mian, 1996).

However, these actors are generally not involved in R&D collaboration with the start up, but by using their own contact networks, they can help the latter to find suitable partners.

Established firms do not generally have much R&D collaboration with competitors, but there are exceptions, for example, in the context of standardisation and precompetitive research. As pointed out by Bengtsson and Kock (2000), competing firms may be involved in simultaneous cooperation and competition, where the relationship between the competitors can take different forms depending on how developed the product is. They argue that the driving force behind this kind of collaboration is the heterogeneity of resources. However, it is important to note that this also applies as the rationale behind inter-firm collaboration in a wider sense drawing on the assumption of resource heterogeneity, implying that the value of a resource depends on how it is combined with other resources (Holmen, 2001; Lind, 2006; Penrose, 1959).

5.2.2 Identifying Key Questions Regarding R&D Collaboration

Our research builds on an analytical framework that includes five key questions used for describing and analysing how start ups collaborate in R&D: Why, When, Who, How and What. The first four questions come from a study of customer involvement based on the industrial network approach (Laage-Hellman, Lind, & Perna, 2014). They were identified by reviewing the literature in this field. Coviello and Joseph (2012, p. 91) focused on small and young technology firms and developed a taxonomy of new product development activities and customer roles in major innovations. They also took their starting point in these five questions. Although both of these studies focus on the involvement of customers, the questions are generic and have relevance also for other types of collaboration partners.

The first question, Why, has to do with the reason for involving external actors. It can be for the purpose of collecting information, gaining access to technology and competencies, testing various objects and getting help with and/or financial support for the development of solutions. Secondly, and related to the When question, firms may choose to involve external actors in different phases of the innovation process (e.g. divided into idea generation, concept development, design and final testing and evaluation). Thirdly, the Who question concerns what types of external actors are involved. Potential partners may differ with regard to their position in the value chain, which technologies or application areas they represent and what organisational characteristics they have. For example, as shown by Coviello and Joseph (2012), characteristics such as inventiveness and creativity are essential when it comes to a small firm's ability to succeed with major innovations. Furthermore, it is crucial that the customer is able and willing to financially support the product development in an early phase. By contrast, features related to technical expertise or presence on a target market are perceived as less important. Fourthly, there are many different ways in which an external actor can be involved, that is, the How question. For example, some commonly used methods for involving customers are surveys, interviews, workshops, user testing in labs or clinics and field testing. Finally, there is a fifth question, What (Coviello & Joseph, 2012; Laage-Hellman & Rickne, 2014). It pertains to the object of the collaboration in terms of what technologies or products the collaborative activities are concerned with and which aspects are in focus (e.g. when testing). The answers to the What question are very context specific, which probably explains why this question is not dealt with to any great extent in the literature. In a practical situation, however, firms need to make decisions on what the collaboration should focus.

To summarise, we propose five related questions to be used when analysing how start ups collaborate in R&D. By considering *why* a start up takes part in R&D collaboration, with *whom* it collaborates, *what* is in focus and *how* and *when* this collaboration takes place, we can identify a set of different R&D collaboration forms.

5.3 Method

This chapter builds on four Swedish case studies which illustrate, in a condensed form, how a focal start up collaborates with various types of counterparts in the surrounding network. The cases, which have their origin in previous or ongoing research projects, have been selected in order to display variety. Common to all of them is that R&D collaboration is important, and this is the main reason they have been selected. However, there are differences with regard to how the start ups do this and the context in terms of industry, technology and the company's origin and age. Furthermore, in this chapter, we have chosen to focus on what we perceive to be especially important or interesting for each case from the point of view of R&D collaboration. This means that not all types of R&D partnerships are necessarily covered by the case. See Table 5.1.

For all the cases, the data have been collected primarily by interviewing key individuals, mainly the start ups' managing directors and founders. For each case, one to two people were interviewed, usually on several occasions. The interviews took their starting point in our analytical framework consisting of the five key questions. In other words, we gathered information about why the company collaborated, with whom, during which development phases, in what ways, and the object of the collaboration. Secondary data, for example, in the form of homepages and press releases, were also used when appropriate. Based on the collected data, the cases in this chapter are described with the focus on key R&D collaborations that have taken place. The empirical observations laid the foundations for a discussion on what forms of R&D collaboration that start ups are involved in.

Table 5.1 Basic information about case companies

Company name	Origin	Industry	Year of establ.	R&D partners in focus
Swedish Algae Factory	Spin-off from the University of Gothenburg	Life science and cleantech	2013	Research organisations Customers
Machine Says Hello	Founded by an independent entrepreneur	ICT	2012	Customers
Lamera	Corporate spin-off from AB Volvo	Materials	2005	Research organisations Customers Suppliers
Micropos Medical	University spin-off founded by four clinical researchers	Medtech	2003	Research organisations Customers Suppliers

5.4 Case Descriptions

5.4.1 Swedish Algae Factory

Swedish Algae Factory (SAF) is a start up within the cleantech industry which focuses on creating environmentally friendly wastewater treatment, combined with the production of organic algae biomass and nanoporous silica material. SAF was started in 2012 as a project by two students from Chalmers School of Entrepreneurship (CSE)[1] together with researchers from the University of Gothenburg and its Department of Marine Biology. The project was first run for one year at Encubator, a business incubator linked to CSE. The current team running the company consists of one of the original co-founding students from CSE, four algae researchers from the university, as well as one process engineer and two additional board members.

It all started with a polar expedition in 2012 during which two researchers from the University of Gothenburg found a new type of algae growing on polar ice. These algae have distinctive characteristics suitable for the Nordic countries; specifically, they are able to grow at low temperatures and under low light conditions. With regard to this, SAF has developed an algae cultivation system, which is both surface and energy efficient, and as a result less energy is needed when producing the algae. Today, SAF is focusing on creating a business model that includes a circular economic mindset and in which carbon dioxide, nitrogen and phosphorus waste is transformed into valuable products. This type of algae, which belongs to the group of diatoms, contains various parts which may be useful in different ways. Therefore, in order to understand what kind of product is suitable for selling, SAF is now testing the algae in several applications together with different counterparts.

The first area of use is related to wastewater treatment. Algae require nitrogen, phosphorus and carbon dioxide to grow. By letting the algae grow in wastewater, the nutrition can be provided to the cultivation system to cultivate the algae in an environmentally friendly way and, at the

[1] CSE runs a master's programme in entrepreneurship and business design at Chalmers University of Technology in Gothenburg.

same time, clean the water from nutrition. Thereafter, when the harvesting of the algae is completed, the algae biomass can be transformed into bio-crude oil by exposing it to a high temperature and high pressure. The bio-crude oil is suitable for production of fuel and phosphorus-rich biochar, a charcoal which can contribute to the recycling of phosphorous. Due to their unique characteristics, the algae make it possible to produce biofuel in an energy-efficient way since they do not need artificial light or heating during cold periods. Furthermore, the silica shell surrounding the algae can be removed and used in different industrial applications. Since this is a nanoporous material, which is both insulating and anti-reflecting, it can be used in, for example, solar cells and batteries.

Due to its early stage, SAF's business model is still under development, and discussions are being held regarding applications that are suitable from a short-term and long-term perspective. When it comes to the latter, the main objective is to develop an algae-based wastewater treatment system that also produces algae biomass that can be turned into bio-crude oil. With regard to the short-term strategy, verification studies have shown that the silica shells could be sold as a high-value product. With the profit from this application, SAF will be able to finance part of the demonstration plant, where the algae biomass will be produced. A long-term plan is to develop an automated production plant where the algae can grow and be harvested. Today, SAF is holding discussions with an external actor on how to develop a harvesting technique which can be used for harvesting on a large scale. If this is practicable, there are plans that a third actor connected to the industrial automation industry will be involved. However, before this is attainable, SAF needs financial support to develop the initial demonstration facility.

Although SAF currently has no paying customers, involving potential customers at an early stage of the product development is one important way to sell in SAF's vision and develop R&D collaborations. This can lead to new knowledge and hopefully future sales and business relationships. Today, several R&D collaborations are run in parallel to test various applications. In this section we have chosen to focus specifically on one collaboration that is related to biomass.

In 2014, SAF established R&D collaboration with Preem, Sweden's largest fuel company with sales of petrol, diesel, fuel oil and lubricating oil.[2] This project was supported by Vinnova (Sweden's Innovation Agency) and Imperial College London. The project aimed to evaluate if the bio-crude oil developed from the algae biomass could be used in Preem's refineries and hence see if it would be possible to transform the bio-crude oil into more useful products such as diesel and plastics. During this project, SAF and Imperial College came up with results regarding the composition of the bio-crude oil, which they presented to Preem. By looking at the composition, Preem could confirm that SAF's product was interesting and that there was a possibility of producing diesel and plastics from the bio-crude oil. Furthermore, Preem gave valuable feedback on the need to reduce the amount of nitrogen in the bio-crude oil. As a consequence, SAF changed its production process by adding one extra step—to extract the proteins in the bio-crude oil, thus lowering the nitrogen level.

SAF's intention with this project was to develop a biomass application and build a customer relationship with Preem. By selling the bio-crude oil to Preem, the oil company would be able to produce diesel and other products in a more environmentally friendly way than with current refining processes. Even though it was proved that Preem could handle SAF's bio-crude oil in its existing plants, Preem had no intention of continuing the R&D collaboration with SAF and, as a result, the relationship with Preem was gradually dissolved. However, the results from the project were promising and can be used as guidance for future R&D collaboration with other potential customers and, to date, they are discussing what can be learnt from this collaboration.

Discussions with a company in the plastics industry have now been initiated, where this actor sees itself as a future customer of SAF and is willing to co-finance SAF's future demonstration facility. The company sees renewable energy as a limited resource, and it contacted SAF as it is interested in its energy solution. There are plans for tests and meetings with the parties concerned, hence a promising collaborative project for the future. Collaborating with customers on a long-term basis is also something that SAF perceives as important for the future. Table 5.2 summarises the R&D collaborations that have been studied in this case.

[2] https://www.preem.se/en/in-english/.

Table 5.2 Summary of R&D collaboration for Swedish Algae Factory

	Who			
	University of Gothenburg (research organisation)	Imperial College London (research organisation)	Preem (customer)	Company in plastics industry (customer)
Why	Transfer knowledge about algae cultivation Joint research	Evaluate bio-crude oil from algae biomass	Evaluate bio-crude oil from algae biomass	Evaluate plastics from algae biomass
When	Idea/concept phase	Early design phase	Early design phase	Early design phase
How	Researcher involvement in SAF's R&D	Lab testing of bio-crude oil	Joint evaluation of test results	Plans for joint tests
What	Cultivation	Bio-crude oil Usefulness for refining	Bio-crude oil Usefulness for refining	Bio-crude oil Usefulness for plastics production

5.4.2 Machine Says Hello[3]

This is a small start up company founded in 2012 by a person with a background in engineering and art. The company specialises in IT-based, interactive applications for public environments. The focus is on stories created when machine and human meet. A key product under development is an interactive painting called 'Painting Says Hello'. It is intended to activate older adults and help them to feel less lonely. The product consists of hardware and software and uses avatars and beautiful environments. In order to make it possible to control the content on the screen, using sound and motion, the company has developed advanced software that enables 'the virtual agent' to interact with the user.

The idea behind this invention came up when the founder observed her grandmother (representing a potential user). After having been very active, the founder's grandmother had become increasingly passive. She was in good shape, physically and mentally, but needed to be more active in order to feel good. Given the growing demographic challenges posed

[3] The text in this section is based on a longer case description in Laage-Hellman and Rickne (2014).

by the ageing population, it is assumed that the demand for this kind of product will increase, creating interesting business opportunities. 'Painting Says Hello' is intended to be a platform on which other firms will be able to develop new content.

When the company was founded, the inventor knew what technology to use and how to do the coding, but in order to gain a deeper understanding of the user needs and the market, the inventor contacted a number of potential customers. These were supposed to be care homes and activity centres for older adults. The contacts with staff and older adults at such institutions showed that there was an interest in the proposed concept and that the availability of a prototype would be necessary in order to fully understand the product and judge its usefulness. An especially fruitful contact was established with an activity centre in the same town. Meetings and dialogue with personnel and visitors provided important information that helped the company to enhance its understanding of the user needs. This knowledge affected the design of the product and helped the company to develop a first prototype that was adapted to the older adults' capabilities and wishes. For example, it was learned that the product should be intuitive and not include special control devices and buttons—thereby making it more user-friendly than existing competing products in the market.

In order to take the next development step, the prototype needed to be tested in a real-world environment. Given the good contact that had been established with the nearby activity centre, it was agreed to conduct the first tests there. The activity coordinator at the centre was very interested in the product and helped the company to carry out the tests. For one month, the centre borrowed one piece of equipment and let the visitors use it. Company representatives did not intervene in the testing, but they visited the centre anonymously now and then and made some observations. After having completed the testing, ten older adults, of the 50 who had tested the product, were interviewed by the inventor. This provided valuable feedback regarding, for example, the most popular activities, the design of the product and how to formulate the instructions to the users.

This information is now used in the ongoing development of the final product. The nearby centre is still interested in the product, and the company hopes it will become the first customer. Besides generating much-needed income for Machine Says Hello, a purchase would also provide

Table 5.3 Summary of R&D collaboration for Machine Says Hello

	Who	
	Swedish care homes and activity centres (customers)	Nearby activity centre (customer)
Why	Understand needs, interest and market	Understand needs Test prototype Test final product (plan) Start sales (plan) Create a reference (plan)
When	Very early after foundation (concept phase)	Very early and during the design and evaluation phases
How	Phone contacts and site visits	Meetings and discussions User-testing of prototype (with follow-up interviews) User-testing of final product (plan)
What	Proposed concept (usability)	Prototype (functionality; effects) Final product (plan; evidence)

an opportunity for further testing and evaluation together with an actual customer and on a larger scale than previously. The main purpose would be to generate data proving the usefulness and benefits of the product and facilitate the marketing directed at other activity centres.

It can be concluded that in this case the R&D collaboration took place only on the customer side. The hardware consists of standardised components and subsystems which are available on the open market. There was therefore no need for R&D collaboration with suppliers. Table 5.3 summarises the R&D collaborations that have been studied in this case.

5.4.3 Lamera

The idea behind Lamera's strong lightweight sandwich material, marketed under the trade name Hybrix™, has its origin in research at Volvo Technology, a subsidiary of the truck maker AB Volvo. In 2004, Volvo gave CSE the assignment to explore and test other applications than the automotive industry. One year later, Lamera AB was founded based on Hybrix' patents, and since then numerous application tests have been carried out in a broad range of industries. The goal is to become the world leader in ultra-light metal composites.

During its ten-year lifetime, Lamera's strategic direction has varied with regard to which application types to focus on. The choice of direction has largely been governed by the outcomes of R&D collaborations with customers. Some customer interactions have been successful and resulted in sales, while others have proven to be dead ends. One example of the latter is Lamera's first customer, a foreign company in the defence industry. The company had bought a small quantity of Hybrix to test if it could be used as a replacement for Kevlar (a strong polymer material). For secrecy reasons, the customer could not tell Lamera why it wanted to change and due to the lack of an open information exchange the collaboration ended. Lamera has also made deliveries to a supplier of cabin food trolleys used in aircrafts. Here, there were some problems with exclusivity that prevented Lamera from communicating directly with the customer's customers. The collaboration eventually stopped when the customer went bankrupt. In another example, Lamera sold its material to a manufacturer of boat kitchens. However, these deliveries were interrupted as the material did not pass certain tests.

The core product of Lamera is Hybrix, a strong lightweight material that compares with steel and can be tailor-made to suit many different applications. To be saleable, the material must always fit into a specific customer application. Carrying out collaborative R&D projects together with potential customers, with the aim of testing the material and developing applications, has therefore always been important to Lamera. In 2012, it had almost 30 ongoing projects of this kind. They spanned a number of different industries, including, for example, the automotive trade, construction and consumer electronics. However, the management of Lamera felt it needed to concentrate its resources, and it took a strategic decision to focus on a limited number of projects. As a result, in 2014, Lamera had five ongoing projects with different customers. A major reorganisation then made the company project based and matched the needs of ongoing projects.

Participation in publicly funded national research projects has been a platform for meeting research organisations and potential customers. In concrete terms, such participation has resulted in two of the ongoing development projects with potential customers, both in the automotive sector. One of these projects was 'Sånätt', which aims to strengthen the Swedish vehicle industry. It was funded by Sweden's Foundation for Strategic Vehicle Research. The goal was to reduce the vehicle weight by

20–40 per cent and to develop the sub-contractors. The project started around 2010, and at that time Saab Automobiles was one of the main parties. Someone at Saab had heard about Lamera and perceived its lightweight material to be promising. This was the reason Lamera was invited. There were about 35 participants in total, including component manufacturers such as Lear Corporation and consultancy firms such as Semcon. After a while, Saab went bankrupt and the project needed to involve a new Original Equipment Manufacturer (OEM), which became Volvo Cars.

Lamera took a leading role in two sub-areas: the door and the underbody. For both of these applications, a physical demonstrator that included panels made of Hybrix was built. This demonstrator has been crucial for showing other participants the functionality and properties of Hybrix. Thus, it was thanks to the demonstrators that Lamera could show its product to the project participants to make them interested in the material. The demonstrator has also been important in relation to another research project with a potential customer in the automotive industry. This other project focuses on transport efficiency at large.

There are examples outside the automotive industry, where the customer collaboration has resulted in sales. One is a manufacturer of hospital trolleys used for carrying medicines. This company was exploring the use of stainless steel but had found it to be too heavy. Initially, Lamera was not able to meet the quality requirements for the boxes of the trolleys. However, Lamera was allowed to deliver the boxes in solid material until the quality problems with its own material had been solved. In relation to this customer, Lamera's sub-supplier of punching and bending services played an important role. The collaboration with this sub-supplier led to the box manufacturing becoming more efficient. Another example of an application in which sales have been achieved is housing facades. Here, the sub-supplier was also involved in designing the metal sheets.

So far, the delivered quantities have been relatively small, and to start growing Lamera would need a volume order. However, the CEO expects this will come soon. Interestingly, Hybrix is based on an idea from the automotive industry, but initially Lamera focused on other industries, and over the years has tested its material in a range of application areas such as defence, boats and aircrafts. Nonetheless, today, automotive applications are again a main focus area represented by two of the five now ongoing customer projects. Entering the automotive market requires a

Table 5.4 Summary of R&D collaborations for Lamera

	Who		
	National research projects (research organisations and customers)	Development projects with potential customers (incl. automotive) (customers)	Punching and bending company (supplier)
Why	Meet potential partners in the automotive industry.	Test material in specific applications with the goal of reaching a volume application.	Make the manufacturing more efficient in specific applications
When	Evaluation phase	Evaluation phase	Evaluation phase
How	Taking a leading role in two sub-areas Demonstrators	In research project and joint testing	Joint development of production method
What	Hybrix	Components Functionality, design and manufacturability	Manufacturability

long-term approach, and Lamera has no ongoing business in the field, nor will it have any in the near future. The collaborative projects it runs with automotive customers are seen as long-term investments. These will not pay off tomorrow, but once a business deal is made the volume will be high. One such a deal would be more than enough for Lamera.

In 2015, Lamera made the decision to invest in a plant for large-scale manufacturing of Hybrix. The company's management had talked about and worked on such an investment for many years. The saying had been "all or nothing" referring to Lamera's future. The reasoning had been that investing in a plant would enable Lamera to scale up production and reach the volumes necessary to meet the needs of the customers and eventually to become profitable. According to the press release,[4] *This expansion is possible thanks to a capital injection of SEK 30 million from the government owned venture capital company Fouriertransform along with an unnamed investor and the current majority owner Midroc New Technology.*

Table 5.4 summarises the R&D collaborations that have been studied in this case.

[4] http://www.lamera.se/eng/images/stories/pdf/pressrelease_eng_20150530.pdf.

5.4.4 Micropos Medical[5]

Micropos Medical is a university spin-off founded in 2003 by four clinical researchers working at different hospitals and universities in Sweden, Norway and the USA. The company is located in Gothenburg where one of the inventors and founders is based, namely at the Sahlgrenska University Hospital. Micropos is developing an innovative microwave-based system for positioning cancer tumours during radiotherapy (RT). Compared with conventional methods for controlling the radiation, Micropos's product, called RayPilot®, improves the precision of the treatment, leading to reduced side-effects and cost savings.

In order to develop a functioning product based on the original ideas, gaining access to state-of-the-art microwave technology was crucial. This was successfully achieved by collaborating with two types of partners. First, at a very early stage, indispensable technical competencies were accessed from Chalmers University of Technology in Gothenburg, where two departments were carrying out advanced research on microwave technology. These departments could help Micropos to develop its product by letting students carry out their master's theses on behalf of the company, with senior researchers acting as supervisors. Some of these students were later recruited by the company. Further contacts and collaboration with one of the departments were developed related to a new research centre for carrying out needs-driven academic research in collaboration with industry. Micropos became one of several member firms. One of the PhD students associated with the centre is using RayPilot in his research. The collaboration with Chalmers was facilitated by Micropos's localisation at Chalmers Innovation, a business incubator situated close to the university. At a later point in time, Micropos benefitted from Chalmers through membership of a research centre where needs-driven academic research of potential interest to the company is carried out.

The second type of partner that played an important role for Micropos's technical development was equipment suppliers. RayPilot consists of three main parts: a transmitter (active marker) implantable in the organ to be radiated, a receiving system and computer software (see Fig. 5.1).

[5] The text in this section is based on a longer case description in Laage-Hellman (2012).

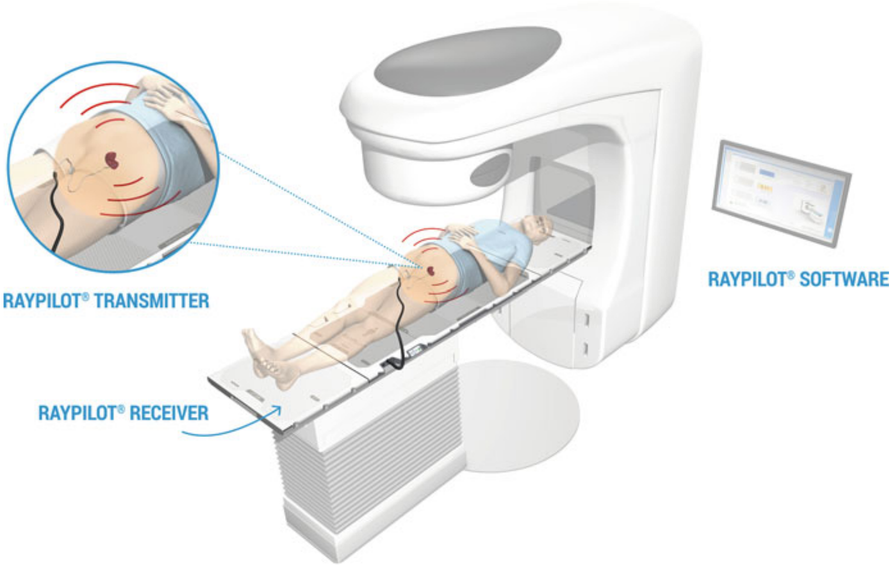

Fig. 5.1 Illustration of RayPilot

While the receiver is built largely of standardised components available on the market, the transmitter is a unique piece of equipment (a consumable, i.e. a piece that is used up) that is part of Micropos's patented solution. Like many other medtech start ups, Micropos made an early decision to outsource production, since building up in-house manufacturing would be too costly. It was therefore absolutely necessary to find a supplier that could manufacture the transmitter. The search for such a supplier started early, soon after the company had been founded. Finding a suitable supplier which was capable of manufacturing the transmitter and willing to do so turned out to be difficult. The ideal supplier should have experience of medical devices, have clean room facilities and have the capacity to deliver a finished product that was sterile, validated and packaged. To find a suitable supplier, Micropos had to go abroad. Many of the contacted companies were reluctant to become involved, however. Micropos was a very small company that was unknown and lacked track record. There was also no proof that RayPilot would work and be successful in the market. Many suppliers therefore perceived collaboration with Micropos to be too risky. Nonetheless, after lengthy discussions with a German company, Raumedic, fruitful collaboration was finally established. Based on intensive work carried out jointly by engineers in the two companies, the design of the transmitter was adapted to enable efficient serial production.

Important R&D collaboration has not only taken place on the supply side. On the demand side, Micropos has had extremely important collaboration with users/customers at different RT clinics. In the very early phase, one of the inventors/founders, who is an associate professor at the Sahlgrenska University Hospital and works part-time for the company, conducted 'technical tests' (not involving patients) at his clinic. Similar tests have been carried out at some other clinics thanks to contacts arranged by the founder group. They are internationally leading researchers with a vast contact network in the international research community. The input from these testing activities was important for the design of RayPilot. Clinical studies aiming to produce proof of concept were also initiated, with Sahlgrenska being the first site.

Now, when there is a more or less finished product ready to be launched on the market, pilot installations have become a key activity. Some ten big RT clinics in several European countries are now testing RayPilot in parallel with the use of conventional positioning methods. The clinics can borrow a complete system from Micropos but often agree to pay for the consumption of transmitters. The purpose of these tests, which are actively supported by Micropos, is to check that the product functions in the local environment and to measure the effects on patients and the clinic. The outcome is intended to prepare the clinic for purchasing the system and implementing it in its day-to-day operations. Each buyer will also become a valuable reference.

Some of the pilot customers are also carrying out clinical trials on RayPilot. Such studies, which lead to scientific publications, are very important for the broader marketing directed at other potential customers, since they can produce scientific evidence of the product's benefits in terms of patient utility and cost-efficiency.

The suppliers of integrated RT systems constitute a fourth category of R&D partner. Today's global market is dominated by two large companies, namely Varian (USA) and Elekta (Sweden). The purpose of this

Table 5.5. Summary of R&D collaboration for Micropos Medical

	Who			
	Chalmers (research organisation)	Raumedic (supplier)	RT clinics (customers)	System integrators (customers/ distributors)
Why	Gain access to microwave technology	Develop a manufacturing solution for the transmitter	Test design solutions Evaluate benefits Start sales Create references	Integrate RayPilot in RT systems
When	Early and late design phase	Design phase)	Design phase Evaluation phase	Late design phase Evaluation phase
How	Master's theses Recruitment Researcher involvement in Micropos's R&D Research project	Information exchange Joint design	Technical testing Pilot testing Clinical trials	Mutual adaptations of design solutions
What	Microwave technology	Transmitter (design for manufacturing)	Prototypes and final product (safety, medical effects and cost-savings)	Final product (interface between sub-systems)

collaboration is to make adaptations to RayPilot and other parts of the RT system in order to ensure effective integration of RayPilot, so it can be included in the offering of complete package solutions. Micropos has now begun to work closely with one of these system integrators and hopes that it will become a future customer/distributor.

It can be added that besides these types of R&D partners, Micropos has had fruitful contacts with several other external actors. These include, for example, patient associations, government agencies, distributors, financiers and other medtech firms (e.g. through the research centre at Chalmers). Table 5.5 summarises the R&D collaborations that have been studied in this case.

5.5 Case Discussion

The case descriptions show that start ups are involved, to a high degree, in the same types of R&D collaboration as established firms, with the difference that start ups do not have any existing business relationships to rely on when they are founded. From the cases, it is clear that interacting with potential customers and users is always at the top of their agenda and, consequently, this is usually the most important type of partner. Depending on the context, R&D collaboration with suppliers and research organisations can also be of great importance. In the following, we discuss our observations with the focus on the major forms of R&D collaboration in which start ups are involved.

5.5.1 R&D Collaboration with Potential Customers

Start ups have strong reason to start building customer relationships very soon after being founded. In all of our cases, the companies' management has been aware of this need and started to seek contact with potential customers. This is a time-consuming and challenging activity that requires a great deal of endurance and patience. For the start up, it is important to find at least one or a few potential customers to work with in order to establish concrete exchange and collaboration. This is necessary, first of all, to achieve a deeper understanding of the users' real needs and how the start up's solution can meet these needs. Second, it is important to find someone who is willing to test the ideas, concepts and prototypes presented by the start up and to give feedback—that is, as strongly emphasised also by Coviello and Joseph (2012), to provide knowledge that can be used for designing the product and developing applications. Since start ups usually have weak finances at the beginning, it is also of great value if the partner is prepared to pay for the product to be tested or contribute financially in other ways (e.g. by funding joint R&D projects). This is the new product development activity called customer-based funding in which customers can be involved as a Development buyer and/or Early buyer (ibid.).

Establishing this kind of collaborative relationship is particularly difficult for start ups (compared with established firms) for a number of reasons. They have to convince potential partners to invest their own resources, for example, to make adaptations to their own products and production processes and to carry out R&D activities (e.g. user testing). In most cases potential partners already have some functioning solution in place, and the invention promoted by the start up may be associated with high uncertainty. Will it work in practice? Will it perform well enough? Will the new product become commercially successful, remain in the market and be supported by aftersales services? There may also be high switching costs. Thus, there may be both technical and commercial risks that make a potential partner reluctant to commit.

Despite these difficulties, all of our case companies have succeeded in establishing fruitful R&D collaborations with potential customers. Two patterns appear from the cases: one broad in which the start up engages in several parallel tracks of collaboration and one focused in which it collaborates with only one customer.

Working with Parallel Tracks

One of the patterns that we have identified is to go out 'broadly' and work with many potential customers and use so-called *parallel tracks*. There are two versions. One involves the start up developing several different areas of application together with different partners. This is what SAF is doing. Another example is Lamera, which has continuously tested numerous applications for its material. In the other version, the start up engages in collaboration with several partners within the same application area. The reason for doing this is that the company may need feedback from more than one user. One example is Micropos's system for tumour positioning. The use setting at hospitals differs, and this is one of the reasons for parallel pilot installations. Furthermore, in the medical field in particular, scientific evidence based on large-scale studies is crucial for the market introduction of new products. Hence, clinical trials have been carried out at different hospitals. As a university spin-off, Micropos is a special case, since the inventors happened to represent the user side (they are clinical researchers). This means that early user involvement could take place at, among other places, a nearby hospital where one of the inventors worked.

Focused R&D Collaboration

The other observed pattern is that from the very beginning, the collaboration is limited to just one customer and typically one specific application. Hence, the collaboration is *focused*. This approach makes sense given the start up's scarcity of resources. Working with parallel tracks may be perceived as too time-consuming and difficult. Focusing on just one customer and one application allows more time to be spent together with the partner, and this may result in a deeper understanding of each other's needs and capabilities and contribute to trust building.

The case Machine Says Hello illustrates this focused approach well. After having contacted a fairly large number of potential customers for its interactive painting, it turned out that one of the activity centres was particularly interested. This provided the opportunity for more extensive information exchange and prototype testing with real users. It is hoped that this activity centre will become the first paying customer, opening up the opportunity to carry out further testing (of the final product) and gain a useful reference.

When pursuing this kind of collaboration strategy, the initial partner choice is very important, for obvious reason, as pointed out by Aaboen et al. (2011). They show that the first relationship can have a decisive influence, for example, over the direction of the product development regarding both hardware and application knowledge. If the collaboration ends for one reason or another, the start up will need to start all over again and find another partner. This means a loss of time and maybe also a costly change of direction. The SAF case illustrates how the start up had to give up its collaboration with Preem but succeeded in finding a new partner in the plastics industry.[6]

[6] Another example of a forced partner change is described in Laage-Hellman (2012, Ch. 6). Promimic, a developer of a new coating technique, had a strategic partnership with Nobel Biocare,

Changing Application Areas and Partners

A critical decision for many start ups, illustrated by several of our cases, is which application area to focus on. Irrespective of the collaboration pattern, when choosing which application area(s) to focus on, there are several aspects that have to be taken into consideration, for example, estimated market size, benefits of the product and availability of willing partners. Sometimes, it is quite obvious what the product should be used for. For example, RayPilot developed by Micropos is a system for tumour positioning in connection with RT that is probably not useful for other purposes. It is quite common, however, that start ups try to commercialise a technology that is relatively generic and has many possible applications. For example, SAF started broadly by including different actors on the user side to develop a number of different applications for the algae, of which bio-crude oil is one.

A possible approach used by some companies is to start by focusing on one application area where the product offers significant improvement possibilities and where the buyers are actively searching for better solutions. The sales potential in such a segment may be relatively small but there may instead be good opportunities to find potential customers that are willing to try the product and collaborate. This may help the start up to develop the product, prove its benefits, start sales and get references, which may in a later phase enable the start up to enter other application areas with greater sales potential.[7] Other studies have also shown that the start up's choice of application area is important and affects how the company develops. Härkönen et al. (2015) describe several cases where early customer collaboration has shown that the initially chosen application

a world-leading manufacturer of dental implants. When the latter, for internal reasons, decided to terminate the joint R&D project, Promimic had to start searching for new partners, which it eventually found in another application field—orthopaedic implants.

[7] Oxeon, another research-based start up that we are now studying, has successfully applied this strategy (Laage-Hellman, Landqvist, & Lind, 2016). This company is commercialising a unique technology for making carbon fibre composites. It started off by focusing on Formula 1 teams, a small but innovative market segment that offered the possibility of carrying out real-life tests and achieving early sales. This paved the way for entering the much larger segment for sporting goods where the customer needs are similar and the product life cycles are relatively short. This is Oxeon's core business today. The aeronautical industry is another large segment that the company is now approaching.

field was not suitable and triggered a change of direction implying the search for new partners. Such strategic changes are often costly and may even jeopardise the company's survival. Nonetheless, they may be necessary, for instance, if all customers are lost (Aaboen & Lind, 2016).

As the cases have illustrated, the establishment of functioning R&D collaboration with potential customers may not be straightforward (see also Chap. 1 Initiation of Business Relationships). Regardless of whether the R&D collaborations are parallel or focused, several attempts to establish partnerships may be necessary. SAF, for example, started off with Preem, but when this collaboration came to a halt, the company had to start searching for a new partner. Lamera initiated several collaborative customer relationships for different application areas, which have now ended, triggering closer collaboration with a handful of potential customers. In the case of Micropos, the relationship with the initial clinical partner did not develop in a favourable way, and there are now other hospitals that have become more important for the development of the product.

5.5.2 R&D Collaboration on Specific Issues

Compared with the above-described patterns of customer collaboration, the R&D collaboration of start ups can take a more specific content and form, as illustrated by three of our cases (Micropos, Lamera and SAF). They show that when there is collaboration with a supplier, this regards *specific* issues. In one case, we also see evidence of specific R&D collaboration with a university.

For Micropos, the development of the implantable sensor was done in close cooperation with a German supplier. This case illustrates the necessity to involve suppliers already at an early stage of the product development—that is, in parallel with the customer collaboration. The case also illustrates the difficulties that a start up may encounter when approaching potential suppliers. The latter may hesitate to become involved, basically for the same reasons as customers. In short, the risk may be perceived too high given the start up's lack of resources, competencies and track record and the uncertainties associated with the invention (especially if this is of a radical nature). In connection with different customer projects, Lamera has involved a supplier of punching and bending services and, by doing so, managed to make the manufacturing of the end product more efficient. For SAF, the algae are currently produced and harvested in facilities located at the University of Gothenburg. However, SAF is now discussing with an external actor how to develop a harvesting technique suitable for producing the algae on a large scale. Future collaboration with suppliers of process equipment is therefore conceivable.

The possible benefits of using universities for specific purposes are illustrated by the Micropos case. During the early product development phase, input from Chalmers was crucial for designing the product. As these examples show, the purpose of the collaboration with suppliers or universities can be very *specific* and aim to solve certain technical problems in the ongoing development work related to the product as such or to the development of specific applications for individual customers.

5.5.3 R&D Collaboration with Founding Institutions

When it comes to collaboration with research organisations, university spin-offs constitute a special case as, 'by definition', they have a relationship already from the beginning with the institution(s) from which they have spun off. Johansson, Jacob, and Hellström (2005) describe this relationship as strong. This is in line with our observations. The relationship with the founder is initially very important in order to transfer the invention to the start up. For obvious reasons, the inventors usually play a key role here. We see this in both of our university spin-offs—SAF and Micropos. The inventors are very active in the companies' product development, contributing knowledge and, in the latter case, also contacts with potential users/customers. Both cases exemplify how researchers behind the invention remain at the university where they continue their research in parallel with being involved in the company. This pattern is in line with other observations we have made (see, e.g. Laage-Hellman, 2012, and Laage-Hellman & McKelvey, 2015). Another variant that we have also seen in previous research is that the inventor leaves the university and takes up a full-time position in the company as, for example, R&D manager.

The impression from our current and previous research is that this early transfer of technology is usually not so problematic and allows the company to take over the full responsibility for developing the product (with or without help from the inventors). A typical pattern seems to be that the importance of the relationship with the founding institution decreases over time while other types of R&D collaboration, especially with customers and suppliers, become more important. This, of course, depends on whether the institution continues to carry out research of relevance to the company. This is in fact happening in our cases, and there is continued collaboration so far. However, we have encountered other cases in which the relationship has more or less disappeared after some time. This can be an effect of the inventor's exit from the university or because the researchers choose to refocus their research.[8]

5.5.4 Open R&D Collaboration: With a Direction

Besides interacting with founding researchers, start ups can benefit from collaboration with research organisations in order to gain access to other technologies and competencies they need for their development. The Lamera case is a good illustration of this through its participation in a large, national research project. As well as generating new knowledge, this project provided an opportunity to establish new partnerships, in this case with potential customers. More precisely, the project enabled Lamera to develop a demonstrator showing how its material could be used in real-life applications. This opened the eyes of other participants, making them interested in testing the material. The reasons for Lamera taking part in the project were broad and open in this sense, while it still knew that the other members came from an industry in which it wanted to become established. The Micropos case provides another example of open university collaboration, namely through it joining a research centre at Chalmers. This offered Micropos the opportunity to come into contact with other medtech companies and participate in applied academic

[8] An example of the former can be found in the case of Oxeon (Laage-Hellman et al., 2016). The latter is illustrated by a case study of Aerocrine (Laage-Hellman & McKelvey, 2015).

research. The topic of this research is of relevance to Micropos but the usability of the upcoming results was unknown.

Hence, we can distinguish an open form of R&D collaboration with research organisations. This collaboration is *open* and allows the start up to expose itself to new knowledge and to get in touch with new potential partners. The outcome is uncertain, but the start up still clearly sees that the collaboration is going in a certain direction. In other words, there is a perceived value in using the university or a research project as a platform for identifying new opportunities and developing future technologies, products and applications.

5.6 Concluding Remarks

The cases have shown that R&D collaboration with external partners is vital to start ups. This is also in line with, or as expected based on, the IMP tradition of seeing a business as interdependent with external resources (Håkansson et al., 2009). The start ups are involved in the same types of R&D collaboration as other technology-based firms. Our cases illustrate in more detail some particularities for start ups given the fact that such firms do not have established business relationships when founded either with suppliers or customers. Due to, inter alia, the scarcity of resources and the lack of experiences, this situation presents a challenge to start ups.

The form of collaboration with potential customers displays a pattern of both working with parallel tracks, in terms of testing applications with several customers at the same time, and focusing on collaborative projects with one potential customer in a certain application area. In both cases, the number of initially contacted customers may be large, but the actual collaborative work carried out at a certain point in time usually takes place with a limited number of partners. While on the customer side focus is concerned with applications for the start up's product, on the supplier side focus has to do with solving specific technical problems, such as, for example, manufacturability of a certain component. Collaboration with universities can also be very specific and concentrated to one or a few partners. However, besides this specific form of collaboration, we have observed that start ups can be involved in an open form of collaboration in which it is difficult to foresee what will come out of it.

There thus appear to be balancing acts in the R&D collaboration patterns between, on the one hand, parallel tracks and open collaborations and, on the other, focused and specific collaborations. There is clearly a need for start ups to be focused and specific in their collaborations given their scarce resources. However, start ups that are developing new technologies may also need degrees of freedom on how to proceed, together with whom, when and in which directions. In our cases we have not observed open R&D collaboration together with potential customers. However, according to Coviello and Joseph (2012), this could be of high value to a start up and a way of recognising opportunities. Overall, how start ups should interact or collaborate with others is a "matter of judgement" (Snehota, 2011, p. 4) as there is always a need for interaction to manage relationships (Håkansson & Ford, 2002). We can conclude that, for start ups, managing relationships with collaboration partners requires judgement and reflection, given that the firm's boundary becomes somewhat blurred when a business is seen as an integral part of a business network (Snehota, 2011).

Hence, this research adds to the understanding of collaborative R&D in business networks in that it identifies forms of collaboration with a range of development partners and not just customers. Nonetheless, in line with previous studies, we see that for many start ups customers are the most important category of collaboration partner. In most cases, interaction with future customers is a must in order to gain access to valuable resources (knowledge, testing facilities, etc.), receive feedback on the use of the product (see Coviello & Joseph, 2012; Laage-Hellman et al., 2014), and understand how the product fits into the customer's operations (Aaboen et al., 2011).

Our research is based on a case study approach of R&D collaborations, and we have pinpointed a need for balancing different types of collaborations from the perspective of a start up. To learn more about the network context in terms of *how* start ups go about establishing and carrying out R&D collaboration in individual as well as connected relationships, leading to successful innovation, there is a need for further research. Given the complexity of this phenomenon, we think it would be useful to conduct more case studies, not least based on the industrial network approach, in order to capture the connectedness between collaborations to understand the networking patterns of start ups.

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6

Starting Up from Science: The Case of a University-Organised Commercialisation Project

Malena Ingemansson Havenvid

6.1 Transforming Science into Business: What Are the Challenges?

Today, the conventional view of the university is not just that of an independent research and educational institution but also as a direct source of new business ventures and innovation (e.g., Meyer, 2003; Rider, 2009). Although universities have historically been expected to contribute to society in various ways (Widmalm, 2008), the contemporary role of the university is to have a more or less *direct* impact on economic growth by providing 'productified' research results ready to become embedded in a business setting (Ingemansson, 2010). The role of creating an *indirect* economic impact, by producing new knowledge and educated people that eventually create benefits for society, is now widely regarded as

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outdated and a more 'networked' view of how universities are supposed to contribute is taking over. This point of view is illustrated by the following quotation from the Lisbon Strategy, which was created as a guide for the European Union (EU) to develop into a 'knowledge-based economy':

> In the past, universities would develop new knowledge and, when it was mature, it might be picked up by business for commercial application. Far too much knowledge remains locked up in universities and the development of new knowledge takes too little account of the needs of business. This innovation model is out of date. Today, innovation is built around knowledge networks which, by sharing, developing and accumulating knowledge, facilitate a rapid development of products and services out of new ideas. (EU Communication from the Commission to the European Council, 2006, pp. 4–5)

The basic idea is that, in a knowledge-based economy, achieving innovation—new products and services—greatly depends on the development and sharing of new knowledge. From this perspective, scientific academic knowledge, and especially cutting-edge science, is given a special role as it in many ways represents the 'knowledge frontier' and therefore potentially holds a great value in spawning new business ideas. A key barrier to achieving such innovation, therefore, is when this type of knowledge remains purely 'scientific' and is not related to business needs in an effective way. Based on this assumption, policy makers have directed substantial resources to the support of academic entrepreneurship and technology transfer (Siegel, Waldman, & Link, 2003)—not least in relation to licensing and start ups (Bower, 2003). This support does not just come in the form of financial resources or legal and patenting consultancy for the researchers, but government is now also encouraging universities to take on a proactive role in the commercialisation of research (ibid.). Through the forming of innovation-facilitating organisations (holding companies, technology transfer office (TTOs), incubators, etc.), universities participate actively in selecting, developing, commercialising and exiting science-based commercialisation ventures (e.g., Baraldi & Havenvid, 2015; Baraldi & Waluszewski, 2011). Since the mid-1990s, this development has greatly affected the engagement of Swedish universities in the issue of commercialisation, and prominent examples of innovation-facilitating systems can be found at Uppsala University, Karolinska Institutet, Lund University and Chalmers University of Technology (Styhre & Lind, 2010).

University initiatives that commercialise research induce a number of questions regarding the requirements for successful commercialisation, as well as the particular conditions for creating businesses on the basis of scientific discoveries (e.g., Baraldi, Ingemansson, & Launberg, 2014). These initiatives have also spawned a wide range of studies investigating policies and commercialisation initiatives in a field now referred to as *university entrepreneurship* (Rothaermel, Agung, & Jiang, 2007). Focusing on how to best nurture scientific knowledge development from a business standpoint, the literature in this field includes investigations of associated features of the universities that commercialise its research, of their internal innovation-facilitating systems, of the commercialisation projects and start ups that are created, of different innovation-promoting policies as well as of the potential 'receiving' industries. The factors that in turn are identified as impacting the success rate of commercialisation are intimately related to the features of the nurturing environment in which business-directed scientific knowledge is supposed to be produced. For instance, access to financial and human resources (e.g., Jones-Evans & Klofsten, 1999), availability of business knowledge (e.g., Locket, Siegle, Wright, & Ensley, 2005), and certain features of the university environment that have a potential impact on the commercialisation projects (e.g., Gregorio Di & Shane, 2003) are all interpreted as key factors.

As this literature assumes a direct link between scientific knowledge development and innovation, focus for how to promote innovation is on how to foster this knowledge development; if the right conditions are in place as this knowledge is being developed, the greater the chances for commercial success. It also follows that the main determinant of whether universities or other public institutions are successful in commercialising research is the quantity of patents, licences or spin-offs that are created. Regardless if the patents or licences are being used for commercial purposes, or the spin-offs are selling products, the scientific knowledge is then perceived as having taken on a commercial form, which is regarded as one of the main challenges. However, in this chapter, it will be argued that the achievement of innovation—the widespread use of any new solution—is not facilitated by changing the conditions for knowledge development. Rather this process is dependent on how *the new*—be it knowledge or a physical solution—can be combined with existing resources in several different settings (Håkansson & Waluszewski, 2007). The context in which the new solution is developed—the *developing setting*—is merely one of three empirical settings that need to be able to combine the solution with their existing resources in a beneficial way in order for it to become an innovation. To enjoy widespread use, the solution needs not only be developed but also manufactured in a *producing setting* consisting of production facilities and business relationships. In addition, it needs to be purchased and utilised by a number of different customers, which means that it has to be combined with resource structures within a *using setting*. Represented by an industrial network perspective (Håkansson et al., 2009), this view holds that both the development and implementation of knowledge is context-dependent. As such, the value of any new piece of knowledge can only be understood in terms of how it relates to specific contexts, that is, the specific resource structures in which it is implemented. Therefore, in order to understand how the work of universities to commercialise scientific research relates to innovation, the relationship between individual, science-based solutions and their developing, producing and using settings must be included in the analysis.

From this standpoint, the purpose of this chapter is to discuss some of the challenges involved in attempting to commercialise science within the context of university initiatives for commercialisation. Using a case study of a commercialisation project initiated and run by a governmentally owned holding company run by Uppsala University in Sweden, the discussion focuses on the individual contributions of the developing, producing and using settings, as well as how these settings needed to relate to each other. Before learning more about the case, we will have a further look at how some of the issues of commercialising science-based solutions are described in the university entrepreneurship literature, and subsequently, at how such a challenge is understood from an industrial network approach.

6.2 Different Interpretations of Commercialising Science

6.2.1 Interpreting the Lack of Internal Resources as the Main Challenge for Science-Based Ventures

While being an obstacle in general for start ups, the lack of internal resources for the project or the start up business is portrayed particularly significant for projects and ventures originating in academic research. As touched upon in the introduction, one such resource is relevant knowledge, and particularly how to develop it from a business standpoint. Referring to new ventures in the interface between public and private, Locket et al. (2005) identify the 'knowledge gaps' that these ventures face at different stages of the spin-off process as a key area for further research. They see knowledge and organisational learning as crucial to investigate further in terms of the business skill sets and capabilities that might be missing at different stages of the new venture. Numerous other studies focus on the need for such knowledge at several organisational levels: the level of the individual academic (Locket et al., 2005; Meyer, 2003), the level of the start up team and management (e.g., Rothaermel & Thursby, 2005) and the level of the innovation-facilitating units (i.e., TTOs, incubators, innovation offices, etc.) (e.g., Siegel et al., 2003; Moray & Clarysse, 2005).

Regarding the individual academic level, it is often believed that academic researchers do not possess the required business knowledge for starting and running a spin-off company and therefore should leave business-specific tasks to business people. However, the inventor should be involved in the new venture in terms of the technical aspects of the invention (Locket et al., 2005). At the level of the start up team, it has been suggested that university spin-offs often consist of teams with insufficient business capabilities, and that the composition of the management teams needs further attention (Rothaermel & Thursby, 2005). At the level of the innovation-facilitating units, it has been proposed that, as the proper transfer of knowledge between the unit and the new venture is so important, the knowledge and skill set of the unit also becomes a crucial resource for successful commercialisation. Thus, the knowledge and skill sets that are relevant for the venture are, first, being able to operate from a commercial standpoint and, second, having an understanding of the specific industry, its customers and the appropriate usages of the technology (e.g., Bower, 2003; Colombo & Grilli, 2010; Feeser & Willard, 1990).

Another crucial resource that is often mentioned is capital. The access to venture capital has been highlighted as having a positive correlation to firm growth, measured as the number of employees of the venture. According to Hellman and Puri (2002), venture capitalists also provide professionalisation of start ups by assigning CEOs and filling other key positions in the company. Further, Colombo and Grilli (2010) distinguish between companies with different levels of industry-specific knowledge, and state that the involvement of venture capital is more valuable to start ups with a lack of this type of knowledge. They conclude that *The entrepreneurship literature generally agrees that human capital of founders and access to venture capital (VC) are two key drivers of the success of new technology-based firms* (Colombo & Grilli, 2010, p. 610).

The general perspective of this literature is that, if the appropriate skills are in place, a new venture should have a better opportunity of surviving and growing. However, while these skills should be industry-specific, address customer needs and technology usage, they are residing within the boundaries of the start up, or at most within the innovation-facilitating context that surrounds it (for instance, the incubator environment). Innovation-facilitating units at universities are viewed, then, as important facilitators of obtaining and transferring such knowledge to the project or venture. While this research has merit, it pays little attention to the need for interaction with the contexts involved in producing and using new products or services. Instead, these contexts are seen as separate in terms of it being possible to have knowledge regarding their requirements without specific interaction. In the next section, I present the industrial network perspective, which holds that interaction is an essential part of innovation processes, and consequently of the development of new ventures.

6.2.2 An Industrial Network Perspective on Science-Based Ventures: The Challenge of Relating the Developing, Producing and Using Settings

The Different Logics of Developing, Producing and Using

From an industrial network perspective, any new solution developed through science, or through any other activity, needs to fit into a socio-material world consisting of investment and other activities if it is to become an innovation. A number of industrial network studies have shown how the value of new technology in this sense is relative and relational (e.g., Ingemansson, 2010; La Rocca & Snehota, 2014; Linné, 2012; Shih, 2009). The relative value refers to how it can be combined with existing solutions in implementing contexts, and the relational value refers to how its benefits depend on the interaction processes between producers and users. This shifts the focus from the internal conditions of the new venture to the inter-organisational context in which it needs to become embedded; it also shifts the focus from the new solution the venture represents to how it fits into resources and can create benefits for others.

Ingemansson & Waluszewski, 2009 and Waluszewski (2007) identify three empirical settings, into which any attempted innovation needs to fit in order to become a widely used solution. These are referred to as the *developing*, *producing* and *using settings*. The developing setting represents resources adapted to the processes of research and development (e.g., Håkansson et al., 2009; Rosenberg, 1994; Van de Ven, Polley, Garud, & Venkataraman, 1999). Typically, these processes take place within environments that deal with explorative activities on a permanent or temporary basis, for example, public research environments, R&D departments or short-term development projects. In the development setting, the solution can remain 'open' in the sense that several directions and options are pursued simultaneously. In the producing setting, on the other hand, the new solution will need to be compatible with physical production facilities, supporting technologies and suppliers of materials and services. In this setting, standardising at least some features of the solution in relation to these production resources is therefore necessary (Dosi, 1982; Håkansson

& Waluszewski, 2007). For individual customers to take the new solution into use, they need to be able to combine it with their existing resources from a using point of view. Customers might represent various types of user environments that all need to gain some value from implementing the solution in combination with a number of other solutions. It might be a solution intended for use within hospital departments specialising in cardiovascular surgery, or for farmers involved in corn production. Either way, each using setting needs to combine the new solution with its specific resources and activities in order to benefit from its use. It is from the combined effects of these uses that the producing setting, in turn, needs to be able to create a positive economic outcome. Thus, the way the various customers purchase and use the solution over time is essential to how the producing structure can create economic benefits from engaging in its production (e.g., Rosenberg, 1982; von Hippel, 1988).

These empirical settings thus represent three distinctly different contexts, into which any new solution needs to fit in order to become an innovation. In addition, in any specific case, the producing and using settings consist of specific resource structures of knowledge, particular technologies, technical components and the suppliers of those technologies and components. Also, the *way* the new solution fits, or does not fit, into each of these three respective settings will affect the other settings. In this way, the settings are also interrelated, which is the main challenge for the development of new innovations. The settings individually relate to the new solution in different ways, whether from a developing, producing or using standpoint. However, the way the settings are interrelated implies that how these different 'logics' work together will significantly affect the innovation process. The different logics, in turn, are a matter of the specific resource structures in these settings. Furthermore, the interaction processes among them will affect how each setting can merge the new solution into its resource structure.

The Importance of Resource Structures

As has been argued, from an industrial network perspective the outcome of innovation processes is to a large degree directed by how the solution can be combined with the existing resource structures that the new solution is to fit into, rather than the qualities of the solution itself. Also influential in the success of innovation processes is how these structures function together as part of developing, producing and using logics. Furthermore, the actors might have different interests and objectives when engaging in such a process. In a study of the semiconductor and biotechnology industries in Taiwan, Shih (2009, p.199) states that the outcome of innovation processes is related to how the involved settings each manage to take advantage of existing resource structures, despite their different interests in doing so: *[…]producing, using and developing interfaces[…] can be characterized by close interaction or be very distant from each other. But irrespective whether the structures are close or not, they all have to take advantage of existing material and immaterial resources […]. This means that the settings will be interdependent at the same time as they have partly conflicting interests.*

In a study of an inter-organisational biotech project involving both academic and business actors, Lind (2015) also addresses the issue of different interests and goals. The project involved actors representing a developing setting (developing the scientific base of the project) as well as potential producers and users. Among these actors and settings, there were different goals that were primarily related to their respective sets of resources. Through a 'goal—and resource-matching' process, some of the goals eventually intersected by the actors identifying resource combinations as 'mutual resources', while others did not. This illustrates that, in the development of new solutions, the interests and objectives of the involved actors will relate to the resource structures in which they operate and how they can utilise them in relation to the new solution; this has been identified as a possibly even greater challenge for science-based ventures than for other ventures (e.g., Ingemansson, 2010; Ingemansson & Waluszewski, 2009). While the developing setting is involved primarily in academic knowledge production, both the producing and using settings represent different value-creating logics and objectives. In turn, this can make the identification of mutual resources difficult.

It also suggests that the outcome of developing new solutions and forming new ventures is not determined by any one actor or any one particular resource. Rather, it is dependent on how *the new* is combined with a number of different resources within different settings, and how the actors in those settings can create beneficial resource combinations in relation to each other. Along these lines, Ciabuschi , Perna, and Snehota (2012), p. 228 propose that new business formation needs to be considered as a collective rather than an individual act: *Given this collective nature of new business formation, how a venture will develop is difficult to foresee and also prevents any single actor driving and directing a new venture autonomously.*

Next, we will investigate a commercialisation project run by the governmentally owned holding company at Uppsala University that involved both academic researchers and business actors. By engaging in a joint collaboration for a new type of battery solution, the aim was to direct and speed up the commercialisation process towards industrial production and use, by gathering together the necessary actors. However, first we will look into the method used to engage in a case study of this project.

6.3 A Note on Method

This chapter details a case study of a commercialisation project that ran from late 2010 to early 2014. The case study approach is often chosen when the focus lies on analysing the role of the context (e.g., Dubois & Gadde, 2002) and the fundamental reasons for particular events (Dubois & Araujo, 2004). It is thus a matter of going in-depth into specific processes and investigating the reasons why they have unfolded in specific ways (Flyvbjerg, 2006). In this study, this was done by investigating the settings of development, production and use in terms of the actors involved in each setting and the main resources related to the processes of the project. For this purpose, *resources interaction* (Håkansson & Waluszewski, 2007) was used as a central concept to identify and analyse the technical (products and facilities) and organisational (organisational units and relationships) resources surrounding the new solution in the respective settings. By making the new solution the focus of study, and examining how it interacted with the surrounding resources in these settings, the purpose was to gain insight into the ways in which science-based solutions need to relate to established business networks, and what role innovation 'intermediaries' or facilitating actors can play in that process.

What should constitute the 'boundaries' of a case study is a widely debated issue with little consensus (Ragin & Becker, 1992). Here, the events that are described and analysed are confined to the time period during which the project was funded (2010–2014). The analytical focus was on tracing the resources of the three described settings that affected the development of the new solution in various ways. With this focus, the study is based on interviews with and observations of the central actors involved in the project as it progressed. The interviews were done over the period 2010–2014 with the academic researchers, the commercial partners and the holding company—in total, 15 interviews. Participating observations were made during two meetings involving the project members in 2010 and in 2012. All the commercial sites of the actors involved were also visited: F.O.V in Borås, Sweden; ETC in Gothenburg, Sweden; and FMC Biopolymers in Ewing, New Jersey, USA. Written sources such as project descriptions and scientific publications related to the project were also used. In addition, three bachelor theses investigating the industrial networks of the project's commercial partners (suppliers and customers) were completed in 2011. The overarching purpose of these theses was to investigate the commercial potential of the new technology in terms of how the partners could engage in the commercialisation project using their respective business networks.

6.4 The Case of the Salt and Paper Battery Project: Developing, Producing and Using Settings Involved in an Attempt to Commercialise Science

6.4.1 The Initial Scientific Research and Development: The Idea for a New Battery Takes Shape

During the 1990s, a research group at the *Department of Nanotechnology and Functional Materials* at the *Ångström Laboratory* at *Uppsala University* started to do research on the cellulose of a particular type of alga—*Cladophora*. The research work, which was led by an associate researcher specialised in nanotechnology and a PhD student with a degree in pharmacy, was based on developing knowledge about the particular features of its surface area, and how this could potentially be used for biomedical and pharmaceutical purposes. It was concluded that this cellulose had a very high surface area (~100 m^2/g), had a high crystallinity[1] and could be dispersed in water. As a result, it had superior qualities compared to the cellulose traditionally used in pharmaceuticals (tablets). In the late 1990s, this discovery created an interest at the *FMC Corporation*—a global supplier of chemicals for agriculture, food industry and pharmaceuticals. FMC was also the only supplier in the world of this particular type of alga cellulose and was therefore a potentially very beneficial collaborator from the research group's point of view. This resulted in what would become a longstanding collaboration between one of FMC's divisions, FMC Biopolymer (now FMC Health and Nutrition) and the research group.

During the first years of the collaboration, the work mainly concerned potential applications for pharmaceuticals. This resulted in the research group discovering several new qualities of the material that were useful for tablets, some of which proved valuable for FMC. The research at Ångström continued, and the idea that the material could also be used for conductive purposes started to form. The question they asked themselves was, what would happen if we could make a material with this high surface area to conduct electricity? Cellulose is however not a conductive material, rather it is used as an isolator of electricity. However, due to the high surface area of the alga it had great potential of interacting with the surrounding environment and with other materials, and therefore also had the potential of interacting with and containing a great deal of ions. For this purpose, the cellulose was coated with a conductive type of plastic (polypyrrole) which made it 'electroactive'. By placing this joint material in a fluid and bringing on a voltage, ions could be 'forced' into the material from the surrounding fluid. The idea was that this material could be used for biotechnical and biomedical purposes as a way to filter both desirable and unwanted protein from different types of solutions. However, in this process, it was discovered that the material could hold a lot more ions than expected. As the basic idea of a battery is that it

[1] This means that the material is organised in a particular structure (compared to an *amorf* material which is organised in a random structure).

should contain as much ions as possible to get a high-energy density, the idea that it could be used as a battery was born. In a publication of these results in the scientific journal *Nano Letters* (Nyström et al., 2009), in which the material was shown to efficiently charge and discharge (thus functioning as a superconductor), it was stated that *we introduce a novel nanostructured high-surface area electrode material for energy storage applications composed of cellulose fibers of algal origin individually coated with a 50 nm thin layer of polypyrrole. Our results show the hitherto highest reported charge capacities and charging rates for an all polymer paper-based battery* (ibid.). This became one of the most read articles of the journal the same year it was published, 2009. It was these initial and encouraging results that were the foundation of starting an academia–industry collaboration led by Uppsala University Holding AB (UUAB) Holding—the holding company managed by Uppsala University and owned by the Swedish government—in the pursuit of commercialising a new type of battery.

6.4.2 A Joint Academia–Industry Commercialisation Project: The Producing and Using Settings Get Involved

In December 2010, the start up meeting of the commercialisation project around the new potential battery was held at Arlanda Airport in Stockholm. It had by then been named the *Salt and Paper Battery Project* (S&PB project) as these were the basic components of the battery—cellulose and a saline solution. The project group attending the meeting consisted of both Swedish and foreign company representatives, a Finnish research institute and the academic researchers from Uppsala. The agenda for the day was to discuss how to proceed in the technical development as well as commercialisation of the new material that could be used for a new type of battery solution. The group, led by the holding company at Uppsala University, UUAB, had just received financing for the next three years from the Nordic Innovations Centre (NICE)[2] for academia–industry collaboration. The goal of these

[2] NICE is a cross-border organisation under the Nordic Council of Ministers for the promotion of economic growth and competitiveness in the Nordic countries. For further information: www.nordicinnovation.org.

three years was to bring forward a prototype that would be ready for commercialisation, that is, industrial applications. A criterion for receiving funds from NICE was that several Nordic countries had to be represented in the group, which, of course, affected which members were selected. However, UUAB's idea for how the group should be formed also specified that the members should represent knowledge and experience of (1) how to further develop the material from a scientific and/or technical standpoint, (2) how to identify appropriate uses and products for the new battery and (3) how to manufacture it in an economically viable and environmentally friendly way. Therefore, the members represented scientific and expert knowledge (the research group at the Ångström Laboratory and the Research Institute of Finland, VTT), a potential industrial user (F.O.V Fabrics in Borås, with its connections to the car manufacturing industry) and production skills with FMC Corporation—a global producer of cellulose and speciality chemicals. The group also had members with product development skills in how to design batteries, namely the battery-testing and development company, E.T.C Battery and FuelCells Sweden AB in Gothenburg, Sweden. This company was also working closely with the car manufacturing industry and had experience of setting up pilot production lines for batteries.

The project leader, UUAB, would coordinate the members of the project, facilitate communication within the group and pursue suitable industrial partners. All members of the group, both commercial and academic, were subsidising the commercialisation project so that they would function as *active* members, actively contributing to the commercialisation process from the standpoint of their respective businesses and ongoing activities.

6.4.3 The Interpretation of Production and Use: The Roles of the Industrial Partners

For UUAB, there were a number of options in relation to an attempt to commercialise the potential battery. One of them was to form a start up, but, as the research was still in its infancy, it was not considered the optimal course forward at that point. Also, from earlier experience of start ups, UUAB believed that this option would take too much focus away from the technical development and the search for appropriate usages of the battery. Instead, it wanted to try a different direction. By forming a group consisting of actors from both academic research and relevant industrial environments, UUAB's idea was to work with several aspects of the commercialisation concurrently, so that the process of finding a use for the new product would be sped up. Whether or not this would lead to the forming of a start up later on was considered a future issue. It had the intention of coordinating scientific research, marketing of the project and the product, as well as setting up a pilot production of the new product more or less simultaneously; as these aspects would be dealt with in parallel, the commercialisation process would also be accelerated. In this coordinating role, the first and main task of UUAB was to identify at least one application for the technology, so that the technical development, marketing and production could advance with the help of an industrial partner, whether within the project group or an 'external' partner. The ambition of facilitating the transition of the new battery from science to industry by handling several issues in parallel shaped the constellation of the project group and the roles of the different actors. Next, follows a presentation of the industrial partners of the project and what their intended roles were.

FMC Biopolymers

FMC Biopolymers—a division of the global corporation FMC Corporation—was involved through its units in Philadelphia, USA, and in Trondheim, Norway. The work of trying to incorporate the *Cladophora* alga in cellulose production was mainly done in Philadelphia. The work in relation to the project of developing and commercialising a new battery technology was focused on scaling up the production of the alga cellulose from laboratory to pilot scale. The task of the group at FMC was to supply the S&PB project with cellulose that could be used for research and development purposes, either by the researchers at Ångström and VTT or the other commercial partners, ETC and F.O.V. Therefore, it was important that the cellulose it supplied to the project was of optimal quality for the particular purpose of developing a material with high-energy density and thus had a high surface area. This demanded that the process development group at FMC needed to start at laboratory scale in its investigation of what types of equipment and chemicals could be used, and then scale up this process. As such, it was about starting from scratch, attempting to build a production process around the *Cladophora* alga.

ETC Battery and FuelCells

As a development company involved in battery testing, ETC Battery and FuelCells in Gothenburg was considered by UUAB a useful partner in testing and developing the new material as part of a commercial battery. ETC was a small non-profit organisation that would act as a link between academia and industry. Its members represented several Swedish universities (among them Uppsala university), private companies (Vattenfall and Göteborgs Energi) and the municipality. ETC owns and/or collaborates with a number of companies, such as the spin-off company, Alelion, which produces lithium-based batteries and of which ETC still owns about 10 %. There are also collaborations and joint projects with, for instance, SAAB and Volvo. ETC's role in the S&PB project was design and laboratory-scale production of battery cells, electrical testing, suggestions for potential applications and suggestions for how to set up a pilot production of battery cells. It was also to work together with Motorola in developing a prototype for a remote control based on the new battery technology. In direct connection to the S&PB project, the battery-testing facility expanded in terms of testing equipment, and a new manager was hired to handle both the testing activities and the communication with the rest of the project group.

F.O.V Fabrics

F.O.V Fabrics is situated in the heart of textile production in Sweden (Borås) and has a vertically integrated production of clothing and technical textiles (for instance, for the car industry, the military etc.). With about 100 employees, it manages to produce about eight million square metres of advanced fabric per year, with the European market as its prime target. The most famous product developed by F.O.V is the airbag, which was launched during the early 1990s. The two current owners of the company, who bought it in 2008, have the ambition of continuing the development of technical textiles. One specific product area they have identified as potentially profitable in the future is that of so-called smart textiles, in which conductive fabrics is one trend. Therefore, when the research results became known to them, the owners of F.O.V approached the research group at Ångström. A dialogue was initiated and, when the opportunity of financing from NICE appeared, F.O.V joined the S&PB project. Its role in the project was dual: to assist in the development of suitable fabric material that could be used as a component in the battery, and identify potential application areas for the battery in terms of technical textiles and clothing. For this purpose, F.O.V hired an electro engineer who was to work with the technical aspects of different fabrics, both in relation to using it as a component in the battery and as an application. Demands from the research group at Ångström related to required qualities of the fabric material was the trigger for the search for fabric suppliers within their established supply network, as well as from 'outside'. Another issue was which type of fabric coating could be used for attaching electrodes, and this was investigated in collaboration with the Swedish School of Textiles. One central issue, apart from the technical development aspects of the battery and how it could be made to function in a textile product, was the identification of customers for such products. Smart textiles and conductive textiles were, and still are, very new product areas and there was no existing supplier to learn from.

6.4.4 The Outcome of the Three-Year Funded Project

The foundation for the commercialisation project was the research results made at Ångström that related to how a particular material with a high surface area (algal cellulose coated with polypyrrole) could carry electrical charge. While the results had shown that it was possible to charge and discharge this material, there was a lot more to find out about *how* this charging and discharging was taking place, so that this process could be controlled and optimised for different purposes. To coordinate this continuing research effort, and to create a distinct link between the academic research and the commercialisation project, the Department of Nanotechnology and Function Materials hired an assistant researcher specialised in electron transport. The objective was to do academic research relevant to industrial applications.

However, an unanticipated discovery put the focus of finding industrial uses for the battery on hold; there was a problem with actually getting the material to hold the charge, and instead it discharged quite quickly. How and why this was happening was far from obvious. The initial hypothesis was that it was related to how the materials were combined in the battery (how the solids reacted with the fluid etc.) and that the solution to the problem, therefore, was to change how the combination was set up. However, further research showed that it was an integral quality of the conducting polymer itself (the polypyrrole); the material degraded as it was being charged, which eventually made it discharge. In 2013, and thus by the end of the three-year, NICE-funded S&PB project, the research group had reached two important understandings in relation to this issue: *how* the material was degrading, and that it was possible to charge the material without degrading it. However, there was still no conclusion in regard to how this could be done within the framework of a battery. In the research process of reaching these two conclusions, the research group stopped using cellulose from alga, as this particular type of cellulose only added to the complexity of trying to learn what was happening with the polypyrrole material and why. Also, in the effort of reaching enough charge of the battery, there were difficulties with completely excluding metal components, which was the initial goal.

During the three years of the commercialisation project, the research generated several PhD projects and publications, and it became the single largest research programme in the department in terms of staff and funding. For the purpose of doing further research on the basic features of the material, the research group obtained funding through a five-year research grant from the *Swedish Foundation for Strategic Research*. During the time of the grant, the group also established an important relationship with the Finnish research institute, VTT, which supplied it with essential knowledge of the properties of the material as well as craftsmanship in handling it in experiments. This cooperation has led to several co-publications of Ångström and VTT, as well as subsequent joint research projects supported by EU funding.

For the commercial partners, the S&PB project was not as significant in relation to the creation of the new battery. In relation to the research that was and is going on at the Ångström Laboratory—which at one point excluded the *Cladophora* alga—FMC Biopolymers is no longer a key partner. However, FMC has, as a result of the project, developed a pilot-scale production (from harvesting to production) of this particular alga cellulose that preserves as much surface area as possible; currently, this is mainly related to the production of their existing products. ETC is also presently no longer involved in the research taking place at Ångström; its collaboration with Motorola is also dormant, as the S&PB has not proven itself as a functional battery technology yet. In addition, when the funding of the project ended (and as ETC is a non-profit organisation dependent on external funding), the company needed to search for other projects in which to become involved. Even though F.O.V Fabrics took the initiative to become involved in the project, hiring new personnel to develop suitable fabrics and tried to identify both suppliers and customers for conductive textiles, it did not engage any suppliers or customers in the project, nor did it engage its own production facilities. In its judgement, these activities were not something it could proceed with until the new technology was further developed and it could determine what type of production adaptations would be necessary. It is, however, still collaborating with the research department at Ångström.

By the end of the project, UUAB had changed its strategy from trying to identify at least one application for the Salt and Paper Battery to a wider approach of marketing the technology as a platform for developing and commercialising different energy storage solutions. The project thus changed its name to *Energy Scandinavia* (ENESCA) and, in the pursuit of industrial partners, it now attends international industrial conferences with central researchers in the Ångström research group, marketing the project through, for instance, crowd sourcing for further ideas of how to implement the new technology.

6.5 Discussion

UUAB's effort to industrialise the production of the new battery technology was unsuccessful within the framework of the NICE-funded project. Speeding up the commercialisation process by involving commercial partners at an early stage and, in this way, trying to shape both the research and commercialisation process in particular directions, did not work—at least not within the set timeframe of the project. To discuss the challenges of engaging in such a project, this section analyses the actors involved in the project from the standpoint of the resources they brought to it, as well as the larger resource structures they represented.

From the logics of development, production and use stated earlier (Håkansson & Waluszewski, 2007), we can conclude that these settings each have a particular way of engaging in the innovation process. In any particular case, there are also specific actors and resources that represent these settings; this has several important implications, for example, while a general logic can be applied to these respective settings, any particular case must be understood from the standpoint of the specific actors and resources involved. This also means that the outcome of the innovation process is a result of these specific actors and resources and, consequently, the specific interaction processes they engage in, both in relation to the innovation process and to all the other activities in which they are involved (e.g., Van de Ven et al., 1999). A second implication is that the existing resources of these actors—with which the potential innovation is to combine—such as knowledge, production facilities and business relationships, are in turn related and adapted to a larger resource structure *unrelated* to the potential innovation. In the case of university-organised commercialisation projects, this means that the outcome will be the result of interaction processes involving different settings conditioned by different logics. More specifically, these settings involve actors with specific sets of resources, and thus each project needs to be understood in the context of how the new solution can be combined with these resources that relate to larger structures 'outside' the project.

In the case presented in this chapter, there was an overarching common objective of the project members to try to develop the battery towards industrial production and use. However, in this pursuit, each member organisation needed to find individual ways to combine the solution with their existing resource structure. In turn, this resulted in different ways of trying to benefit from and engaging in the project. Part of the *developing setting*—the research group at Ångström Laboratory and VTT—mainly engaged in testing materials in terms of learning about their basic qualities and features. Being involved in basic and applied research, these actors engaged a set of resources that were suited for exploring the components of the potential battery on a fundamental level. While there was a clear interest in identifying commercial uses for this potential battery solution, these actors could also benefit in other ways from the ongoing research process. Therefore, the quite unpredictable development process of the potential battery was actually creating a number of unforeseen benefits. The research group at the Ångström Laboratory produced several publications and PhD projects, engaged in further research collaboration with VTT and received further funding from different sources. Thus, from an academic point of view, the way in which the battery remained a 'research puzzle' was in this way positive; in fact, it grew to become the largest project at the department.

As the research needed to gain more knowledge about the energy-storing material (polypyrrole), the development process took a particular direction. This in turn had direct consequences for FMC Biopolymer. Involved in both developing a pilot production line and producing large quantities of the specific alga needed for the project, FMC was part of the *producing setting* for a main component of the battery. During the project, it managed to develop and scale up the whole process, from harvesting to supplying the alga. However, as an effect of the research process in the developing setting, the alga was eventually removed from the research process and consequently the project, which meant that the resource structure of FMC was no longer of any benefit to the developing setting or to the project at large. However, for FMC, this was not a purely negative development, as its larger resource structure of earlier investments, products, production facilities and business relationships was mainly related to algae and not to batteries. Therefore, its main interest was in pursuing more knowledge and developing more efficient ways of handling this specific alga in relation to the products it was already involved in, such as pharmaceuticals and foodstuffs. This meant that the resource adaptations performed by FMC were still creating benefits for it, but not in the way originally intended. Thus, while FMC appeared to represent highly relevant business knowledge at the onset of the project, and even engaged in the production of a main component, the way the commercialisation process evolved due to the developing setting completely changed its role. This complicates the idea portrayed by some of the university entrepreneurship literature that the appropriate knowledge and skill sets should be in place for a more successful commercialisation project (e.g., Locket et al., 2005; Rothaermel & Thursby, 2005). Evidently, the knowledge and skill sets that are needed can change quite drastically as an effect of the interaction of resources, both within and between settings.

For the potential users—F.O.V and Motorola—the ever-evolving nature of the research process and solution made any investments or adaptations in their resource structures inconceivable. Before the basic features of the potential battery technology were established (such as the components and their conductive abilities), it was difficult for them to relate it to their existing products, production facilities, suppliers and customers. Thus, the *using setting* of the potential battery was finding it impossible to justify the engagement of any resources in relation to an unfinished technology. F.O.V was a potential user of the battery in terms of incorporating it into textiles and it represented knowledge of large-scale production, but only in relation to fabrics and textiles. Therefore, it first needed a functioning battery in order to justify adapting its production processes to the new technology. The same applies for Motorola; in order to start incorporating the battery into its products, it would have to be clear how it would interact with the other components of its products and production processes. This shows that, while the idea of engaging potential users in the project was a way of trying to speed up the commercialisation process, the processes needed for a 'true' identification of use to happen require embedding the new solution within specific user environments. As a first step, this demanded that some features of the solution remained constant. As shown by Ingemansson (2010), the overall effects of such embedding processes take time to appear and it is only through these that the 'true' user pattern and buying behaviour is revealed. Again, this complicates the picture of having knowledge of the appropriate usages of new science-based technology ex ante (e.g., Bower, 2003; Colombo & Grilli, 2010; Feeser & Willard, 1990).

Lastly, ETC was also involved as part of the developing setting in creating a pilot production line for a complete battery solution. However, due to the insufficient knowledge and financial and production resources that ETC involved in the project, it would not have itself been able to become a producing unit for the new battery. Its knowledge and technical resources were thus connected to developing batteries, not producing them. This means that there was no 'full' producing structure around the potential battery technology. Thus, the producing setting, represented only by FMC Biopolymer, could not engage in establishing a production process that could assemble or produce the battery as a whole. While there surely would have been some challenging adaptation processes had such an actor been involved, there were no resources that could have been used as a standpoint for such a process.

This analysis shows that the potential battery solution, that was originally supposed to be a 'mutual resource' (Lind, 2015) from which all the project members could create various benefits, primarily remained a resource to the academic researchers in the developing setting. The producing setting managed to use the development of the solution in a beneficial way only in relation to one of its components, the alga, to which its resource structure was already adapted. For the using setting, it was hard to provide guidance on how to further develop the solution, as it could not relate it to its existing resources. This also made it difficult to create any benefits from a using point of view. The role of the innovation-supporting holding company, UUAB, was to facilitate and coordinate the commercialisation project. However, as the analysis of the settings of development, production and use has shown, the influence of such support was very limited, as the process depended on the interaction between settings that needed to create their own benefits in relation to their specific resource structures. These existing structures were not something that UUAB could have had any real influence on. Therefore, it was ultimately about how the potential battery solution could be combined with these structures and which adaptations could be made on this basis. In this combining process, the actors that benefitted did so not necessarily in relation to the goal of the project, but primarily in relation to their own existing resources and ongoing activities.

6.6 Conclusions

The nowadays 'networked' policy view of universities suggests that they are (or should be) part of knowledge networks that ultimately facilitate and speed up the development of new products and services. One approach that has been observed at several prestigious Swedish universities is to organise commercialisation projects based on new research to identify commercial applications that might otherwise have remained 'undiscovered'. From this view, the main problem of commercialising science is that the knowledge being produced at universities traditionally is 'locked up' rather than being more openly revealed to various commercial actors. Making universities and researchers part of networks that include business and investment actors is therefore seen as an essential part of the solution to this problem. Focus is placed on the *availability* of scientific knowledge, which, once accessed, can be applied in a business environment, with the right skills.

The university entrepreneurship literature (e.g., Rothaermel et al., 2007) investigates a number of factors that appear to affect how well science-based ventures succeed. In essence, these factors relate to the resources available for the individual venture to exploit, for instance in terms of relevant knowledge as well as financing. Here, the focus is instead placed on the individual venture, project or start up, in terms of how it needs to build a base of human and financial capital to make sense of relevant markets. This type of 'inside-out' perspective of the firm presupposes that the knowledge needed for the new venture to develop as a business can be identified ex ante, that is, before the involvement of relevant production partners and users. Although some type of market analysis and forecasting is necessary for new ventures without established producing or using structures (existing suppliers and customers), this assumption is problematic. Firstly, it is far from evident which type of customers is actually relevant and, secondly, it is largely unknown if and how they will use the new products or services (e.g., Ingemansson, 2010; Waluszewski, Håkansson, & Ingemansson, 2014).

In the case presented in this chapter, it was shown that, while business actors were involved in the project, the way their knowledge could be applied was largely dependent on how they could engage their existing resources in the project and which benefits that could be created from doing so. Thus, in order to engage in the production and use of any new solution and provide specific knowledge of how to do so, it needs to become related to the resource structures to which it is supposed to contribute. Therefore, 'general' business knowledge is insufficient and, even when specific actors interested in commercialisation are involved, the main challenge remains how to engage in the innovation process in a beneficial way from the different logics of development, production and use and in relation to specific resource structures. Furthermore, from the perspective that knowledge is context-dependent, the assumption that scientific knowledge development can be shaped by the facilitation of innovation becomes 'backwards'. Rather, to serve a purpose, knowledge will mainly be related to its surrounding context, and therefore its actual usefulness always needs to be revealed over time through interaction processes. Thus, from an industrial network perspective, the ultimate challenge of starting up new ventures from science lies not in how to better 'reveal' new research results to commercial actors or how to gain access to human and financial capital. The main challenge is rather managing to combine the new solution created from these results into producing and using settings. This is part of a process that lies outside the influence of any individual actor (Ciabuschi et al., 2012), as it needs to involve multiple actors that need to be able to create their own respective benefits from engaging in either producing or using the new solution.

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Part IV

Academic Spin-Offs and the Issue of Commercialising Science. Some Empirical Experiences

7

The Impact of a Start Up's Key Business Relationships on the Commercialization of Science: The Case of Nautes

Enrico Baraldi, Andrea Perna, Fabio Fraticelli, and Gian Luca Gregori

7.1 Introduction

The purpose of this chapter is to shed light on how start ups deal with the complex task of commercializing science. While the *linear "spin-out funnel"* model (Clarysse, Wright, Lockett, Van de Velde, & Vohora, 2005) views commercialization simply as a bridge between technology and the market, the process of connecting science to industrial or societal needs is more complex and transforms the original science into something else

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(Pavitt, 2004; Grandin, Wormbs, & Widmalm, 2004) rather than simply transferring it over a bridge. This "something else" is often "downgraded" because the most cutting-edge discoveries are too advanced and clash with established investments and the other technologies already in place (Håkansson & Waluszewski, 2007, pp. 6–10). Therefore, most scientific knowledge is used in the business world, after it has already been embedded in a complex socio-technical network through several connections created with surrounding technologies, actors and organizations (Håkansson & Waluszewski, 2007, pp. 6–7). Following this approach towards the commercialization of science and the adoption of a network perspective (Håkansson & Snehota, 1995) means "the real challenge in commercializing science is making it fit in the established socio-technical structures of producers and users" (Håkansson & Waluszewski, 2007, p. 10).

This challenge is even more compelling when, as shown in previous studies (Aaboen, Dubois, & Lind, 2011), we consider that the efforts of new ventures to commercialize their offer depend on some *initial and key business relationships*—specifically customer relationships—as well as *particular conditions* that affect, at a network level, the new venture's development. Therefore, we take the perspective of a new venture facing a business network, and we refer to science as the object of a commercialization process, whereby a complex set of relationships transforms science into something else of commercial value. Because start ups are small companies and have minimal network connections, the first relationships they establish play a pivotal role in the new venture's development. Accordingly, we call them "key relationships".

Against this background, the purpose of this chapter is to illustrate how initial key relationships influence the way in which a start up commercializes science. The first part of the chapter offers theoretical insights into the critical role that business relationships play in supporting or limiting the efforts that new business ventures make to commercialize science. The second part of the chapter focuses on the particular case of an academic spin-off, Nautes, established at the Università Politecnica delle Marche, Italy, and its first customer relationship. By means of this empirical study, we emphasize how business ventures are shaped and strongly affected by their initial and key business relationships, which can play two different roles: as facilitators or inhibitors of the commercialization process. The chapter ends with a discussion of how new business ventures may overcome the barriers created by the first business relationships and exploit the opportunities related to their initial and key customer relationships. More specifically, by looking at the academic spin-off as a central actor, we focus on how this new venture, managed by researchers with limited experience commercializing their innovation, engaged with a large customer and *learnt*, albeit in a turbulent way, how to take its business forward.

The main contribution of this chapter is its explanation of the commercialization process of science by taking an inter-organizational perspective. Secondly, we investigate the complex nature of relationships between new and established companies. Thirdly, we examine the embedding process of science over time by describing several adaptations between the new solution and the surrounding context (Akrich, Callon, & Latour, 2002, p. 209; Van de Ven, Polley, Garud, & Venkataraman, 1999), starting from the first customer and continuing with subsequent customer relationships.

7.2 Theoretical Background

New business ventures creation and development have attracted the attention of many researchers, and the debate in academia is still blooming. Within the domain of entrepreneurship studies, how, why, when and under which conditions new companies develop has been an important research area for a long time (Shane & Venkataraman, 2000). As pointed out by Jones and Holt (2008), it appears that this phenomenon is not yet clear enough. Considering its relevance from both a managerial and scientific perspective, it deserves additional study. In other words, it would be interesting and intriguing to shed more light on the "chaotic and complex" process of new business creation and development (Aldrich, 1999).

The role that business relationships play in supporting a company's development is widely recognized within the Industrial Marketing and Purchasing (IMP) tradition (Ford, Gadde, Håkansson, & Snehota, 2003, 2006; Håkansson & Snehota, 1995). Developing new products with counterparts, entering a new business and expanding the business operations abroad typically require the creation and development of business relationships. But establishing business relationships is a complex task for both established and new ventures (Gadde, Hjelmgren, & Skarp, 2012; Håkansson & Ford, 2002; La Rocca, Ford, & Snehota, 2013): "*the development of a customer relationship requires coordination of the interactions between a customer and a supplier. This coordination entails costs and problems for both companies and it limits their freedom to coordinate with others*" (Ford, Gadde, Håkansson, & Snehota, 2011, p. 53).

In the past few years, specific studies have investigated the impact of business relationships on the creation and development of new business ventures (Ciabuschi, Perna, & Snehota, 2012; Snehota, 2011). One challenging aspect identified is the *specificity* of the early business relationships in enhancing or hindering the new venture's growth.

The key role of relationships for new business development is even more pivotal when we refer to science as the "product" of a new venture, since the production and using setting will require significant changes and adaptations in the science being commercialized, so as to make it more "productified", reproducible and reliable. In particular, providing an embedded view of commercialization, Baraldi and Launberg (2013) stress that "*the 'embedding process' of science [into pre-existing networks consists of] the emergence of interfaces between a focal scientific discovery and the other material and immaterial resources necessary for developing, producing and utilizing it, so to turn that science into an innovation…*"

The "resource interaction perspective" (Baraldi, Gressetvold, & Harrison, 2012) provides a useful toolbox to investigate the way in which key relationships affect start up development: by focusing on particular types of resource interfaces and how they change over time, this perspective helps to map the process of the commercialization of science and how it is affected by key relationships. Therefore, the analysis in this chapter revolves around the key relationship that influences the development of a new business venture in parallel with the commercialization of its science, namely the process that transforms science into a product/service valuable for new users.

Some IMP studies have been carried out with the specific purpose of illuminating such issues: for instance, Aaboen et al. (2011) analyse how start ups develop their initial customer relationships. These authors clearly show that the product offered by the new venture has to fit with the customer's resource structure, and there is an important implication: by interacting with the customer, the start ups learn with whom they can develop future relationships (ibid., p. 56).

Besides the positive effects that the initial relationships have, new ventures also face several problems when interacting with counterparts for the first time (La Rocca et al., 2013). The product might still be partially incomplete or the organizational form under development: accordingly, the early relationships look undeveloped, unstructured and uncoordinated (ibid., p. 1026). Moreover, as shown by Johnsen and Ford (2007), because new ventures lack the experience to manage initial relationships, they are likely to be greatly influenced by their counterpart at this stage.

Therefore, the influence of the initial key relationships on start up development may turn out to be *positive* as well as *negative*. Håkansson and Snehota (2002) point out that business relationships always have a certain burden. The authors discuss several reasons, motivations and factors negatively affecting the development of business relationships. For instance, the more the company is *dependent* on few relationships, the higher the burden of those relationships will be (ibid., p. 92). Because they are not yet established within the business network, new business ventures depend on the few other counterparts they have started building relationships with: consequently, the termination of a key business relationship may have overwhelmingly negative effects for the start up at this early stage.

This overview of the literature has introduced the impact of key business relationships on the commercialization of science and hence on the development of academic start ups. Our theoretical background dealt with both the positive and the negative side of building business relationships from the new business venture's point of view.

7.3 Methodology

This chapter relies on a case study focusing on 14 years (2001–2015) of the operation of a high-tech company, Nautes S.p.A. (Nautes), an Italian university spin-off from the Università Politecnica delle Marche

(UNIVPM). The case was chosen because it represents an intriguing example of a spin-off that during its early development was mostly affected by one initial customer relationship. Moreover, it can be considered the first academic spin-off from UNIVPM, and this “mother organization” is an actor that played a complex role in Nautes’s development. In order to investigate the pivotal role that these two key business relationships played for Nautes, we adopt a qualitative case study method (Yin, 2003). The empirical material was collected between January 2014 and June 2015 by using two different and complementary strategies (Stake, 2005, p. 443): data collection was handled via in-depth interviews and public or internal document analysis. Interviews were collected through a typical cumulative approach, by interviewing new informants as they were mentioned as “bearer[s] of specific knowledge and useful to reconstruct the facts” by other informants, while documents were double-checked with key informants to evaluate their internal validity.

Eight face-to-face interviews were conducted, recorded, transcribed and jointly analysed by the researchers using a protocol of content analysis preliminarily shared among the authors in order to deduct a “meaning of the meanings”. The people interviewed were one full professor at UNIVPM (Prof. D.I.—fictitious name) responsible for the “Liaison Office” at the time of Nautes’s founding, one manager at the UNIVPM (Mr. A.I.—fictitious name) responsible for the “Liaison Office” today, two current representatives from Nautes (Mr. Gialletti, CEO and founder, and Mr. Massimo Manzi, sales manager) and one former representative from Nautes (Mr. M.D.G.—fictitious name, board member of Nautes).

The case analysis was developed using an *abductive* approach (Alvesson & Sköldberg, 2009, p. 7), which, according to Mayan (2009), aims to generate interpretations that ask for new data collection in a kind of snowball path. In other words, we opted for “systematic combining” (Dubois & Gadde, 2002): an iterative process was used to analyse collected data in the light of an emergent theoretical frame.

The collected data are solid enough to describe the phenomenon accurately and to reflect on the possibility of refining and developing the existing understanding of new venture development and commercialization of science as viewed from a network perspective.

7.4 Case Study

7.4.1 Overview of Nautes in 2014

Nautes S.p.A. (Nautes) is an Italian firm focusing on the design and development of software for social and project management, learning management and troubleshooting. In 2014, the company's turnover was €1.5 million (Gialletti, 2015). It had reached €1 million in 2008, representing a steady yearly average growth of 25 % since 2001, the year it was established, and then increasing at a yearly average of 10 % until 2012 (Gialletti, 2015). Nautes currently employs 30 people.

Nautes develops and produces solutions for midsized and large Italian companies such as Indesit (one of the largest home appliances producers in Europe), Maserati (producer of luxury cars, which belongs to the Fiat Automobile Group) and CheBanca (an Italian bank). In 2015, the consolidated portfolio included more than 60 customers operating in several industries, including banking, pharmaceuticals, manufacturing and services. The customer retention rate over time is more than 30 %, and around 20 clients make up 70 % of the total turnover (Gialletti, 2015).

Currently, Nautes offers three products: Nautes SM (a social/project management system), Nautes LM (a learning management system) and Nautes TS (a customer support system). Nautes SM is a software platform aimed at reducing time to market for innovators through a high involvement of human resources and a shared goal approach. Nautes LM is a tool for managing corporate learning through offline, online and blended courses. Nautes TS is a problem-solving system that optimizes the use of resources for customer support. Moreover, the company provides co-development services to customers in need of customized features for complex projects.

7.4.2 2000: The Origin of Nautes's Business Idea

In 2000, the Departments of Civil and Building Engineering and Architecture of the Università Politecnica delle Marche (UNIVPM) located in Ancona, Italy, took part in an international consortium involving several European universities and companies. The consortium was formed around “W.I.N.D.S.”,[1] a research project whose aim was to define a set of requirements for advanced design learning environments. One of the main goals of this project was the creation of a Web-based intelligent design tutoring system. Because of the need of digital technology, the W.I.N.D.S. project involved three Ph.D. students from the Computer Science Department at UNIVPM. These young researchers (Marco Gialletti, Marco Giretti and Gianluca Trombin) had enough skills in the field of computer science to guarantee the successful implementation of the tutoring system.

The W.I.N.D.S. project was important for at least two reasons. Primarily, Gialletti, Giretti and Trombin had the chance to work together, as a team, on a concrete project aimed at developing an innovative technological solution. Secondly, through this experience, they understood the relevance of exploiting the experience of end-users in software development. Marco Gialletti recognized that users, with their own cognitive processes and behaviours, should influence software features during its creation process, even at the very early stages of development. He also realized that “ergonomics” was a key success factor in the development of software, especially for knowledge management and learning platforms. The early works within W.I.N.D.S. would therefore give an important imprint to Nautes, the company that would soon be involved in the development of digital learning environments focused on simplicity and usability.

7.4.3 2001: Request for Financial Support Following a Business Plan Competition

The success of the W.I.N.D.S. project inspired the three Ph.D. students to take part in eCapital, a business plan competition that funds innovative ventures.[2] This competition is still supported by public institutions such

[1] As the official project’s brief explains, W.I.N.D.S. involves the analysis of a number of students’ design review sessions in regular university classrooms, in order to point out the relationships occurring between the different forms of designers’ cognitive involvement (conceptual, visual, social, emotional, etc.) in design. http://www.dicea-bc.univpm.it/index.php/deisgnstudies/web-based-intelligent-design-tutoring-system-winds

[2] http://www.ecapital.it/

as the regional government of Marche and UNIVPM, and its first edition was organized in 2001. Participants have to present a business plan that is assessed and evaluated by a scientific committee (comprising researchers from several universities from the Marche region). The best idea is awarded a financial grant. Although Giretti and Trombin were involved from the beginning, Gialletti was the main promoter of the new venture initiative, and together they received a grant to set up a new business venture: Thus, Nautes was born on June 28, 2001.

7.4.4 Nautes as a Quasi-Spin-Off

The initial capital investment in the company was €15,000, which was the entire value of the grant received from eCapital. From the very beginning, Nautes's founders aimed to commercialize some form of Web-based software to support learning and tutoring.

"*Nautes was funded under the impulse of the vision of its founders. In 2001, we strongly believed that the knowledge management software industry could be vigorously innovated by simplifying interfaces and processes, and just because of this idea we started our business. Once we received the winning prize from eCapital, we set up our offices in Jesi, our hometown, and we started working on a new software idea*" (Marco Gialletti, Nautes's CEO).

At the time, Nautes had no direct or formal connection with UNIVPM. The only link with the university was indirect and informal: the company founders had their scientific affiliation there. Nevertheless, the university's management and faculty greatly appreciated the efforts of Gialletti and his colleagues in setting up a company starting from a project that was born in a university department. Very soon, Nautes was framed—at least informally and internally—as the first university spin-off of UNIVPM. Moreover, at a time when there was a great expectation about the role that universities could play as an innovation actor, Nautes was seen as an important test bench of the spin-out process for the entire university.

"*In 2001, when Nautes was funded, UNIVPM was working on the development of a set of rules for the regulation of academic spin-offs. Nautes was therefore seen by UNIVPM as an 'archetype' of what 'transferring knowledge'* *would mean in the following years. There was a great deal of attention and a lot of interest about what was going on with Nautes. The W.I.N.D.S. Project Director (Prof. Grassi), and the Rector himself were enthusiastic about the initiative of Nautes, and they emphasized its value—even if symbolic—on several official occasions*" (A.I., UNIVPM International Liaison Office).

When UNIVPM eventually finalized the regulation of academic spin-offs in 2001, Nautes was the first company to be formally named as an academic spin-off by this university.

7.4.5 UNIVPM and the Development of the Initial Business Relationship

Historically, UNIVPM initiated collaborations and developed joint research projects with private companies from the area around Ancona. Those collaborations led UNIVPM to gain trust among these companies and to be recognized as a valuable partner of these companies in new technology scouting.

Among these collaborations, the relation between UNIVPM and a leading Italian company operating in the lighting business, "IGU" (fictitious name), was particularly strong. IGU was established about 50 km from Ancona in 1959. The company currently employs more than 1,000 people, and the turnover in 2014 was €184 million (IGU, 2015). IGU operates internationally with a number of owned retailers across Europe, Asia and the Americas. Historically, IGU has worked with the Department of Civil Engineering at UNIVPM to develop and test new products. Fresh graduate engineers from UNIVPM are also regularly recruited by the company. Even if IGU was not directly involved in the W.I.N.D.S project, its managers heard about the Nautes experiment and were interested to understand how to use its technology to improve its own processes.

According to Gialletti, the "Nautes experiment" caught the attention of several key actors related to UNIVPM, but IGU was the first to understand its potential and to start looking for a concrete way to introduce the Nautes's approach into its own processes.

7.4.6 The First Customer

In October 2001, IGU put the first-ever order to Nautes: it asked for the development of "LC", a new e-learning platform that would be used to train its customers (installers and architects) all over the world. What made it possible for a totally new company like Nautes, without a prototype or a pilot installation of its product, even to be considered as a reliable supplier by a big company like IGU?

According to Professor D.I., one of the promoters of UNIVPM's first spin-offs regulation, the exchange of information between UNIVPM and IGU was a preliminary condition that made the latter interested in Nautes as a potential supplier. Moreover, the W.I.N.D.S. project was a catalyst of relationships for at least two main reasons. Firstly, thanks to this experience, IGU had the chance to get to know Nautes' scientific background and genesis. Secondly, Professor D.G. (fictitious name), the formal supervisor of the W.I.N.D.S. project, endorsed the Nautes team based on his direct work experience with its members. Moreover, the role played by Professor D.G. was essential in putting Nautes and IGU in contact with each other: as stated by Professor D.I., "*the role of D.G. was essential to guarantee the trust needed to obtain the first order by a worldwide player on the international market of lighting design*" (D.I., Department of Information Engineering, UNIVPM).

The business relationship between IGU and Nautes turned out to be fruitful from the start: IGU found a reliable IT partner that was able to provide knowledge management solutions, while Nautes got an excellent chance to commercialize its technology despite having limited experience in sales. While Nautes handled some technical issues related to the complexity of the project, the interaction developed over time: the main effect of this increasing complexity was reflected in the negotiation of the price of the solution provided by Nautes. Since the technology was offered to IGU at a very convenient price, no particular problems arose in this regard for the first few years. Gialletti was very willing to establish the business relationship with IGU, mostly with the goal of learning as much as possible from it.

In 2002, IGU's commitment to its business relationship with Nautes grew stronger in response to the high quality of technology offered, as well as the strong commitment demonstrated from Nautes's side. Consequently, IGU decided to buy a stake corresponding to 30 % of

Nautes's capital. Thanks to this operation, IGU also acquired a place on the board of Nautes.

For six years, between 2002 and 2008, IGU was Nautes's main (indeed, dominant) customer. With a total turnover of nearly €5 million over the years, IGU regularly accounted for about 80 % of Nautes's turnover. Minor deals were struck with other clients, but IGU always influenced these new business relationships: moreover, these "minor" clients were often business partners of IGU or located in the Ancona area.

The importance of the business relationship with IGU has been well pointed out by Gialletti: "*The business relationship with IGU was essential for our development. Its international and complex profile encouraged the continuous improvement of our software and gave us the chance to learn from the best players, not only regarding products but also managerial practices*" (Marco Gialletti, Nautes's CEO).

IGU had provided Nautes with commercial opportunities and was fully engaged in supporting its R&D activities. It was clear that IGU considered Nautes its own "spin-off" more than a university spin-off.

7.4.7 Conflict with IGU

Over time, Gialletti and his colleagues realized that the business relationship with IGU could potentially lead to problems. Although IGU provided most of the turnover, it often constrained Nautes with respect to the development of new customer relationships: it believed that the strength of Nautes' solutions mainly derived from the definition of the requirements made by the staff of IGU. Additionally, IGU considered Nautes an internal IT department aimed at developing a learning management solution for the company. Nautes was too focused on creating customized features on LC and was not capable of creating general, resalable and scalable products. In 2008, tension between Nautes and IGU emerged when IGU's representative on Nautes' board tried to hinder Gialletti's attempts to develop new customer relationships. While Gialletti was focused on pushing the firm's technology onto the market by offering it to new potential customers, IGU was not open to sharing it with others.

In 2009, as a result of this tension, IGU sold its shares and exited from Nautes. The company also stopped making purchases from Nautes. Of course, this action caused a major financial problem as Nautes' turnover was dramatically reduced: in the 2003–2008 period, IGU's weight on the total turnover had been around 43 %, while in 2009 it was only 20 %, and in 2010 less than 5 %.

In order to avoid a fatal crisis, Nautes had to start looking for new potential customers immediately, as Gialletti described in an interview: *"A new high-tech venture, especially when it's an academic spin-off, is based on big innovation. This kind of company is often mostly involved in the technical details of product development, and it risks neglecting the importance of understanding the deep needs of customers and competitors' offerings. After IGU's exit, we had to systematically identify our unique selling proposition, while creating a sustainable business model and reinforcing our [other] business relationships"* (Marco Gialletti, Nautes's CEO).

7.4.8 "Recovering" from IGU: Searching for a New Customer

In 2009, in order to create and develop new customer relationships, the Nautes management team was focused on two main activities. Firstly, it was looking for experienced salesmen who could relate Nautes to new customers and introduce its technology into its processes. Gialletti met a university schoolmate who had resigned from a large consulting company in the Milan area. This person accepted to introduce Nautes to some companies with which he had developed projects in the past: in 2009, Nautes developed and then sold a customized solution for learning management to "Che Banca" (retail bank of the Mediobanca Financial Group). This new customer balanced the losses caused by IGU's exit and prevented a huge reduction in sales.

Secondly, Nautes engineers started to redesign the software that had originally been developed for IGU. The new product design was "market-driven", meaning that Nautes, for the first time since its inception, applied a systematic review of potential customers' needs and competitors' offerings. Because of this analysis, a completely redesigned software interface was introduced, and the entire software suite was made accessible online through browsers or mobile devices.

During this phase, UNIVPM played an important role—like at the beginning, when it connected the company to IGU—in facilitating the creation of relationships with new customers. In particular, after IGU's exit from Nautes, UNIVPM's management board mentioned Nautes during workshops and conferences as a successful knowledge-transfer experience, which contributed to building a positive reputation for Nautes.

7.4.9 The Further Development of New Customer Relationships

Starting in 2010, Nautes created commercial partnerships with companies that were operating in complementary sectors, such as consultancy or IT firms. Massimo Manzi, the sales manager at Nautes, frames these partners as different "channels" through which Nautes' technology reaches various customers. Owing to the peculiarity and the characteristics of the firm's products, third parties like independent agents cannot sell them autonomously. In other words, Nautes is still not in the phase of selling its solutions by delegating the entire commercialization process to a direct or an indirect sales force. However, Nautes has been shifting from the "special project paradigm"—whereby it created a unique, customized solution for each customer, sharing just the same software core with other projects—to the "customized product" paradigm—whereby each customer receives a parameterized version of Nautes' product, with some lines of specially developed code provided on a case-by-case basis. This paradigm shift is also witnessed by the composition of Nautes's revenue sources over the years: until 2012, the value of revenues from software licences and customizations had been only 30 % of special projects revenues, while in 2014 it was more than 60 %.

7.5 Discussion

The case of Nautes sheds light on how start ups deal with the complex task of commercializing technologies, especially science-based ones, by building initial key business relationships. Furthermore, this case is useful in defining the concept of commercialization itself, by conceiving it as a process of development of business relationships more than simply as a bridge between technology and the market.

In particular, our discussion addresses how key business relationships affect start ups' development. We analyse the process through which Nautes commercialized its technology by emphasizing three main aspects: (1) with *which particular actor* the key business relationship was initiated, considering the characteristics of both the customer and other actors involved; (2) the particular *type of support* Nautes received from these actors (e.g., mediating, financing, learning effects); and (3) the *power and dependency* between these organizations and the start up, Nautes, as a potential source of *negative effects* on the venture's development. In order to illuminate the development process of this venture, we introduce the metaphor of "imprinting", which stresses the influence that significant other interaction partners in the surrounding network exert on the activity, resource and actor dimensions (Håkansson & Snehota, 1995) of a new venture (La Rocca & Perna, 2014).

7.5.1 Phase 1: Nautes as a University Spin-Off Imprinted by UNIVPM and IGU

Once Nautes was established in 2001, the company may well have brought together the competences and experience of some academic researchers, but by and large it was very much like a blank slate in terms of activities, resources and identity. The technology and the business idea were also only at an embryonic stage. It was at this very early stage of its life that Nautes received a clear imprint from UNIVPM. This imprinting concerned especially the *actor* dimension of Nautes, as UNIVPM assigned it a clear identity: that of being its first-ever academic spin-off. In turn, this identity further contributed to creating legitimacy, also in relation to other actors because of the connection with a well-established institution.

However, a first problem for Nautes was to find a suitable customer interested in using its technology. In this phase, Nautes was primarily committed to finding an organization with which to develop a new solution starting from its approach to software design. In the early stages of Nautes's life, "commercializing" simply meant creating an initial customer relationship that was strong enough to keep the company alive with a stream of revenues sufficient to cover its costs.

A couple of aspects of the actor-level imprinting from UNIVPM became relevant at this point: the W.I.N.D.S. project at UNIVPM was relevant to Nautes for at least two reasons. Firstly, it allowed the founders to be aware of the opportunities of developing a new and innovative solution. Secondly, the project was the spark to make Nautes reliable for established companies like IGU: even after winning the eCapital prize, Nautes did not know how to get its first customer, and it was mainly thanks to its relationship with UNIVPM, as well as the favourable connection to the W.I.N.D.S. project, that the spin-off was able to link up with IGU.

According to all the informants, UNIVPM played a crucial role in *supporting* Nautes—not so much in financial terms, but in a different form. UNIVPM already had a significant relationship with IGU and acted as a *mediator* to enable the establishment of the business relationship between the two companies. Since Nautes had never done business with IGU before, UNIVPM clearly had a *positive* influence over the development of the new venture by providing a suitable commercial opportunity. Such a role in the development of a university spin-off company is similar to the mediating function that incubators play (Bergek & Norrman, 2008, pp. 24–25; Ahmad & Ingle, 2011).

The start of the relationships between Nautes and IGU signalled another type of imprinting for the new venture—this time, more at the level of its *resources and activities*, all of which were now explicitly oriented and adapted (Håkansson & Snehota, 1995) to fit the customer's requests. In particular, the initial configuration of Nautes's business relationships, in which there was only one main customer who, after a year, also became a shareholder, emphasizes the double-edged sword nature of key relationships, which can create *overdependence*, especially at the very beginning of a new venture. How then did Nautes act and react to the imprinting from IGU?

Clearly, IGU affected Nautes's development in a positive manner, at least up to a point. Nautes's survival and growth in the earliest stages of its life have been made possible by the *financial contribution* of the first deal with IGU. Nautes also *learnt* how to negotiate with external partners, thanks in large part to its interactions with IGU: it is important to stress here that Nautes was a much smaller firm than IGU, and therefore any occasion for negotiations and discussions offered Nautes important learning opportunities. Finally, this relationship also provided an important opportunity to connect with and then exploit significant resources held by IGU once the relationship was established: for instance, IGU's managerial competences, processes and needs were exploited by Nautes in order to further develop and test its software solutions. The imprinting by IGU clearly marked Nautes in terms of its new R&D activities as well as financial and technical resources gained thanks to this customer relationship (Håkansson & Snehota, 1995).

However, interacting with such a large and dominant customer also has disadvantages for the further development of the start up. Being the main customer of Nautes, IGU is perceived (at least at the very beginning) as the most promising way for Nautes to commercialize its technology. The commitment of Nautes to this relationship is therefore absolute and complete and, as a result, reduces the bargaining power of Nautes and allows IGU to have a strong influence in product configuration. This business relationship is like a cocoon that allows Nautes to survive during the first stages of its life, but it simultaneously traps Nautes and prevents it from growing freely, thus becoming a crystal cage. The initial advantage of IGU's imprinting disappears or, better, is transformed into a strong dependence on IGU that soon locks Nautes into the structure of IGU, with its resources and activities all oriented in a single, unilateral way that limits their heterogeneity (Håkansson & Waluszewski, 2002; Penrose, 1959), that is, the possibility of being recombined in new ways with other resources, ideally with other actors in the network (Baraldi et al., 2012).

This is why *tensions and conflicts* appear over time as the key relationship with IGU develops. When it was no longer a vital opportunity, the relationship with IGU became a clear problem. After the decision to increase its control of the relationship by acquiring Nautes shares, IGU even had the formal power to limit the freedom of Nautes to expand its network horizon (Ford et al., 2011) by finding new customers. Without a doubt, Nautes made business out of the relationship with IGU, but from a certain point on, IGU acted more as a hindrance to the development of Nautes. Without any reaction to the imprinting received from IGU, the tangible risk for Nautes would be to limit its development (Håkansson & Ford, 2002).

In summary, the development of Nautes has been both *positively* and *negatively* affected by the key relationship with its first main customer.

7.5.2 Phase 2: Nautes Connects to Others Within the Business Network

When Nautes decided to take measures to leave its first key customer relationship, it had to reorganize its internal resources in order to grow by finding new customers. The imprinting from IGU meant, for instance, that Nautes had not developed any real marketing function. Therefore, first of all, the marketing and sales department gained importance over the technical one. This shift was due to an evolution in the very meaning of commercialization, which the Nautes management teams developed internally thanks to—or even as a reaction to—the business relationship with IGU. Commercialization moved from being viewed as “the process of understanding the needs of a customer and translating them into a bundle of software features” to “the process of relating to a business network”. This shift basically amounted to opening Nautes to the imprinting coming from many more actors than just a dominant one.

Nautes understood the importance of acquiring and connecting with new resources capable of introducing the firm’s technology to other customers. After acquiring additional customers from a former consultant in the Milan area, Nautes started to develop repeatable and scalable patterns to find sales partners with whom to develop new projects (something they called “channels”).

Nautes did not have a stand-alone “product” yet, but rather than being totally dependent on a single special project with only one customer, Nautes started repeating the “special project paradigm” through several new business relationships being developed (the Nautes team labels this approach “customized products”). Nautes is therefore still an IT service company capable of partnering with other companies (namely consultancy firms) that pass its technology on to final customers. In fact, since 2010, only 35 % of Nautes's whole lead generation has come from the company's own sales force. The reconfiguration of actors, resources and activities in this phase is totally oriented towards reducing dependence on a single customer and a single "channel". Thus, the development we observed goes from being *imprinted* by one or just a few dominant actors to becoming open to the influence of several actors in its network.

7.6 Concluding Remarks

This study adopted the IMP perspective to investigate the impact of key relationships on the development of new ventures, focusing empirically on an Italian university start up that soon after its founding commercialized a knowledge management IT software. This case study explored how the new business venture has been affected by two main business relationships that left clear imprints at the levels of its activity, resource and actor dimensions (Håkansson & Snehota, 1995). For instance, one of these relationships, the one with the customer, ended up exerting a positive effect at the beginning before subsequently blocking the company's development.

These dynamics make visible what many IMP studies have shown in terms of the "burden of relationships" (Håkansson & Snehota, 2002), especially when new companies are struggling to become more established (La Rocca & Perna, 2014). Our contribution rests in showing that such burdens *also* hold for newly started companies, and thus for relatively *new relationships*, rather than long-term, established and hence institutionalized relationships, which are those typically mentioned as burdens for the particular companies (Håkansson & Snehota, 1995, p. 10).

The case suggests that besides the duration of a relationship, the *power/dependence imbalance* in a relationship between a small new firm and an established large one can also be a source of problems, as it creates a burden at least for the less powerful party. The smaller and younger firm needs not only stability and certainty, which a larger and more established counterpart can offer, but also the freedom to develop and broaden its repertoire of experiences.

On the other hand, the very same "burdening" relationship can also have positive impacts on the small party: as we observed, Nautes *learnt* several things by interacting with the same larger counterpart, such as how to negotiate and how to exploit its technical knowledge. In some way, despite the tensions and the break caused by the power/dependence imbalance, the very same relationship can also prepare the ground for further developments of the new venture. There is, however, in the background also another relationship, which, although probably not directly involved in daily operations, can be activated when needed, namely the one with the "mother" university, which acts as a *bridge to other relationships*.

Thus, the relationships with both UNIVPM and IGU have clearly influenced how Nautes has sought and cultivated other new business relationships in order to overcome the crisis with IGU. Therefore, both the internal learning process based on substantive interactions with key partners and the dynamics of single relationships affect and shape the pattern of future business relationships developed by the start up.

To sum up, this case study shows the importance of the key business relationships in "shaping" the next development of new relationships, particularly when the actor has limited resources available and is new to a network. In line with Ford et al. (2011), the understanding of interactive behaviours in one or more business relationships represents an important step in explaining how other business relationships develop.

As for further research avenues, we stress the need to develop a dynamic model focused on understanding how new ventures, such as university spin-offs, *balance* the effects of the *imprinting* derived from initial relationships with the *independence* that seems necessary to let the company embrace "others" within the business network. Our empirical case clearly confirms the relevance of coping with these issues: imprinting and independence can be viewed as two opposite forces that frame new venture development from an interactive point of view.

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8

Start Ups as Vessels Carrying and Developing Science-Based Technologies: Starting and Restarting JonDeTech

Enrico Baraldi, Marcus Lindahl, and Andrea Perna

8.1 Introduction

The creation of start ups is often aimed at commercializing science-based technologies (Pries & Guild, 2007; Shane, 2004; Wright, Clarysse, Mustar, & Lockett, 2007) and keeping control of them (Siegel, Waldman, Atwater, & Link, 2004). However, due to a high rate of failure, it is particularly hard to predict whether or not start ups will succeed in commercializing their technology. Several barriers have emerged over time at individual, financial, organizational and technological levels (Markman, Siegel, & Wright, 2008).

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Start up companies, including academic spin-offs, need to overcome several critical junctures and reach a final threshold of sustainability (Vohora, Wright, & Lockett, 2004). However, inter-partner problems, cultural issues, lack of awareness about customers' needs and lack of financing may limit the possibility that a technology reaches the market. One possible scenario is the failure of start up. Consequently, an intriguing research problem is understanding whether the technology carried by the failing company follows the company's destiny or it continues living, irrespective of the company's faith. And, if the technology continues its innovation journey (Van de Ven, Polley, Garud, & Venkataraman, 1999), it is interesting to explore how this was possible, including the key question of "who takes it over?" A new *vessel* carrying it along the innovation journey appears necessary or else it would sink in the treacherous waters of the "innovation sea".

As much as research on entrepreneurship focuses on the individual entrepreneur or the start up company per se, it tends to neglect what happens after the company fails, as much focus is rather on the success factors or possible causes of failure, such as the aforementioned barriers. Moreover, in management research, there is a bias toward sampling success stories rather than unsuccessful ones (Denrell, 2005). Accordingly, there is a need of looking beyond the company's failure or success.

Focusing on the faith of a single company and closing analysis after the successful introduction of a technology or its failure, either in the lab, the "death valley" or on the market, misses the rather typical restart and creation of *new* commercial ventures based on the *same* technology (see e.g., Hoetker & Agarwal, 2007).

Studies such as Hoetker and Agarwal (2007) show that the knowledge of failed companies "lives on" and can be diffused across the entire industry through their former employees, acting as carriers to other organizations. However, rather than these general knowledge diffusion patterns, this chapter concerns what happens to material resources, competences and relationships created specifically by the various actors such as universities, private companies, public agencies and research centers involved at different times with focal science-based technology.

Therefore, a key research question is *how these resources, competences and business relationships are transferred from a specific vessel to the next one*, which takes over the baton along the innovation journey. In order to shed light on the mechanisms that allow the transition of technology and related resources from one organization to another, we have been inspired by Gilsing, Bekkers, Bodas Freitas, and van der Steen (2011), who point out that academic spin-offs are "effective vehicles to exploit radical, early-stage technologies" (Gilsing et al., 2011, p. 640).

We consider, instead, the concept of a "vessel" as a metaphor for identifying *any kind* of organizational arrangement which brings technologies throughout the innovation journey. Since this journey entails *embedding* the technology in different and constantly changing contexts (Baraldi, Gregori, & Perna, 2011) where new actors can emerge over time, it may even be difficult to identify a specific organizational "structure" hosting the technology at a certain point in time. Therefore, we introduce the concept of a "vessel", because it embodies the dynamic nature of technology transformation when moving from one organization to another. Different types of vessels can be start ups, established companies, inter-organizational research projects or a combination of them. One important characteristic is that vessels are identified here as "temporary hosts" of science-based technology.

This type of research purpose calls for a longitudinal approach by analyzing the innovation process of science-based technology by first looking at how the vessels (e.g., start ups) combine resources around this focal technology (Ciabuschi, Perna, & Snehota, 2012) and then at the mechanisms by which these resource combinations (Baraldi, Gressetvold, & Harrison, 2012) move from one vessel to the next. Against this background in order to address these issues, this chapter features a case study centered on infrared (IR) sensor technology based on academic science and the companies acting as vessels that carried and developed it, including the bankruptcy and restart of one of these, JonDeTech. The chapter is organized as follows: first, we provide our theoretical framing and then refine our research questions and methodology. This is followed by the case study of JonDeTech, which is analyzed and discussed in our discussion and conclusion sections.

8.2 Theoretical Background

Historical analyses of technology development indicate that the innovation journey of focal technologies simultaneously continues if the companies or the other more or less formal organizational structures and teams behind the technology fail or disappear.

For instance, the pyrosequencing DNA analysis technology was first introduced in the market by the Swedish firm with the same name, but was later dismissed due to difficulties in achieving profitability by the originating company, just to eventually become a commercial success under the control of the US firm 454 (see Ingemansson, 2010 and Strömsten & Waluszewski, 2012). Another example is the thin-film solar cell technology copper indium gallium diselenide (CIGS). Developed by the Swedish firm Solibro, this technology was later involved in the bankruptcy of its parent company, Q-Cell, and was eventually purchased and commercialized by the Chinese firm Hanergy (Perna, Baraldi, & Waluszewski, 2015).

Evidence shows that, despite the failure of companies, technologies can live on or that the failure of a company can even support the diffusion of its knowledge to other organizations and enable a restart of the innovation process with multiple companies involved (see Hoetker & Agarwal, 2007). Indeed, in their longitudinal analysis of long-term innovation processes, Van de Ven et al. (1999) stress how the actors involved in an innovation journey change constantly—some enter and some leave it. Typically, at the end of the journey, there will be an attribution of success and fame to the organization that is still present and closely related to a technology at the moment of its eventual commercialization (Van de Ven et al., 1999), even if the major contribution to the progress of the journey was made by some other organizations or firms which disappeared or even went bankrupt along the way, just to be forgotten at the eventual moment of success.

Even if the innovation journey is chaotic and non-linear (ibid.), progressing through it comprises of the key activities of scientific discovery, technical development, industrialization (upscaling), commercialization (Aarikka-Stenroos & Sandberg, 2012) and, eventually, adoption by users. An important mechanism driving the innovation process is the creation of connections between resources belonging to the three distinct and overlapping settings of development, production and use (Baraldi et al., 2011; Håkansson & Waluszewski, 2002). However, creating such connections is challenging as the three settings represent different sets of logic which can collide, namely development requires *novelty*, production requires *efficiency and stability*, while use requires *adaptability* and *simplicity* (Baraldi et al., 2011; Håkansson & Waluszewski, 2007). What is then, the role of start ups in the innovation journey of their technologies and connecting the three aforementioned settings?

According to Ciabuschi et al. (2012), during such innovation journeys, start up companies play a key role as organizational units capable of assembling resources, otherwise widespread in a socio-technical network. This particular view on entrepreneurial efforts stresses how new ventures can create new combinations of social and technical resources, many of which have not previously been combined or connected. Technical resources include products, laboratories and facilities, whereas social resources embrace knowledge, expertise and also, a set of *business relationships* to external parties (Baraldi et al., 2012). In this sense, the firm functions as an important node connecting the technology being developed to external counterparts such as suppliers, investors and customers. These actors are in turn connected into a complex industrial network in which a new technology needs to be embedded in order to become an innovation (Baraldi et al., 2011; Håkansson & Waluszewski, 2002, 2007).

During this process of embedding, technologies need the support of particular actors to become successful innovations: start up firms can be viewed as the primary vessels which, while transforming original ideas and solutions, also propel technologies in their journey. However, these vessels also need to relate to other actors to find a broader support of their technologies (Akrich, Callon, & Latour, 2002; Latour, 1987) until they may need to make an exit (often due to economic constraints).

Other vessels may then appear, which take over the technology (i.e., physical artifacts, know-how and patents) and further transform it by combining it with other resources. However, while some resources, especially physical and codified ones (e.g., patents), may be relatively easy to take over, other resources, social and tacit resources (e.g., expertise) are more complex to transfer. In particular, it is not clear as to what happens to the relationships that the initial vessels had created to support their technology: do these business relationships disappear together with the vessel/organization, or can they still be attached to the technology, ready for some other firms and vessels to revive and exploit?

8.3 Research Questions and Note on Methodology

This chapter reverts the typical focus of entrepreneurship research. Instead of focusing on the entrepreneur or the start up venture, it focuses on a particular technology and views start ups simply as organizational arrangements that transform and carry a focal technology through its innovation journey. Consequently, our data collection on the innovation process of a particular IR sensor technology is aimed *firstly* at obtaining data about:

– which were the *organizational entities*, or *vessels*, carrying and transforming this technology from its first appearance as a scientific idea and discovery until its emergence as a product.

We are further interested in what these organizational arrangements, and especially the two involved start up firms, have accomplished for this technology in terms of assembly and combination of social and technical resources (Baraldi et al., 2011; Håkansson & Waluszewski, 2002). Therefore, we collected data about this second type of elements:

– which *resources* and *relationships* emerged within and around the vessels propelling this technology during its innovation journey.

Our first rounds of data collection indicated that several vessels (organizational teams, projects and start ups) followed each other during this innovation journey, leading us to collect further data and formulate our *research questions* more explicitly as follows:

1. Which, among the resources and relationships that vessels create and combine, are carried from one vessel to another?
2. How are the resources and relationships carried over from one vessel to the next?

In order to analyze this innovation journey and the resources and relationships of the various vessels involved, we conducted a longitudinal in-depth case study. The first round of interviews with the main academic inventor (and also entrepreneur for both start ups) and the key industrial partner was conducted in 2014 and covered retrospectively the period of 1997–2014. Afterwards, the case study was performed as real-time study following the events as they unfolded (Halinen & Törnroos, 2005). A total of nine interviews were conducted, lasting between 40 and 90 minutes. The questions covered topics such as the initial setting of technology development, motivations to establish different vessels, pattern of business relationships surrounding the various vessels at different points in time, factors and dimensions that may have affected the technology development and vessels.

8.4 A Journey with Many Vessels: JonDeTech and Sensor Technology

JonDeTech Sensors AB was founded by Mikael Lindeberg in 2013 from the ashes of its predecessor, JonDeTech AB. The head office is located in Stockholm, Sweden, and it employed five people in 2015 (Lindeberg, 2015). This company owns patents and intellectual property (IP) rights of a new IR sensor technology whose origin dates back to 1997 when a Swedish company named SenseAir AB (SenseAir) was looking for solutions to produce low-cost gas sensors. SenseAir's founder—Mr. Hans Martin—contacted Uppsala University (UU) and started a research project in which Mr. Lindeberg was involved as its main leader. In 2008, Mr. Lindeberg agreed with SenseAir to establish the spin-off company, JonDeTech. However, after nearly four years the company filed for bankruptcy.

8.4.1 A Look at the Technology: Thermophile Infrared Sensors Based on Nanotechnology

A sensor is, in general, a device which detects some specific features of its environment. Its principle goes back to more than one hundred years ago, but its structure has been developed only in recent years. Sensors typically convert a physical parameter—such as temperature—into a signal which can be measured electrically. Two different temperature sensing methods are currently present in this field: contact and non-contact. In order to work, "contact sensors" have to be put in physical contact with an object or substance whereas "non-contact sensors"—such as IR—detect temperature by capturing a portion of the energy emitted by an object. Non-contact sensors hold several advantages compared to contact sensors. For instance, they can monitor objects difficult to reach and the risk of contamination over the measurement process is removed.

Most IR thermal sensors adopt a "thermopile", which is an electronic device that converts thermal energy into electrical energy. Thermopiles are composed by several thermocouples—temperature measuring devices consisting of conductors. Traditionally, thermophiles are produced on a silicon membrane with their junctions placed beside each other in the same horizontal plane.

Producing IR thermal sensors on silicon requires a protective encapsulation, affecting the weight of the sensors as well as their field of applications. Therefore, smaller and thinner sensors can be used more extensively in a wide spectrum of applications, but the technology for producing thin IR sensors has been only recently developed. An attempt in this direction was made in Sweden by Dr. Mikael Lindeberg who published, in 2008, a journal article on the Journal of Micromechanics and Microengineering (JMM), whose main goal was to show a new and unconventional manufacturing process for very thin thermopiles based on nanotechnology.

The microstructure was manufactured by using common printed circuit boards (PCB) processing steps. Basically, the idea was to produce sensors consisting of tiny metallic nanowires deposited on the plastic of a thin PCB. An accelerator was used to irradiate the plastic material in order to make tracks.

This process should make the production of sensors at low costs and improved functions possible. Moreover, a unique advantage consisted of the "form" factor, the possibility of producing flexible sensors with a wide optical span. The sensor device—attached to a flexible PCB carrier—could be fitted, mounted or glued to most surfaces. This technology did not need any "protective housing" since it was very robust. In addition, another important factor which characterized this technology would be the possibility of modifying the "area" of the sensors according to the customers' requirements.

Therefore, this technology opened up new heat sensor applications for several consumer products such as microwave ovens, tumble driers, stoves and mobile phones. Furthermore, it can be adopted in the aerospace industry as well as in nuclear plants because it resists radiation.

8.4.2 The Origins: The "SUMMIT" Research Program and SenseAir

The origins of JonDeTech AB are intertwined with a Swedish company SenseAir and the public research program in microsystem technology (MST) "SUMMIT".

SUMMIT was launched in 1996 and ended in 2005 as an initiative for coordinating and promoting research in the MST field with the specific goal of favoring the commercial implementation of this technology in Sweden. The program included a knowledge center strongly supported by the Swedish government for financing the MST industry by means of a clear strategy focused on facilitating the collaboration between companies and academia. Therefore, the main actors involved were the *academic institutions*—UU and KTH Royal Institute of Technology, the *research institute* Acreo, *private companies* (e.g., Ericsson, Sandvik Coromant and SenseAir AB) and the *Swedish innovation agency Vinnova*, which was the founding partner.

The Department of Engineering Sciences from UU was in charge of the program with the role of main coordinator. All in all, 29 people were directly involved over the SUMMIT's lifetime. Looking at financing over the entire period (1996–2005), academic, industrial and funding partners contributed more or less with equal funding (see Table 8.1), while the research institute Acreo provided a minor contribution. The financial support was, in the beginning, oriented to develop materials and technologies but eventually extended to also cover systems and components. The R&D activities were oriented toward five main fields of MST applications: replication, fluidics, optics, sensors and actuators.

Table 8.1 Financial contributions to SUMMIT from different partners, 1996–2005 (Million euros)

	Total (Million euros)	Total (%)
(1) Academic partners (total)	**5.78**	**30.5**
– UU	4.6	24.3
– KTH	1.18	6.2
(2) Research Institute: Acreo	**0.85**	**4.5**
(3) Industrial partners (total)	**6.57**	**34.6**
–SenseAir	0.37	5.6
–Ericsson, Sandvik Coromant	6.20	94.4
(4) Funding partner: Vinnova	**5.76**	**30.4**
Total	**18.96**	**100**

In the field of sensors, SenseAir (see Box 8.1) was rather interested in developing a novel technology to make a vertical thermophile sensor for IR detection in flexible PCB. Although this company did not invest heavily in SUMMIT (only 370,000 Euro over the entire period), its founder, Mr. Hans Martin, was interested in taking part in the research program in order to find a solution for producing "low cost" thermophile IR sensors, which were the most expensive products made by SenseAir.

In 1997, Mr. Martin started collaborating with a master's student at UU, Michael Olsson, to solve the detector issue. The project led to relevant technical results, but the drawback was the expensive investment necessary for developing the production of that artifact.

In 2001, Klas Hjort—professor in Material Science at UU—was appointed as Director of SUMMIT in a time where the focus of the program shifted toward the transfer of results from academic research to industrial assets. Basically, the SUMMIT board realized that the best way to strengthen MST in Sweden was to only support research projects that had the opportunity to reach commercial interest. This was exactly what Mr. Martin was looking for in SenseAir.

At the end of 2001, Prof. Hjort came up with the idea of proposing to Mr. Martin a meeting with one of his Ph.D. candidates, Mikael Lindeberg, who was running a research project that, according to Prof. Hjort, might be very useful to help SenseAir in addressing their problems concerning the fabrication of IR sensors.

Box 8.1 SenseAir AB company's background and overview

Hans Martin received a Ph.D. degree in molecular spectroscopy from the Physics Department, University of Stockholm, Sweden. As a research student, starting in 1974, he built up the Laser Spectroscopy Sub Department, pioneering in tunable lasers and novel methods to explore molecular structures and dynamics. He started the company Laser Spektrum in 1986, working with diode laser systems and laser technology for gas sensing. With the idea based on the commercialization of low-cost gas sensing using IR technology, he became the co-founder of Martionics AB in 1989, a company which later became SenseAir AB (SenseAir).

In 2014, SenseAir's turnover reached about 12 million euros and it employed 105 people; Mr. Martin is co-owner of the company and R&D manager. The headquarters is located in a small city, Delsbo, in the central-east part of Sweden. SenseAir has two subsidiaries, one in the USA and one in China, and relies on a wide distributor network in Europe.

SenseAir has been recognized as the world-leading manufacturer of infrared carbon dioxide (CO_2) sensors and controllers.

Source: Martin (2015)

8.4.3 The Birth of JonDeTech AB

In 2003, Mikael Lindeberg successfully defended his Ph.D. thesis at UU, titled *High aspect ratio microsystem fabrication by ion track lithography,* and got a position as a postdoc researcher at the Department of Engineering Sciences, UU. In August of the same year, the first patent application was filed.

The collaboration with SenseAir started in the same year when a joint project was set up with UU aimed at showing the functionality (proof of concept) of the new technology for producing low-cost sensors. It was a very promising opportunity, starting from the research carried out by Mikael Lindeberg as the intention was to produce detectors at a very low cost and reach a price around 0.10 Euro (in the beginning of 2000, the average price of detectors was around 3 Euro).

In December 2005, when SUMMIT was concluded, Mr. Martin applied to Vinnova for about 500,000 Euro with the goal of conducting a project aimed at achieving this important production cost reduction. In the meantime, the first generation of prototype sensors was produced at UU. A couple of important results were that the principles of detection were demonstrated and the feasibility of the production process was verified. This was considered as a very important achievement. In May 2006, Vinnova granted the funding applied for to Mr. Martin, who hired Lindeberg part-time in his company at that point. Lindeberg's salary came in equal parts from SenseAir and UU.

Up to the end of 2007, the activities carried out at UU and at SenseAir by the project team composed by Mikael Lindeberg, Prof. Klas Hjort and Mr. Martin were basically focused on studying and analyzing how the low-cost sensor production process might be arranged and simplified. In June 2007, the second generation of prototype sensors was produced at UU's laboratories. Finally, the challenging fabrication process had been simplified by establishing it on the conventional PCB-processing toolbox. At the same time, the detector was tested in the SenseAir gas-sensor platform.

When the money from Vinnova ran out—in late 2007— the project team had to make an important decision concerning how to continue working on that promising project. The key question, according to Mr. Martin, was: shall SenseAir continue financing the project and industrialize the technology? After a while, SenseAir's management board realized that the industrialization process would have been quite costly and due to its small size, SenseAir would not be able to support any production development. The investment needed, estimated of being approximately 15 Million Euro, might create financial troubles in SenseAir. Therefore, the company decided to continue with their traditional business of specific gas sensor applications. Moreover, although the technology was really promising, it was still unstable and not mature enough to be commercialized in a short time. In addition, Mr. Martin pointed that the largest market potential of the technology would actually be outside SenseAir's market focus and interest.

The only possible strategy open was the possibility of creating a new spin-off company. The idea was to offer Mikael Lindeberg and Prof. Hjort to take over the technology and related IPs without any costs (a patent was achieved in 2007). Thus, in January 2008, the company JonDeTech AB was founded.

8.4.4 The Early Days of JonDeTech

JonDeTech AB, henceforth JDT1, was created as a result of an important compromise between SenseAir and the scientists Lindeberg and Prof. Hjort. If the technology would turn out to be useful for gas sensors, SenseAir would have the right to use it. In a way, the intention of SenseAir was to keep, in case of success, the right of commercially exploiting the gas sensor technology developed by JDT1.

The small company received financial support from SenseAir (about 100,000 Euro) and initial advice from the holding company of UU (UUAB Holding), which often supports innovation projects and start ups where UU researchers are involved. Initially, only two people were employed by JDT1: Mikael Lindeberg himself, as leading researcher, and a production engineer. The project team also included Mr. Martin and Dr. Henry Rodjegard from SenseAir. Dr. Rodjegard was hired at SenseAir in 2006 as researcher with the specific task of following the research projects that SenseAir was involved in.

UUAB did not invest any equity in the company, so the main investors were SenseAir (which owned about 70 % of the shares) and three researchers from UU, owning 30 % of the capital (Mikael Lindeberg 15 %, Prof. Hjort 10 % and a Ph.D. from the Department of Engineering Sciences with 5 %). Later on, SenseAir transferred its shares in JonDeTech directly to its own shareholders. In fact, in 2008, SenseAir had more than 100 shareholders. As a result, equity representing 70 % of JDT1's capital was divided between a very large number of actors. The JDT1 board consisted of five persons, two from SenseAir and three researchers from UU. In 2009, Prof. Klas Hjort was appointed as chairman of the board.

Since the beginning, the company was also located within the Uppsala Innovation Center (UIC). The main purpose of this incubator—partly owned by UU—was to support the development of new business ventures. JDT1 was involved in one of the UIC programs named Business Lab, which provided knowledge about business development and financing to the company's management.

In the last period of the incubator program, a business coach was assigned to JDT1. In 2008, Mr. Bengt Åkerström took this position.

His main task was to advise the company's management concerning the development of the company. The first activity was setting up the company's business plan and finding potential customers for testing the products. Moreover, JDT1 tried to also look for potential industrial partners. However, the connections that JDT1 had started with some companies located in Stockholm were not developed because the company started to make a small and pilot production of their own sensors. JDT1 seemed to have all the components and knowledge necessary for starting such production autonomously. In terms of technical resources, in 2008, JDT1 could rely only on the University facilities such as laboratories and small machines in order to start an initial production of sensors in a small scale. The sensor was, for the first time, mounted on a flexible PCB carrier and a complete IR measurement system was presented at the Sensor + Test exhibition in Nuremberg, Germany.

However, although JDT1 could produce good quality sensors by means of the University equipment, there was an urgent need to establish a production facility capable of reaching large volumes. In November 2008, the company was awarded funds from VINNOVA for 30,000 Euro, a far cry from what would be necessary to create such a facility.

8.4.5 Looking for Solutions to Urgent Issues: The Crucial Period 2009–2011

Several problems appeared right after the company was set up. First, JDT1 needed money to proceed with the technology development in order to start producing sensors. The technology had been tested at UU, but the University's equipment had limited possibilities of making tests for real, full-scale productions. However, in March 2009, a small-scale production line with a capacity of up to 50,000 sensors per year was installed. Second, it was quite clear to Mikael Lindeberg that the company did not have enough competence for developing its organization. There was a lack of skilled people for such key tasks as marketing, management control and financing. Moreover, there was an urgent need to find a CEO with industrial and sales experience. Therefore, both Mr. Åkerström, the business coach, and Mr. Lindeberg started to look for an external CEO. After a while, they found a person with an electronic industry background, but the JDT1's board preferred not to hire him.

In November 2009, Mr. Åkerström was asked to step in as the company's CEO and he accepted, although this new role in JDT1 was in conflict with the business coach responsibility that he held within the UIC incubator program. As an exception, and only for a temporary period of six months, Mr. Åkerström accepted his new role. His main focus was on finding investors and financial sources beyond SenseAir's shareholders.

Even if JDT1 was granted in December 2009 a further funding of 200,000 Euro for two years by the Swedish agency VINNOVA for a research project aimed at developing a special family of micro-chips, the large money necessary for setting up a production facility was still missing. According to Mikael Lindeberg, at least 1,5 million Euro was necessary in order to arrange the first pilot production line based on JDT1's own technology. The forecast, made in 2009 indicated that once the technology development was completed, in order to make JDT1 a profitable company, it would be necessary to produce at least 100 million sensors per year, making the creation of a large-scale facility a necessary stepping stone in this innovation process.

In 2009, the main investor and owner of JDT1, SenseAir, was facing a crisis due to the sensor market downturn. Consequently, all management focus and investments by SenseAir were on gas sensors for the automotive industry, their main expected market. Therefore, SenseAir management decided that they would not take the risk of investing in JDT1 to finance the latter's production facility. Moreover, in this period, the mother company was discussing with a potential buyer interested in taking over only SenseAir assets, not JDT1: therefore, from being a potential new business opportunity for SenseAir, JDT1 turned out to be a problem child at this point.

It was rather difficult to find any kind of investors willing to pay the substantial money for new technologies such as the sensors developed by JDT1, even if the potential market for these products was promising in terms of sales volume. JDT1 showed potential investors and customers their business case, demonstrating the opportunity of making profit out of the commercialization phase. Moreover, in 2010, they produced at the University's facility, in a very small scale, a number of "demo kit" sensors which were delivered to potential customers.

In the same year, several kits were sold to customers such as American Intel and to the Korean company Samsung. The latter company was even very interested in collaborating with the possibility of building a long-term purchasing plan. However, JDT1 was met with considerable technical problems and instead of scaling up the technology, the company had to step back and reevaluate the entire process to gain enough quality. According to Prof. Hjort, the quality issue was related to the lack of testing of the prototypes coming out of the University-based facility.

8.4.6 The End of a Short Journey: JonDeTech Goes Bankrupt

How should it go to the market? This question was left unanswered by managers at JDT1 for several reasons. Of course, as the technology was not ready to be either produced in a large scale or fully utilized by users, JDT1 did not really sell it to any customers. The high-volume production needed for keeping the final price of sensors low required finding a rather large actor willing to support the necessary investments in a manufacturing facility. SenseAir did not have enough power and resources available for supporting JDT1's business.

The innovation journey of JDT1 turned out to be more troublesome than expected. In the beginning, SenseAir's management was rather optimistic in assuming that some large multinational companies could support the young firm of JDT1, but the market response was grossly overestimated. Although the technology development showed brilliant results, potential customers were not yet ready to accept the new and still partly unproven technology offered by JDT1.

Therefore, the lack of potential investors and immediate customers of the technology dragged the company toward an unavoidable crisis. In 2011, the company's board announced that JDT1 went into bankruptcy. About 55 companies spanning from electronics to the semiconductor industry were approached with the aim of finding a buyer of JDT1 technology. However, the liquidators could find no buyers. In June 2012, the liquidation within the bankruptcy process was completed.

8.4.7 Aftermath: The Rise of JonDeTech Sensors AB

The attempts to save JDT1 and subsequently, its technology, had been time consuming. It was very hard to sell the IPs, such as patents, to other sensor manufacturers. No companies were interested in working with the special production processes invented and developed by the Swedish team over the last nine years. There simply did not seem to be any place where that technology could be taken. In the meantime, Mikael Lindeberg took another job in a Swedish company and for about 18 months, did not take any further steps to rescue the technology he had developed.

However, in 2013, Mikael Lindeberg met for the first time at an informal event an entrepreneur, Mr. Michael Olsson, who had been working for several years in different companies producing fire alarms. Mr. Olsson also patented his own detector and in 2004, he founded a small company which had been growing in Sweden specializing in producing and selling smoke detectors.

Mr. Olsson became interested in the story of JDT1 and eventually decided to buy out the IPs over the technology of JonDeTech. At that point, a new company named JonDeTech Sensors AB, henceforth JDT2, was founded. Mikael Lindeberg, Mr. Olsson and an expert salesperson started this new company with private money and each got an equal amount of shares. It was in December 2013 that the new company became located in Stockholm.

From an organizational point of view, a working team was built rather quickly, with Mr. Olsson as chairman of the board empowered to look for financing, Mikael Lindeberg as chief technology officer (CTO) and Mr. Patrick Lundström as CEO. The CEO of the company came from the sensor industry and brought his experience into the company his as well as potential business partner contacts. Moreover, as of 2014, a Swedish private investor supports the company, with an initial investment of one million Swedish Kronor (SEK). In the same year, the company applied and got funded from the Swedish innovation agency Vinnova. Out of the total grant of 200,000 Euro, 50,000 Euro are intended for investigating whether industrial production methods are applicable for the manufacturing of sensors on a large scale (*evaluation and analysis of potential* *manufacturing of unique IR sensors*), whereas the rest is aimed to take the production to an industrial scale by the end of 2016 (*development of large-scale production process for unique IR sensors*).

Therefore, JDT2 is very much focused on industrializing its technology. The ambition is to upscale the production of its technology by the end of 2016. As the new company decided to keep the same technology developed with SenseAir and UU, the prototype production process is now stable and is going to be started. The goal is to outsource the production of sensor prototypes to companies operating in the PCB industry (see the above section regarding the description of JonDeTech technology). Usually, companies that produce PCB already have tools and other resources in place, even if in order to fulfill JDT2's requirements, it would be necessary to utilize "special" machines (e.g., for attaching the nanowires on the surface), which have been partly developed by Lindeberg and his staff.

8.4.8 Toward Producing the Sensor Technology: The Key Business Relationships of JDT2

Compared to the "old" JDT1, the company's management is now trying to find out a way of producing its sensors, while Mikael Lindeberg has already started to figure out how to commercialize its technology in terms of targeting customers and a selling approach. According to Mikael Lindeberg, there is a very interesting project being discussed with a big global producer of consumer electronics from Asia, who considers the JDT2 technology as "absolutely outstanding". However, in order to start the commercialization with this customer, two different issues must be overcome: the design and test of customized machines for running the production process and the final validation of the production process.

To deal with these issues, the company has recently developed two important business relationships. The first is with the German Fraunhofer IZM Institute (IZM Institute) and the second one is with a small Swedish company called Swedish Electroforming Technology AB (SET AB). Box 8.2 provides some details about these two organizations.

Box 8.2 Overview of IZM Institute and SET AB

Fraunhofer IZM is part of the Fraunhofer-Gesellschaf, a worldwide leading research organization. The research and development is carried out by several different branches located throughout Germany, usually in appealing university towns. Private companies as well as public institutions may rely on Fraunhofer concerning how to develop, test and manufacture new products. IZM Institute is one specialized unit of Fraunhofer-Gesellschaf, located in Berlin, which focuses on technologies and services necessary for developing reliable electronics and integrating new technology into applications. Among the offered services are manufacturing and prototyping of sensors and sensors packaging.

Swedish Electroforming Technology AB is a small company located in Sweden. It was formed in 2006 as successor of Alpha Sweden Electroforming systems. It operates in the manufacture and sale of electroforming equipment for optical disc.

Source: Interview with Lindeberg (2015).

IZM Institute was already contacted by Lindeberg back in 2008, but discussions did not lead to any concrete collaboration between IZM and back then, the newly started JDT1. The goal of the current collaboration, starting in 2014, with the IZM Institute concerns the improvement of the industrial production process of the initial technology developed by the former JDT1. In other words, Mikael Lindeberg is trying to better understand how to develop the core equipment for producing sensors. In this respect, between 2003 and 2008, many activities and tests were carried out at the Ångstrom Laboratory (UU), but at that time, Lindeberg was not totally aware that the PCB industry would have been the targeted production partner. The tools created at UU were not typically used by the PCB industry. Therefore, it has been necessary to work hard in order to come up with a quick solution, namely machines also fitting the production setting of the PCB industry.

The relationship with SET AB has been running since summer 2014. This company uses a production process similar to that of JDT2 and, according to Mikael Lindeberg, the collaboration is important for understanding how to design the machines producing the nanowires that will characterize the company's sensors. According to the schedule, JDT2 will start, for the first time, a small prototype production of commercial sensors by January 2016.

8.5 Discussion

Our discussion is organized in two sections. The first one is aimed at identifying the organizational arrangements acting as vessels for the focal technology and addresses the issue of when the company intervened along its innovation journey. The second section addresses the two research questions we raised in Sect. 8.3, namely (1) which, among the resources and relationships vessels create and combine, are carried from one vessel to another? and (2) how are these resources and relationships carried from one vessel to another?

8.5.1 Identification and Manifestation of the Vessels Carrying the Focal Technology

We identify as many as five different vessels directly involved in carrying and transforming the IR technology in subsequent moments in time: (1) the individual manager, Mr. Martin, within the company SenseAir; (2) an inter-organizational team within the SUMMIT project including Martin, representing SenseAir, and Hjort and Lindeberg representing UU; (3) then, a separate project team financed by Vinnova, hosted by UU and supported by SenseAir (still including the same three persons as above, i.e., Martin, Hjort and Lindeberg); (4) a dedicated start up company named JDT1, majority-owned and financed by SenseAir and with UU researchers as minority shareholders and active manpower (Hjort and Lindeberg); and (5) finally, JDT2, owned by Lindeberg and two external (non-university or SenseAir affiliated) persons and financed by Vinnova and a private investor.

Looking at these five vessels, the case appears particularly interesting because it somehow contradicts the traditional university spin-out funnel (Clarysse, Wright, Lockett, Van de Velde, & Vohora, 2005) as well as the traditional linear model of innovation (Balconi, Brusoni, & Orsenigo, 2010). In fact, instead of coming from basic university research subsequently turned into a commercial entity, the technology is first "spun-out" from a larger company (SenseAir) and only eventually does it become carried by an academic spin-off company (JDT1).

In a way, the IR technology was pushed backwards in the innovation process because SenseAir considered it not yet mature for industrialization.

Therefore, a more apt vessel such as the research company, JDT1, was created. JDT1 could, in fact, reduce the financial risk of SenseAir. For instance, SenseAir could still keep control over this promising technology via its majority equity in JDT1. As the financial stakes and risks became too high for SenseAir, JDT1 was left to go into bankruptcy and it was subsequently the only personal attachment to this technology was by one of its inventors, Lindeberg, which reconnected the technology to a new start up, JDT2. Thus, the technology has been harbored in three different companies: SenseAir, JDT1 and JDT2. This evidence supports our argument of companies being simply vessels carrying (while also transforming) technologies through their innovation journeys. Even more than so, these vessels are "disposable" as they can be bankrupted without major concerns, as showed by the faith of JDT1.

From an industrial network viewpoint (Håkansson & Snehota, 1995), the role of SenseAir in relation to focal technology and the other vessels created is particularly important. SenseAir is, in fact, both a vessel itself in the early moments of this innovation journey, and then becomes a pivotal external actor for other vessels. Therefore, the way in which SenseAir is embedded technically and commercially in the IR sensor network influences its interest and actual support of the focal technology as the IR technology was rather peripheral for SenseAir and lacked strong customer and supplier relationships around it. The originating company progressively decreased its engagement with it, basically handing it over to JDT1, and then accepting its loss during the bankruptcy.

Even if we identified above a total of five vessels, that is, organizational arrangements, which transformed and carried the IR technology in its innovation journey, we will now focus on three of them: (1) the (inter-) organizational project teams backed by SenseAir, which summarizes the first three vessels above; (2) JDT1, the first, bankrupted start up company; and (3) JDT2, the second still operating, start up company. We consider, for each of these three organizational arrangements, which resources and relationships they were able to create, combine and mobilize.

1. **(Inter-) Organizational Project Teams**: These teams include both the work within SenseAir by Mr. Martin and the collaborations initiated later on between SenseAir and UU, involving specifically Lindeberg and Hjort. At the beginning, the key resources were just an

idea about the potential process to make IR sensors. This was later combined with the competences of specialized academic researchers who were also able to turn the original concepts into patents (IPs), first filed by the researchers and also later on by SenseAir. An important resource of the original, SenseAir internal project is certainly the connection with the SUMMIT project, running within an academic context, which opened the door for creating a key relationship with the Ångström lab at UU, and specifically with the two aforementioned researchers as a way to access their expertise. Vinnova's financing of about 500,000 Euro was the main financial resource employed by the inter-organizational project teams, with SenseAir covering only 50 % of a person's salary with their own funds. Still, SenseAir offered the *potential* "resource" to the emerging IR sensor technology of being embedded within an established firm. However, no relationships with customers within this specific technical area were created, either by SenseAir or by the academic researchers. There was also no particular attention paid to the need of large investments for scaling up and building a manufacturing plant for this technology—an issue which would become a major source of problems in the future.

2. **JDT1**: The newly started company obtained, free of charge, as core IPs the patents on the embryotic technology created by SenseAir and the UU researchers. Another key resource within JDT1 was the relevant and deep scientific knowledge from the UU team combined with the industrial expertise of Mr. Martin from SenseAir. Looking at relationships, JDT1 obtained the support even if only in the form of advice from UU Holding AB, and a more working and operational relationship with the Ångström site for the laboratory and pilot facility. The relationship with Vinnova was transferred from the inter-organizational teams to the start up of JDT1, leading to obtaining finances in the form of a 200,000 Euro grant from Vinnova. Another important relationship for JDT1 was with the incubator UIC which provided space and advice. The latter then turned into an internal human resource (the business coach becoming JDT1's CEO). Finally, of particular importance was the ownership relationship with SenseAir, which contributed, however, rather limited financing of only 100,000 Euro, whereas

JDT1 would need more than 100 times this amount for building a full-scale manufacturing plant. It is accordingly hard to find any positive effects of this ownership relationship, especially on the financial plane. What happened instead was a desperate search for other investors after SenseAir's realization of the large financial resources needed for building a manufacturing plant, signaling the owner's willingness of exiting from JDT1. On the customer's side, no relationships were created except from the first, resulting in not so many fruitful contacts with potential customers. Even during the liquidation process, it would result as impossible to find companies interested in buying the IPs on the IR sensor technology. On the supplier's side, Lindeberg tried to engage with some organizations, such as potential manufacturing partner IZM Institute, but no relationships were built because the idea was to continue developing the IR technology by means of the relationship with SenseAir.

3. **JDT2**: Similar to JDT1, the second start up company also obtained IPs such as patents from the bankruptcy of the first company. However, these IPs now concerned a more stable and refined technology. Financial resources were provided by one private investor/business angel (for about 100,000 Euro) and a new grant from Vinnova (for about 200,000 Euro). Other important resources were the expertise and developmental know-how brought in by the same academic researcher behind JDT1, Mr. Lindeberg. Furthermore, the key lesson learnt from the previous start up (JDT1) was carried as an important resource by Mr. Lindeberg into JDT2, namely the realization that a manufacturing plant for scaling up the core technology is fundamental. Therefore, JDT2 not only created specialized machines but also two key supplier relationships with IZM Institute and SET AB. The relationship with IZM Institute was based on past interactions developed by Lindeberg in 2008, while the one with SET AB was created from scratch. Finally, the first relevant contacts with a big potential customer from Asia were initiated by JDT2. Compared to JDT1, the relationships around JDT2 appeared as more "functionally" organized: two key suppliers and one potential customer, with apparently no relationship with a negative or hindering effect, such as the one JDT1 had with SenseAir.

8.5.2 Which Resources and Relationships are Carried Between Vessels and How?

Considering our first research question (*which resources and relationships are carried from one vessel to another*), it is interesting to notice an important difference in the passage from the first to the second vessel (from the inter-organizational projects to JDT1) if compared to the passage from the second to third vessel (from JDT1 to JDT2). A lot of the resources and relationships were carried from the first vessel, like the inter-organizational projects, to the second vessel, JDT1. This transfer of resources and relationships is not surprising as everything was somehow influenced and held together in the first passage by SenseAir.

However, relationships to fundamental partners, such as key suppliers and customers, were still missing as SenseAir could not contribute to them. Instead, very few relationships were transferred from the second vessel, JDT1, to the third one, JDT2. Only the relationship to UU, although this actor has not played so far a central role for JDT2 (at least not as much as for JDT1), and that to Vinnova remained, which actually recurs as a financing provider in all three vessels. Most of the other relationships were instead created basically from zero by JDT2. The relationship with IZM Institute was not really inherited from JDT1 as it stopped back then at the level of discussions. Rather than relationships, the key resources connecting the second and third vessels appear therefore as being *artifacts, competence*, namely the core technology, with its associated IPs, and *people*, namely Mr. Lindeberg, with his expertise and know-how.

As for our second research question (*how* resources and relationships were carried from one vessel to another), key transmission mechanisms reside in the locations and people involved, even if we identified that it follows different patterns. Starting from the individuals, Mikael Lindeberg played a central role along the entire IR journey, but in different ways at different moments. The technology was brought from the inter-organizational project to JDT1 as a "natural and logical" consequence of Lindeberg involvement in the research project, carried out jointly by SenseAir and UU. He continued basically working in developing the technology and only added some employees and knowledge to JDT1. Therefore, working in the same "locations"—Uppsala University laboratories and SenseAir headquarters—supported and made easier the passage of all resources from one vessel to another.

Instead, the transition from JDT1 and JDT2—which took almost two years—turned to be a bigger and somehow more painful step. The relationship with SenseAir was not active anymore and the one with UU was much weaker than in the past. The employees moved away from JDT1 and found other opportunities. The production equipment they were working on got obsolete and was returned to UU. However, Lindeberg, as already pointed out, did not give up and bought all the IPs and patents. Most importantly, he reactivated some important contacts built several years before at JDT1—the one with IZM Institute—eventually leading JDT2 to carry out the validation of the prototype production processes. Other earlier interactions with companies were located in Stockholm, which Lindeberg contacted during the JDT1 time when searching for partners to start some process development activities.

The passage of the technology and other key resources from JDT1 to JDT2 would not have been possible if Mikael Lindberg had not initiated interaction with some specific actors several years before the birth of JDT2. This signals the importance of planting seeds for future relationships via a broader net of contacts. At the same time, the fact that JDT1 was locked inside the relationship with SenseAir lead Lindeberg to look for solutions outside that structure and to plant those very seeds, eventually leading to the start of new key relationships by the new vessel, JDT2.

8.6 Conclusions

The innovation journey of the IR technology has showed how different resources and competences have been transferred, combined and transformed by specific vessels in relation to other vessels. Creating new vessels, including starting up new companies, has lead technology to continue being developed and improved and, in that respect, we have observed a central role played by the individual entrepreneur and the business relationships created around the focal technology.

As we show by our case analysis, the innovation process does not proceed or end in a linear single path. Rather, as long as the entrepreneur(s) who may well differ from the inventor, believes in the long-term business case, that the innovation can be "hosted" in a new organization. As our reading of the case shows, when one organizational host no longer provides a healthy environment, the innovation journey can continue by carrying over key innovation components (such as technology, production or market know-how and actual relationships or simple contacts) into a new favorable vessel. Thus, in general terms, our case shows the importance of distinguishing between *the creation and development of companies*, that is, start ups, and *the innovation journey itself*. In fact, according to Van De Ven et al. (1999), these companies are just actors intervening in the innovation journey, but they can change from one moment to another with no guarantee of the same actor starting and finalizing the innovation journey. As shown in our case, the development of the IR technology transcends through several companies which either fail or are unable to support further innovation activities. Still, even if the last chapter of the IR technology at hand is not written yet, the process continues to unfold into new organizational arrangements, bringing in new vessels, continuing the innovation journey.

In our view, the case of JonDeTech and the IR technology underlines several important aspects for the general study of innovation. By shifting from the organization as unit of analysis to focusing on the technology, we can clearly see the processual character of innovation, entailing several gradual transfers and transformations of the resources involved. Thus, going from proof of concept to market does not necessarily take place within the same organization. Furthermore, this case suggests that innovation scholarship needs to pay much more heed to the question of failure, intended both as the dismissal of a particular organization and as a stop of the innovation journey. Arguably, innovation scholars tend to view a failure of the host company as proof of the failure of the innovation process, emphasizing too much how such a process is limited by the specific organization that promotes it. Our case clearly shows that it is vital to distinguish between organizational and innovational process failure, as innovation attempts can actually wear out several vessels. Next to this conceptual contribution, our study also has methodological fruit to provide to the innovation literature. In several cases, we as innovation scholars probably need to shift not only the *unit of analysis* but also the *time frame* of or our studies of innovations with respect to success and failure. This holds even before we start with the question of diffusion and absorption.

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Part V

Start Ups and the Role of Policy Actors

9

The Challenging Life of University Start Ups: The Different View of Value Creation in a Policy Setting Compared to a Business Setting

Tommy Shih and Alexandra Waluszewski

9.1 Successful University Start Ups: A Wanted but Rare Phenomena

University start ups are, in the Organisation for Economic Co-operation and Development (OECD) and European Union (EU) policy setting, viewed as important means to transform scientific advances into innovations, corresponding both to market and societal needs (Mowery & Sampat, 2005; Rider, Hasselberg, & Waluszewski, 2013). The high expectations on the ability to directly transform social and material resources, valuable in an academic research setting, into new products/services to contribute possible value in a business setting are rooted in the

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so-called 1990s science and innovation policy doctrine, with the OECD as its most prominent advocate (Eklund, 2007; Waluszewski, 2011). The doctrine points to university research as an important but underutilised direct source of innovation for growth and societal welfare. In the wake of this policy regime, a number of measures have been undertaken to stimulate the commercialisation of research results, with the establishment of university start ups as a key measure.

From the policy perspective, the basic recipe for the creation of university start ups is founded upon a seemingly simple template to (1) facilitate the direction of research to the identified market and societal needs, and (2) facilitate the start up companies' ability to transform these into new products/services (La Rocca & Snehota, 2014; Rider & Waluszewski, 2015). Hence, the point of departure is that scientific advances are among the most important factors for the creation of start ups. Moreover, a transfer structure manifested through innovation offices, science parks and incubators are important for supporting the emergence of start ups. Most OECD and EU member states follow this model, regardless of whether the research ownership results follow the suggestions of the US Bayh-Dole Act, which ascribes intellectual property (IP) rights to universities, or if it belongs to the researcher behind the results, as for example in Sweden (Damsgaard & Thursby, 2013).

The outcome of the increasing attempt to commercialise research results has been an overall surge in the number of university start ups. The most extreme example is perhaps Japan, where the government in 2001 appointed university start ups as means to reinvigorate the economy, and where more than 1000 start ups were already established three years after the release plan (Walsh, Baba, Goto, & Yasaki, 2008). However, the growing number of start ups is far from the same as achieving a growing number of successful innovation journeys.

The failure rates for university start ups are high in comparison to other kinds of new companies, for example those, which emanate from research institutes and corporations (Ensley & Hmieleski, 2005; Wennberg, Wiklund, & Wright, 2012). Moreover, even if the product/service that the university start up launches eventually results in a successful innovation, it is not necessarily the start up company that is behind the resource industrialisation and global marketing. Instead, potentially successful innovations tend to be absorbed by large companies where they can be embedded into established research and development (R&D), production and marketing structures. (Mirowski, 2011, pp. 199–208; Pisano, 2006; Perna, Baraldi, & Waluszewski, 2015)

Hence, there is significant research experience indicating that what in a policy setting appears as a valuable research result, suited for commercialisation through the establishment of a start up company, does not necessarily appear as valuable from the business producer and user perspective. This notion is behind the overall research question of this chapter: *What expectations are university start ups exposed to in a policy setting compared to a producer and user setting?*

To answer the question, two case studies of university start ups illustrate the interfaces, which are required to create value in a business producer–user, respectively, in a policy setting; the latter defined as transnational, national and local actors established to fulfil governmental politics and policy. The content of the paper is organised as follows: the next section presents the theoretical framework, followed by the methodological discussion. Thereafter, the two case studies are presented, as well as an analysis where the expectations each company faces in its setting are discussed. The concluding discussion focuses on the consequences of the differences in producer–user and policy logic.

9.2 A Note on Policy's Ambition to Create Start Ups from Universities

The traditional function of universities has been education and research. Under this charter, the proverbial term 'ivory tower' came to become a notorious description of the university, but the picture of universities being independent of society has lately become revised (Etzkowitz, Webster, Gebhardt, & Terra, 2000). Shortly before the shift to the new millennium comprehensive policy efforts to revitalise the academic sphere and make it a direct contributor to societal value creation were implemented in a large part of the developed world (Shane, 2004). Today universities are to be active stakeholders in economic growth—the so-called third mission (Montesinos, Carot, Martinez, & Mora, 2008). This has been evident in the many policy discourses that target universities as the centre of attention in measures to advance national economic goals (see e.g. Persson & Pagrotsky, 2004). Especially the commercialisation of research results, emanating from universities, has become major policy and research concerns. Today university research is highly associated with innovation and economic development (e.g. Bercovitz & Feldman, 2006; McKelvey & Holmén, 2009). On this notion, academic research has been increasingly commoditised, with a number of policy-initiated changes to the organisational structure of universities, as well as charter to accommodate the increased focus on commercialisation of research (Kneller, 2007).

While there are many channels through, which research can reach society, one of the main channels is the creation of spin-off companies (Landry, Amara, & Rherrad, 2006). The literature on university start ups acknowledges that academic spin-offs are often founded on the basis of technological advancements rather than market opportunities (e.g. Aaboen, Laage-Hellman, Lind, Öberg, & Shih, 2016). As such, the university start ups do not usually have the necessary market relationships from the start to commercialise ideas (Aaboen, Dubois, & Lind, 2013). This has generated interest in the support systems that seek to aid university start ups in the commercialisation of their ideas. For example, much has been written about the incubators (Rothaermel & Thursby, 2005) or the technology transfer offices (TTO) (Di Gregorio & Shane, 2003) and their supportive functions. In studies of incubators and TTO the focus primarily lies on the strategies that these organisations utilise to aid university researchers and start ups, which can include the provision of resources or the establishment of organisational links (Rothaermel & Thursby, 2005). The attention thus aims at role these support organisations provide start ups in the research commercialisation process (Baraldi & Waluszewski, 2011).

However the increase in academic entrepreneurship has stimulated a debate regarding the rationale for government support of academic entrepreneurship projects (Baraldi & Waluszewski, 2011). Although academic research plays an important role in societal development the effectiveness of research policies to direct these efforts are contested (see e.g. Rider & Waluszewski, 2015). A reason for this is that the failure rates for university start ups are high in comparison to other kinds of new companies, for example those, which emanate from research institutes and corporations

(Ensley & Hmieleski, 2005; Wennberg, Wiklund, & Wright, 2011). There is also criticism towards the underlying assumptions regarding how university research is contributing to economic growth and how start ups should be supported. For example, Waluszewski (2011) notes that the policies that are implemented bases on a linear and systemic view of innovation, inferring that the policy assumptions implicate a wrongful view of how innovation usually arises. This implies that the support from policy can have detrimental effects on start ups and their development (Shih, 2016). In summary, university start ups are often embedded in policy structures. These are set up in order to aid the start up companies to build up their competencies and resources bases in order for them to be competitive in the market place. However, the step into established business networks might be considerable and the start up tends to continue finding solutions to survive within the established relationships with innovation support actors.

9.3 University Start Ups in an Interdependent Business Landscape

A basic empirical observation made by Industrial Marketing and Purchasing (IMP) scholars is what is depicted as *connectedness* among companies and organisations. In order to be valuable to others, both parties of a buyer and seller interface adapt in relation to major investments made in each setting (IMP Group/Håkansson, 1982, p. 394). Over time, major interactions concerning the supply and use of products, processes and services tend to emerge into business relationships and create imprints on the social and material resources involved. This implies that interdependencies over time and space are important features of the business landscape, which have consequences for any attempt to create change; in terms of the introduction of a new innovation and/or a new business actor. As characterised in Håkansson, Ford, Gadde, Snehota, and Waluszewski (2009, p. 263):

> An interactive view of the business landscape suggests that the form, the use and development of each resource and activity is not determined by a single actor or by the characteristics of the activity or resource in itself, but by its interactions with others.

The empirical observation of interdependency, which is theoretically depicted in the resource heterogeneity assumption—that is, the notion that economic value is not given but created in interaction (Håkansson et al., 2009; Penrose, 1959)—has also significant consequences for start ups and the creation of space for commercial solutions that they bring forward. As suggested in Håkansson et al. (2009, p. 66), the value of a company's resources depend on how they are combined with those of particular counterparts, and furthermore, on how those combinations interact with other direct and indirect related resources. Thus a start up, which most often lacks important relations to counterparts on both the supplier and user side, appears especially vulnerable (Öberg & Shih, 2014).

The nature of the start up, if it is not a spin-off from an established company, is that it in general lacks important interfaces to a commercial producer and user setting. Here, university-based start ups are facing an especially tricky situation. Their main interfaces are related to academic research units and academic innovation support organisations; not to specific counterparts in a commercial producer and user setting (Aaboen et al., forthcoming; Baraldi & Waluszewski, 2011). Furthermore, even if the scientific advancement an academic start up is based on can be considered as a valuable contribution in an academic setting, this is not a guarantee to be equal to a commercial producer and user setting. The more a solution that is going to be embedded into a commercial producer and user setting differs from the social and material structures of these, the more difficult it is to combine the investments in place and consequently, to contribute with value (Håkansson & Waluszewski, 2007). Hence, besides the general challenge of start ups, concerning how to contribute to value in a producer and user setting when interfaces to significant counterparts are absent or immature, university start ups also represent solutions that have emerged outside of these settings. As La Rocca, Ford, and Snehota (2013); La Rocca and Snehota (2014) underline, the key issue is how these newcomers and the commercial solution they provide can be embedded into established producer and user structures.

In this perspective, an important question is how university start ups first established relationships, that is, to such units as university TTO, incubators, science parks and so forth (Clarysse, Wright, & Van de Velde, 2011; Kneller, 2007) impact on the embedding process—a question that is disputed by researchers engaged in this issue. For example, Chapple, Lockett, Siegel and Wright (2005) underline that technology transfer officers in general have background as university administrators rather than coming from the field of business, meaning that they lack experiences of the basic characteristics of commercial production/marketing and use. That might provide a different view of what aspects of a university start up are valuable in a commercial setting, compared to how these are considered from the perspective of the latter. Kaufmann and Tödtling (2002) make a related observation and note that innovation support to university start ups tends to be focused on development, rather than activities leading to the commercial production and use of innovations.

Hence, the initial relationships that university start ups establish with policy-related actors—such as university TTO, incubators and so forth—can infer a logic that is significantly different than the one encountered when facing commercial producer and user settings (Öberg & Shih, 2014; Waluszewski, 2011). In the setting established to support university start ups, the focus is on *novelty,* not on investments in established producer–user settings (Baraldi & Waluszewski, 2011; Shih, 2016). However, novelty has no value in itself in a commercial producer and user setting. In order to contribute value in a user setting, the newness has to create benefits for the users of pre-investments in related products and product systems. In order to contribute to value in a producer setting, the question of how to utilise pre-investments in a facility system, that is, investments related to production, logistics and marketing, as efficient as possible is paramount (Håkansson & Waluszewski, 2007, p. 153).

To catch the different ambitions of university start ups—from the company view of embedment in a producer and user setting, respectively, from a policy perspective to the successful commercialisation of research results—a theoretical and methodological approach developed by IMP scholars will be used (Håkansson et al., 2009). With the so-called Actors, Resources and Activities (ARA) model (Håkansson & Snehota, 1995) as the conceptual *and* methodological foundation, the following factors can be investigated: (a) what main actors, what main resource combinations, and what main activity structures are considered as important to establish interfaces *from the university start ups' point of view,* and *respectively from the policy actors' perspective.* The IMP research tradition, in terms of considering *methodology* as a consequence of the overall research question, and how it is approached theoretically (Håkansson, 1982, pp. 28–53), is also followed. This implies that methodology is focused on how different types of focal actors, the university start ups' respective policies, are approaching the commercialisation process, rather than concentrating on any fixed methodology techniques.

9.4 Data Collection

In order to investigate the aforementioned research question, two rather restricted empirical studies have been conducted, explicitly focusing on two research, university-based start ups' approaches in the commercial producer and user setting, considered as their focal business settings. Respectively, how each commercialisation process is dealt with by the involved policy actors is addressed. Hence, the empirical investigation outlines the start ups networking in two contexts: (1) the commercial producer and user context, and (2) the policy context, including actors such as university innovation offices, incubators, as well as other related local and national policy organisations.

The investigation was based on 22 face-to-face interviews made with 14 respondents representing the focal start ups, partner companies, university innovation offices, incubators, and local and national policy organisations. All interviews were conducted between 2013 and 2015. The interviews were of a semi-structural character, and ranged between one and two hours. A theme based on relevant actors, resource and activity focus was outlined for, and adjusted to, each interview, depending on the actor and network context. This interview strategy served to gain knowledge of the broader processes and provide the researcher room to additionally develop more detailed questions during the interview or in follow-ups.

Secondary data were also utilised such as: official policy documents, newspaper items, industry reports, websites, transcribed speeches and statistical material. Presentations from the company and investor meetings were also visited. The secondary sources identified events, established timelines, gave varied perspectives of the development processes studied and helped to substantiate the pictures given by interviewees (cf. Huber & Power, 1985). The analysis followed an iterative approach where the authors moved between theory and empirical results to deepen the analysis and ascertain the theoretical contribution (Dubois & Gadde, 2002; Ragin & Becker, 1992). The analysis also moved between perspectives of interviewees and the overall descriptions of developments to create the case descriptions.

9.5 Case Studies

9.5.1 Redoxis

In 2007, Dr Peter Olofsson and Professor Rickard Holmdahl established a biotech company, named Redoxis. The ambition was to develop early-stage drugs indicated for autoimmune diseases, and license them to pharmaceutical companies (i.e. a common aim but difficult commercialisation path for biotech company). Holmdahl had been Olofsson's PhD adviser at Lund University in Sweden, and the company was formed based on their research on autoimmune conditions. After his PhD studies, Olofsson had continued working on the project through EU funding at a biotech company, Arrexis, in Gothenburg for three years. Arrexis later dissolved, and in the wake of this event Redoxis was founded, with an established office in Gothenburg, consisting of three employees. Olofsson received the rights to the project he had worked on, and the equipment used was acquired for a small sum. Research collaboration was also ongoing with Holmdahl's laboratory in Lund. Soon another PhD graduate from the laboratory joined Redoxis. With this employment, the research activities were moved to Lund.

The founders made the first investments into the company. After one year, further investments were required into Redoxis. An angel investor, agreed to fund the company for one year. This allowed Redoxis to work on various projects and attract the attention of new investors. Two new investors decided to support Redoxis. These were a biotech consortium initiated by Lund University, LU Bioscience AB (LU Bio), and Karolinska Development, the holding company of Karolinska Institute. With the funding from the actors, new rules were introduced for how research commercialisation should be conducted. According to Karolinska Development regulations, principal investigators were not allowed to be CEOs or scientific officers of the companies that their ideas were based on. This regulation had come about through earlier experiences from having researchers as CEOs that had difficulty balancing R&D with business development. The rule left Redoxis with no other choice than to allow for external management of the development of the research discovery.

A new biotech company, ProNoxis AB, was formed based on the project developed by Redoxis. LU Bio, Karolinska Development AB and Redoxis funded the start up. ProNoxis' main idea was to develop anti-inflammatory therapeutics. Early on, a patent was filed and granted. Patenting was particularly important for LU Bio and Karolinska Development. Funding agencies and innovation support actors use patents as one of the main indicators of an 'innovative' company.

As Olofsson was not allowed to run the new company, he remained at Redoxis where he devised a new strategy with his colleagues. Drug development is long and capital intensive and, Redoxis did not have the means to sustain this business direction, hence, the company believed in the opportunity to sell services in animal testing for autoimmune inflammatory diseases. To become a contract service provider would be a way to generate income quickly and lower the operational costs. The service business focused on the animal models that had been developed during the research at the university. From 2010, the service business had started to generate income from clients, and among the customers were both smaller and some medium-sized pharmaceutical companies.

ProNoxis continued to develop independently, but in 2012, Karolinska Development publicly listed the company on the Stockholm Stock Exchange. This event also led to the termination of ProNoxis as a company, as Karolinska had decided to terminate all of its portfolio companies that did not have projects in clinical trials, and among these was ProNoxis. The project was reacquired by Redoxis which was allowed to purchase the rights to ProNoxis' drug project for 1 Swedish Krona. The drug development projects had mainly been EU funded and embedded in research and academic networks. Even after Redoxis decided to switch to become a service organisation, close ties were kept with universities, and new employees have been recruited from the research group at Lund University. LU Bio, an actor formed by Lund University to aid life science-based university start ups, was also supportive of Redoxis with both funding and networks. The available funding, however, granted through organisations such as LU Open or the Lund University Innovation System (LUIS, the university TTO), was fairly small in the context of the biotech business (at most 2 million SEK in total). In 2012, LU Bio was also terminated as an organisation, and with this also the continued support of university-based biotech start ups. Notwithstanding, at this time Redoxis had transformed into mainly a service business and less attention was aimed at the drug projects. Some minor efforts, however, were put into drug development projects, which provided opportunities to develop animal models used in the service business. For contract research, Redoxis also received EU funding and works together with other actors in developing animal models for autoimmune diseases.

Since 2013, Redoxis has been located in the Life Science Incubator (LSI), Medicon Village, Lund. The LSI is located in the old facilities of Astra Zeneca, which was rebuilt and today named Medicon Village. The incubator offers its services to start up companies in the life science area within the Greater Öresund region (including Lund, Malmö and Copenhagen). The location next to Lund University also associates with different support services, as well as spatial closeness to commercial and academic actors. All the companies have connections to the university sphere. At the LSI, Redoxis was able to receive favourable conditions for animal testing and laboratories. The LSI rented space for its companies and as such, embraced the risk for them in its incubator. This meant that the rent, per square metre, was the same for all incubator companies instead of each company having to negotiate individually with Medicon Village. Moreover, LSI also provided instruments and equipment for its incubator companies to use. This has also stimulated collaboration between the companies in the incubator. For example, Redoxis uses another start up in the incubator for its services in imaging and microscope services. The incubator does not invest in the incubator companies. Those companies are here left to their own efforts, or via the help of the associates/board members or employees of the companies to establish customer relationships.

Redoxis is quite niched (autoimmune diseases, arthritis, Multiple sclerosis, Guillain Barré Syndrome, animal models), which makes the number of potential customers only a handful in the Nordic countries. The present customers are in India, Russia, the USA and Europe (Germany and England foremost). There are some large and mid-sized pharmaceutical companies that are customers. Redoxis has also negotiated with larger pharmaceutical companies. In one case, the pharmaceutical company was dissatisfied with the patenting and specification of the contents, indicating the preference of pharmaceuticals to early stage discoveries themselves.

To fund R&D, Redoxis has filed several applications with Vinnova, where 50 % company co-funding is required. Recently, Redoxis applied for a grant to develop an animal model to be used to sell services. The company received 500,000 SEK from Vinnova's Forska och Väx (Research and Grow) programme. Writing applications takes a lot of time and also requires experience. For example, with the EU applications there are organisations that help the writing process and take 10–15 % of the grant if achieved. The support from the policy actors can be helpful, particularly to reduce the company's risk. For example, this could be when seeking to employ more people. Here, funding from policy organisations such as the Swedish Agency for Economic and Regional Growth (Tillväxtverket), Vinnova or Region Skåne could be of help. The negotiations are however not always easy. Often these policy organisations require companies to have patents. Redoxis had earlier used the patent firm Awapatent in Sweden, and Potter Clarkson in the UK, to file patents. Due to the costs associated with the patenting process and maintaining them, Redoxis has reduced the number of patents. One, for example, had cost the company 1.7 million SEK when it was discarded. Currently, only one patent remains, mainly for marketing purposes. In this regard, Redoxis has somewhat distanced itself from the policy request of the patent protection of ideas, and in the eyes of policy becomes less of an 'innovative' company. Notwithstanding, with the transformation into a service organisation, the revenue in 2015 was over 5 million SEK and reached break even for the first time. Today, 80 % of the activity, in terms of time spent in the company, is focused on service, while 20 % is spent on drug projects. The original founders today own the company and the employees have smaller stakes. One angel investor has hitherto funded the company. Most funding for research has been received from policy organisations and EU projects, without the owners having needed to lose stakes. The network of Redoxis is illustrated below.

9.5.2 Nattaro Labs

Nattaro was founded in 2010 by Camilla Ryne, Magnus Bäckmark, Carl Magnus Hansson and Christine Dahlman-Jacobsen. They had all participated in an entrepreneurship course organised by Teknopol, a business support organisation in the South of Sweden. It was during an open innovation project the four participants had come together and decided to start a company. Ryne was a biologist and professor in chemical ecology at Lund University. Her research focused on the communication of bed bugs. The others came from engineering and/or business backgrounds. All had been working for a number of years and felt that they needed a change in their working life. With their different backgrounds and competencies, they formed a shared vision for building a company based on Ryne's research on bed bugs (their chemical communication and behaviour). The aim of the company was to commercialise the research that Ryne had undertaken at Lund University.

As a part of the entrepreneurship course, the team also learned what kind of organisational actors could be solicited for early stage support of entrepreneurial endeavours. Considering the company's lack of financial resources, it was convenient and advantageous to locate within the local science park, and solicit the help of the university support structure to academic entrepreneurs, especially with a university-based idea. This included establishing relationships with incubators, university TTO, and the regional public funding agencies. The start up was firstly financed by an accelerator grant from LUIS, the university's TTO. This start up grant, including a smaller grant from ALMI (a public funding agency), allowed the company to pay a smaller wage to the owners for a period. LUIS also invested in Nattaro and acquired shares, as well as had one of its business advisors take a position on the company board. Hence, the initial seed funding came from the public funding agencies and the TTO. The requirements to be met, in order to be granted funding, are often more lenient than if the start up would go directly to private investors. The funding allowed the start up to work on its ideas for the first few months, and to test whether the ideas were viable in a business context.

In the first year, the company was located in a tech-based incubator, Ideon Innovation, in Lund. The role of the incubators is to offer services and support entrepreneurs in the business development process. In this case, the incubator offered limited business advisory, however the company has received cheap office space and infrastructural support. The incubator functioned as an environment where experiences could be shared with other entrepreneurs. For example, through discussion of specific customer problems, or issues related to IP. One of the main ideas of the incubator is to provide networking for the start ups. Ideon Innovation focuses on helping start ups to create ties with general business support actors, such as tax advisory, legal matters, IP rights (if applicable), finding potential financiers, and innovation support actors. For these services, the incubator established relationships with various organisations, for example, accounting companies such as Price Waterhouse Cooper, legal companies, Sparbanken Öresund (a local bank), Almi Innovation and other actors. This has resulted in the incubator taking a more service-orientated approach to incubation, by foremost providing networking opportunities, business coaching and physical office space. The incubator did not provide any lab space and the business support did not include involvement in strategic decision making processes.

Due to the lack of laboratory space, Nattaro moved into another incubator focused on life science, the LSI, in the same area. Here, the company got laboratory space. This was necessary as it needed its own research facility and hired also non-university-affiliated researchers. During the first two years, the company had utilised the laboratories and facilities at the university for the research and development. During the time in the first incubator, business advisors had encouraged the company to participate in local and national business plan competitions, to test its competitiveness and also create some media exposure. Nattaro was acknowledged as having good potential in competition, as well as raising additional capital from the founders and also securing a Research and Grow grant from Vinnova. The start up was forming and establishing relationships with main actors in the innovation support system, such as the incubators, government agencies and so forth. In parallel, discussions with potential customers were ongoing. Nattaro engaged with potential industrial customers from the start. These provided the company with indications for product development. Early customer contact was a source of market knowledge. For example, Nattaro's first product was the result of discussion with the technicians of pest control companies that provided input on the difficulty to apply the powder directly on the pest-infested environment. From this knowledge, the powder was attached to a piece of tape to be applied under bed where bedbugs usually host. Another benefit that Nattoro experienced from early customer contacts was that gaining revenue from early customers demonstrated the viability of the business, as well as eases the validation of the company to external actors, enhancing credibility.

For Nattaro, the time from initiation of contact to actually signing contracts was two years. It took this time for Nattaro to learn the specific needs of its large customer and to also convince of the product reliability, production and delivery. During this time there was also the build-up of trust and personal connections. Lessons learned from a specific customer relationship were of course also internalised in the development of new customer ties. In 2013, the company received their first customers. This was the Migration Bureau and a larger pest control company. In 2015, Nattaro had five employees and a turnover of nearly four million Swedish kronor. Due to the R&D investment and wages, the company had still not reached breakeven point.

Early on, Nattaro did encounter conflicting logics between the requirements/advice from the innovation support actors, and the market-based actors. These included, for example, the case of the incubators that needed to report back to funders, for example, the regional policy organisation, national innovation agencies and the municipality. These funding actors have been asking to view results in terms of, for instance, the number of relationships being formed between actors regionally and nationally or, the number of patents. Hence, there has been a deviation sometimes between the goals of advancing business development and pursuing sought after metrics from the innovation funding agencies and other business support actors such as the TTO and incubators. While the company initially sought to fulfil some of the policy emphasis on IP protection, it has not been possible to patent any of the science behind the commercial ideas. Nattaro however, continues to be a research intensive company and the majority of costs arise from R&D. As such, the company has been fitting into the local innovation support structure and its emphasis on supporting research based spin-offs from the university.

9.6 Analysis

9.6.1 The Policy Setting

The cases illustrate that the main attention from policy is directed to the commercialisation of research results, and the general recommendation is that university start ups engage in a patenting process. Hence, policy imposes a logic which, as underlined by Baraldi and Waluszewski (2011, p. 52) relies on future expectations 'of selected scientific ideas', implying that their main engagement is directed to the establishment of interfaces with actors related to an academic and commercial developing setting.

The cases also illustrate that both Redoxis and Nattaro, due to lack of resources and interfaces with counterparts in a producer and user setting, were more or less forced to utilise the local innovation support structure they were provided with by different policy actors. For example, due to lack of financial resources, it was advantageous to locate within the local science park, which provided cheap office space and infrastructural support. There, the start ups could solicit the university support to academic entrepreneurs. This included establishing relationships with, for example, incubators, the university TTO, innovation advisory organisations and public funding agencies.

However, to utilise university innovation support structures also implies to be related to the goals of these actors, which does not necessarily support the start up's long-term ambition: to become embedded in a producer and user setting in such a way that it is beneficial to both the start up company and its related suppliers and customers. The evaluation logic of policy actors is focused on the interface between the academic and commercial business setting. For example, the commercialisation of start ups is evaluated in terms of the number of relationships being formed between actors regionally and nationally in the number of patents and university spin-offs. Hence, the university start ups face a tension between the goals of advancing towards paying customers and complementary suppliers with providing the policy actors with metrics, indicating that they have supported a successful innovation journey.

9.6.2 The Producer–User Setting

The expectation from Nattaro's emerging user setting, expressed by pest technicians, was the provision of a treatment, which the personnel did not need to handle directly. Although Nattoro's product did fulfil the user requirement of being environmentally friendly and safe, the requirement of being application friendly was an obstacle to overcome.

The expectation from Redoxis' emerging user setting was that the company could provide a service to the pharmaceutical companies that was important in development activities. This meant that from the user setting, the idea of delivering a patented product was considered as less useful for its clinical research. Through user interaction, Redoxis emerged into a service company, which contributed to be an important activity from the customers' point of view.

Thus, although there are significant differences among the investigated university start ups in terms of their basic technologies and user settings, they both experienced the tension from the different logics of the producer and user settings compared to the policy setting. While patenting was an important metric in the policy perspective, it played a more varied role in the business setting. For example, Redoxis' initial contacts with pharmaceutical companies resulted in negotiations concerning the quality of the patent, and difficulties in finding a direct fit in the pipeline of the prospective customers. Hence, for the customer the patent has no value in itself, but is evaluated in terms of its role in relation to other resources in the user setting. This was obvious in the case of ProNoxis that was liquidated ahead of an Initial Public Offering due to the lack of clinical research. Early user contacts instead resulted in Redoxis realising the possibility to gain revenue by providing animal testing services. This, however, was met with a disinterest from policy actors, when the start up sought funding for developing the service business.

Nattaro engaged with potential industrial customers from the start. This provided the company with indications for product development. The advantage of early customer contact is that the emerging solution is adapted to resources that have an interface within an established producer and user setting (Håkansson & Waluszewski, 2007). Quickly gaining revenue from customers also decreases the dependency of external financiers, which have to focus on their return on investments and not on the producer–user embedding process (Strömsten & Waluszewski, 2012). For Nattaro, the time from initiation of contact to actually signing the contracts was two years. It took this time to learn about the specific needs of its large customer and to also convince the customer of the reliability of the product, its production ability and delivery security. During this time, trust and personal connections were also established. Lessons learned from a specific customer relationship were of course also internalised in the development of new customer ties.

9.7 Concluding Discussion

The growth in the number of university start ups since the 1980s has been stimulated by the proactive role of transnational and national policy commissions at different levels; to increase the direct utilisation of public-funded academic research in business and industry through the commercialisation of academic research (Mirowski, 2011; Rider et al., 2013). In this endeavour, publicly funded scientific research at universities across the developed world has been seen as a strategic resource for the nation, and at the disposal of the government for economic and societal value creation. As such, extensive measures have been taken to establish an environment conducive to academic entrepreneurship. Examples of measures included: legislative changes concerning ownership rights of IP originating from research; infrastructural investments, in science parks and industrial clusters; and the establishment of new organisational actors such as incubators, government innovation agencies and so forth (Mirowski, 2011; Rider et al., 2013).

These changes and resources compose the environment in which university start ups are intended to thrive and prosper. Although statistics show a growth in the number of university start ups, failure rates for these are also very high, even in comparison to other kinds of start ups, such as ones from research institutes and corporations. Taken into consideration the amount of public funding, which is channelled into the academic entrepreneurship system, the equation seems even more remarkable.[1] The presented case studies have given a detailed insight into a question raised by, among others, IMP scholars engaged in innovation studies (Baraldi & Waluszewski, 2011); namely, does the contemporary innovation support system help, or even inhibit, university start ups to develop and prosper? The case findings have illustrated the consequences of a logic suggested by Baraldi and Waluszewski (2011, p. 189) that university innovation support relies more on 'betting' on potential innovations. Here, the ability for early investors to create 'exit' is a key issue, rather than 'muddling through' the context of innovation. Despite their differences in technology and application areas, the investigated university start ups share the same experiences that their 'muddling through' process, in the producer and user contexts of respective innovation, was realised in adverse conditions from the university innovation support units.

9.7.1 Contributions

The empirical findings have illustrated that innovation support organisations, which most often are university start ups' first counterparts, have specific requirements that might directly conflict with the start ups' ambition to become embedded in a commercial producer and user setting. University start ups are commonly established with a non-existent or weak business network. When the innovation journey to commercialise the research initiates, they need to establish themselves in networks through which they can gain resources. The case findings illustrate that the university innovation support structures develop in order to aid the start up companies in building their competencies and resource bases.

[1] This question relates to the disputed question on how the focus in commercialisation affects the *content and direction of research*, discussed in Rider et al. (2013).

This is achieved in order for them to be 'competitive in the market place', disregarding the complexities of the embedment process. The start up company has to survive a 'double' embedment process: in order to mobilise resources, it has to obtain a place within an innovation support system and deliver metrics considered as evidence for a beneficial commercialisation process in this structure. Moreover, in order to establish relationships with paying customers and complementary producers it has to adapt its commercialised product/service in relation to what is valuable within these settings. The latter process is poorly supported, and sometimes even hindered, by policy's innovation support system.

The study illustrates that through relationships with policy actors, the start up company is encouraged to follow a certain development path, promoting interactions with actors on the basis that they are local, and on the creation of assets such as patents (Baraldi & Waluszewski, 2011; Öberg & Shih, 2014). In order to establish a university start up, the company is more or less forced to become an integral part of a policy network. Hence, the investigation illustrates that the environment the support structure composes can limit the start up's ability to combine resources in a broader business network. Thus, it is suggested by these studies that what in a policy setting appears as a valuable research result, suitable for commercialisation through a start up company, does not necessarily appear as valuable from a business producer and user perspective. As Öberg and Shih (2014) describe, different network structures can have large variations in logic. Here, the fit with the start up company in the network logic of established networks structures is an important aspect for the potential embedment of a new actor (ibid.). Start ups that can add value to formed inter-organisational structures have ease of access and a combination of resources (Snehota, 2011).

9.7.2 Policy and Managerial Implications

The policy implications that are derived from this chapter include the suggestion to better understand the effects of institutional start up support and how this can actually make companies embed in these institutional structures. The cases illustrate the deleterious effects of being 'too' embedded in the policy setting. This in turn affects the start up, especially the university start up, to transform combined resources into value producing innovations in a business setting. Hence, policymakers need to find ways to broaden their network horizons, to also include the logic of the producer and user setting, when allocating funding to university start ups. Policymakers too must be aware of the pitfalls of patenting too much, and too early.

The managerial implications for the university start up concern the necessity for start up managers to seek an interface with business actors early on. This allows the companies to better understand not only their markets but also the limitations of new technological and/or scientific ideas in an established business setting. Thus, as with policymakers, the university start up manager needs to be able have broader network horizon that enables the company to more efficiently manage its resource combinations.

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10

The Coordinating Role of Chinese Policy Actors in Developing New Biotechnology Start Up Companies to Promote Industrial Development

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10.1 Chinese Policy Actors' Involvement in Developing Start up Companies

All around the world there is an increased understanding among policymakers that the establishment of start up companies is the backbone of future economic growth. It is argued that the development of new companies can increase the innovation rate and contribute to industrial change. This belief is also championed by the Chinese government, which has especially emphasised the possibility of start up companies to facilitate the establishment and development of strategically important industries. The promotion of high-tech industries already started in the

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late 1980s; however, since the 1990s, policy attention towards developing some strategically important sectors has been apparent.

In this chapter one of these strategically important industries, namely the Chinese biotechnology industry, will be described and investigated. How the Chinese state government influences the biotechnology industry in different ways will be described. Linné and Shih (2013) suggest that policy actors can play an important role in industrial development by establishing crucial relationships and capabilities for companies. Especially in developing economies, authors have noted the integral role of the powerful state in the coordination of industrial development (Child, 1994; Mathews & Cho, 2000). Scholars have highlighted the heavy state involvement in the Chinese business landscape (Child, 1994; Nee, 1992). In this vein, the contribution of the chapter lies in investigating how policy actors intervene in industrial development, and especially how start up companies are established, formed and developed due to influence from policy actors. For this reason, the chapter focuses on discussing *the role of policy actors in the establishment and development of new start up companies with the aim to contribute to industrial development.*

A conventional view regarding the development of start up companies in the biotechnology industry is that they emerge from scientific research findings. These discoveries are research based and form the basis of commercial ventures which are established from universities, research institutes or recognised companies. Much of the extant literature on start up or new technology-based firms focuses on their lack of resources, legitimacy and/or newness liability (Lee, Lee, & Pennings, 2001; Zimmerman & Zeitz, 2002). In an industrial network context, the problem has been formulated in terms of the lack of initial relationships such as those to established suppliers, customers, government and financing bodies (Mathews & Cho, 2000). Hence, a start up company has usually not yet attained a "network position" (Aaboen, Dubois & Lind, 2013). Moreover, the new business venture has not developed crucial "capability to interact" (Ciabuschi, Perna & Snehota, 2012, p. 227).

In the Industrial Marketing and Purchasing (IMP) literature, the emergent nature of networks is foremost emphasised, where actors are interdependent and have different business aims. However, as researchers note, less has been studied about the proactive role of actors in steering network activities, as well as the provision of resources from them (c.f. Rampersad, Quester, & Troshani, 2010; Ritter, Wilkinson, & Johnston, 2004). Olsen (2011) also discusses the drawbacks of having powerful actors in business networks where it is emphasised that they hold a specific position in affecting the gains among business actors—gains that are not evenly distributed. This also relates to the dark sides of networks referred to by Håkansson, Ford, Gadde and Waluszewski (2009). Notwithstanding, there is also a general lack of studies focusing on the possibility of powerful actors, such as policy actors, to steer, coordinate and establish relationships within business networks (Welch & Wilkinson, 2004).

Against this background, a country such as China with a strong state government is a suitable empirical arena to study and investigate how policy actors engage in business networks and set the conditions for industrial development and start up companies. Studies related to high-tech industries in China highlight the importance of the state government for new business ventures (see e.g. Tan, 2011). This research, nonetheless, says little about in what way the Chinese policy engages in developing relationships central to start up companies. To deepen the knowledge of this notion, the chapter uses start up companies as a point of departure in order to describe how Chinese policy engages in industrial development.

The organisation of the chapter is as follows. In the next section, a theoretical discussion is presented including a short backdrop to the importance of relationships for industrial development, and a discussion on state guidance in a Chinese industrial perspective. After the literature discussion a methodological section follows. Thereafter, two case studies are presented involving start up firms in the Chinese biotechnology industry where state policy actors and the role of the state government for the creation of new ventures are emphasised. The subsequent section offers a comparative discussion of the cases, followed by a conclusion related to the power of policy actors in steering business networks.

10.2 A Note on Chinese Policy Influence on Start up Companies and Business Networks

10.2.1 The Development State and Policy Guidance in a Chinese Context

Development state research focuses on the investigation of East Asian Economies, including China (Besson, 2009; Johnson, 1982; Nolan, 2001). Here, the main focus of analysis is on the active role of the government in the path to industrialisation and modernisation. In promoting industrial development within these developing economies, the government has taken an integral role (Besson, 2009; Mathew & Cho, 2007; McGregor, 2012; Nolan, 2001). For instance, government agencies have been important in promulgating policies to establish national champions. That is, the state has appointed large businesses and business groups to lead the industrial development, along with providing state ownership in strategic and prioritised industries (Nolan, 2001). Hence, governments have been crucial for industrial growth, including: technology diffusion, imitation and learning among business actors. Mathew and Cho (2007, p. 17) describe it as a: "deliberate act of policy design and implemented by the countries themselves". In the same vein, Wade (1990) discusses "governing the market", which is achieved through the mutual interdependence between industrial policy and industrial performance (Weiss, 1995).

A similar stance is taken by China. With the introduction of the open-door policy in 1978, the Chinese government reformed the earlier "backbone" of industrial development in China, the state-owned enterprises (SOEs), through the policy to "grasp the large—let the small go" (Nolan, 2001). Hence, large SOEs were transformed into national champions within prioritised industries, while small SOEs were sold for alternative ownership. During the modernisation of China, Chinese leaders have emphasised the importance of having large national champions to lead the way in industrialisation and modernisation within a number of industries and sectors (ibid.). Due to its transition from a command economy to a more open market system, scholars suggest that ties to policy actors belonging to the Chinese government are even more important for companies due to the lack of established institutional frameworks in China (Hoskisson, Eden, Lau, & Wright, 2000; Krug, 2012). The development state literature notes the importance of governments in directing industrial development; however, these studies are investigations at the macro-level, lacking detailed descriptions on how policy actors affect and engage in business relationships on an organisational level. Moreover, the government state literature has mainly looked at the role of large companies in the development of high-tech industries. Recently, start up companies and their role in industrial development have received increased attention.

10.2.2 High-Tech Industries and Start up Companies in China

One can identify three main research streams related to high-tech start ups in China: (1) the agglomeration factors of new ventures in clusters (Conlé & Taube, 2012; Dornberger & Zeng, 2009; Gu, 1999; Kroll & Liefner, 2008; Suderland, 2005; Zhang, Cooke, & Wu, 2011); (2) the establishment and development of innovation systems (Cao, Simon & Suttmeier, 2009; Gu & Lundvall, 2006; Lazonick, 2004; Liu & White, 2001; Xie & White, 2004); and (3) the introduction and development of industrial/innovation policies (Eun, Lee, & Wu, 2006; Huang, Amorim, Spinoglio, Gouveia, & Medina, 2004; Liu, Simon, Sun, & Cao, 2011; Wu, 2007). Common to these research streams is the main focus on the infrastructural aspect of new business formation, that is, the studies concentrate on how to create a suitable milieu and support structure for business activities within high-tech industries. While the development state literature only focuses on the macro-level, these three research streams mainly focuses on the meso-level, and to some extent the macro, such as in the case of national innovation systems. Thus, these streams also lack attention to micro-level interactions such as investigations of the establishment and development of relationships among business and non-business actors.

Nonetheless, just as the development state literature, these research streams also recognise Chinese policy as important for the Chinese business landscape. Policy actors are important as they control the critical resources necessary for the establishment and development of new companies (Sheng, Zheng, Zhou, & Li, 2011). The encounter with policy actors is therefore a natural part of Chinese companies' business landscape (Child, 1994; Liu, 2008; Lu, 2000; Rooker, 2015; Zhao & Aram, 1995). Hence, by connecting to such actors, companies can increase legitimacy along with gaining access to resources such as knowledge, or access to other business relationships (Low & Johnston, 2010). Su and Hung (2009) describe the Chinese government as the main financier of high-tech projects and mention policy actors as fostering entrepreneurship in biotechnology. Lazonick (2004) also discusses financial support from policy actors as an important ingredient in establishing high-tech industries, naming the support as "patient capital". To get a more detailed picture on how policy actors steer the establishment and development of companies, the chapter hereafter describes the industrial network approach, which emphasises the importance for business development as connecting to other organisations.

10.2.3 Start up Companies and Business Networks: The Importance of Relationships

As stated above, the industrial network approach emphasises the importance for any company to connect to other actors to access, share and combine critical resources. This infers that business activities and industrial development are "collective" and inter-organisational phenomenon (Håkansson & Waluszewski, 2002; Håkansson et al., 2009). As a consequence, it is impossible for a single company to internally have the necessary knowledge to develop its own business, a situation that is especially important for new ventures such as start up companies. In forming and developing a new company, it has to embed itself in a context of users and producers to be economically viable: scholars recognising the specific liabilities that new business ventures face, such as the lack of critical resources, knowledge, relationships and legitimacy (Lee et al., 2001; Zimmerman & Zeitz, 2002). This is particularly the case of start up companies (Hyytinen, Pajarinen, & Rouvinen, 2015). As the new company initiates with a new product or idea, it needs to establish legitimacy and gather resources from a heterogeneous network context (La Rocca, Ford, & Snehota, 2013; Zimmerman & Zeitz, 2002). In order to do this, the new business venture needs to determine organisational relationships primarily with established actors within the network (Hoang & Antoncic, 2003; La Rocca et al., 2013; Zhao & Aram, 1995). Relationships to customers are critical ingredients in determining the economic viability and survival of the start up (Aaboen, Dubois, & Lind, 2013); these might also be the most difficult relationships to form and develop for a start up company.

The interdependence of actors in a network suggests that there are opportunities to influence others directly as well as indirectly (Harrison, Holmen, & Pedersen, 2010). This of course goes in two directions and points to how business activities are embedded in a context (Håkansson & Snehota, 1995). A relevant management question for any company is how actors can utilise others to create value by combining and sharing resources (Ford & Mouzas, 2013; Håkansson & Waluszewski, 2002). Ritter et al. (2004) discuss the importance of creating value through four main types of relationships, which together form the "value net" of any company, as outlined: (1) *Relationships to customers* as critical in understanding the needs and wants of the users, alongside being important for resources to develop new products and services; (2) *Relationships to suppliers* are critical in establishing physical production along with development processes; (3) *Relationships to complementors,* which refers to organisations with complementary products but also government agencies, are important in accessing regulations and attaining licences; (4) *Relationship to competitors* can be especially important for developing new services or standards.

Hence, to be able to share and combine resources necessary for a business development, such as complex technological solution, would be difficult without the presence of strong established relationships between varieties of actors (Håkansson & Waluszewski, 2002). Here, the start up company is at a disadvantage compared to established firms, as it often does not have any developed critical business relationships. Thus, as Aaboen, Laage-Hellman, Lind, Öberg, and Shih (2016) discuss, resources may need to be connected, recombined or substituted, as a prerequisite for the embedment of a start up company in a network. These adaptations are necessary for the company to gain a network position. Such a position is however associated with power relations in a network, and consequently the ability of any company to act within its context. As Håkansson et al. (2009, p. 253) describe: "network effects always tend to favour those who have the ability to mobilize resources, their own and those of others." Olsen (2011, p. 95) also describes business networks as imbued with power as "certain actors will tend to dominate". Hence, there are certain actors that have attained powerful network positions which can affect the business network as a whole. As a consequence, these powerful actors can, to a large extent, influence how value and benefits are spread among actors in the network; a distribution that in many ways is spread unequally among them (Olsen, 2011). Ritter et al. (2004, p. 181) also recognise that some actors can impose more control and power over the network than others by emphasising "The ability to develop and maintain effective and productive relationships with their other members of their ecosystem is a fundamental property of any living organism. This ability varies between firms." Ritter et al. (2004) too describe unbalanced relationships in relation to power as "followship" or "leadership" relationships, in which the follower is totally dependent on the powerful leader. Olsen (2011) especially highlights actors stemming from policy as having a distinct powerful role in business networks with access to critical resources such as financing, legitimacy and relationships necessary for business development. Thus, it is recognised that policy actors have a powerful role to play in business network (Welch & Wilkinson, 2004).

10.2.4 Summarising the Theoretical Discussion

As discussed, the Chinese state government plays a central role in the Chinese business landscape, in particular through the provision of resources for companies. Moreover, industrial policies have steered large companies and business groups to invest in prioritised industries according to the development state literature. This raises questions regarding how new ventures such as start ups are "nurtured" and "governed" by state policy actors on a company level. It is of interest to learn more, and understand how policy actors are engaged in business relationships and business networks in prioritised high-tech sectors in China, and especially how state policy actors affect relationships necessary for the establishment and development of start up companies. In understanding the role of policy actors in industrial development, the industrial network approach is departed from, emphasising the importance for companies to determine a position in a network by forming relationships to established actors, of both business and non-business character (e.g. policy actors). Consequently, to be able to develop, start up companies need to increase relationships to a variety of other actors—customers, suppliers, complementors and competitors—within the established network. The following analysis mainly focuses on how policy actors intervene and steer relationships related to start ups companies, with the greater aim to promote the development of the biotechnology industry. Hence, by analysing critical relationships related to start up ventures, the aim is to reveal how policy actors influence and steer the conditions for start up establishment and development within the Chinese biotechnology sector.

10.3 Methodology Considerations

This study uses a case study methodology to illustrate the steering of policy actors in the Chinese biotechnology industry. The focus is on how biotechnology start up companies are established and developed with the help of Chinese policy actors. In line with several other scholars, the usefulness of case study methodology when investigating industrial development and relationships dynamics is noted (Dubois & Gadde, 2002; Halinen & Törnroos, 2005). Scholars have also mentioned case studies as a suitable methodological approach when investigating and understanding a specific setting (Dubois & Gadde, 2002).

The context of the study is the Chinese biotechnology industry where the setting is illustrated through two cases focusing on the development of two start up companies. Both of the companies have evolved from established companies and are viewed as start ups. The reasons are the companies' status as new business entities, and as well as having business focus based on new areas in comparison to those of parent companies.

The cases were also selected as they both display a strong connection to policy actor involvement and complement each other by representing two diverse fields within biotechnology: monoclonal antibodies and vaccines. Through the cases it is revealed as to how policy actors intervene and steer differently due to varying contexts. The cases suggest various ways as to how state policy actors guide industrial development through influencing the relationships of the start up companies in various ways. In order to identify start up companies involved in late drug developments, assistance from GE Healthcare was received—the word-leading supplier of biotechnology equipment to research organisations as well as industrial actors. Finding start up companies that were involved in late development and production meant that both how they established and also developed crucial relationships with other actors such as research organisations and users could be investigated.

The cases are based on both primary and secondary data. The main data was collected during three field trips to China between 2004 and 2007. The main primary data collection consists of 26 interviews, with respondents that can be divided into three groups. The first group involves interviews with people employed at the start up companies. The second group involves people employed at GE Healthcare as it is the main equipment supplier to the start ups and has detailed knowledge about the customers and their business development. Finally, the third group involves respondents with general knowledge about the Chinese biotechnology context. In the latter group for instance, a professor was interviewed at a key national laboratory in Beijing, a Managing Director for a company providing clinical services to biotechnology companies, and the director of Shanghai Biotech Association. These interviews provided a more general background of Chinese biotechnology and its development. Secondary material was collected through Chinese state policy actors such as Ministry of Science and Technology (MOST), along with a variety of reports and academic literature in order to increase understanding of the contextual setting, the Chinese biotechnology industry, and the monoclonal antibody and vaccine sector in China. In addition, written material regarding the start up companies was too sourced.

10.4 Chinese Policy Engagement in Industrial Development and Chinese Biotechnology

Before 1978, China's economy was heavily planned and the majority of manufacturing was conducted by SOEs. The government decided what the companies would produce, how much and at what price. It also controlled the production of scientific research at universities and research institutes. Direct interaction between suppliers and customers and, between scientific and business units was forbidden. Instead, Chinese policy actors acted as mediators between suppliers and customers along with science and business. With the open-door policy issued in 1978, the Chinese government emphasised the importance of modernising China through the "marketisation" of the Chinese business landscape. As a consequence, the role of state policy changed and a step-wise process towards a market economy was initiated whereby the Chinese government opened up for reforming the SOEs along with allowing new types of ownership. Due to the reformation, companies and organisations could interact directly without the interference of Chinese policy actors.

With the "open-door" policy, the Chinese government also highlighted science and technology as the main ingredients in modernising China and establishing a "socialistic market economy". As a result, an increased focus on developing high-tech industries and high-tech products, along with the commercialisation of scientific discoveries, were emphasised by the Chinese government. In the late 1980s and beginning of the 1990s, large multinational companies (MNCs) controlled the supply of high-tech products in the Chinese market. Due to the dominance of these MNCs, the Chinese government wanted to establish a domestic knowledge pool to be able to commercialise scientific discoveries. As a consequence, biotechnology became one of seven prioritised high-tech industries, especially identified as important for the future development of China (MOST, 2007). To support the development of biotechnology, the Chinese government issued several policies related to it. The first set of changes was initiated by the 863-plan issued in 1986 by the MOST. The aim of the plan was to establish a knowledge base within basic biotechnology research at universities and research institutes. In the late 1980s, the government started to acknowledge the importance of companies to commercialise and produce scientific discoveries. As a result, MOST promulgated the Torch plan in 1988, which was the starting point for establishing economic zones and science parks all over China. Since the beginning of the 1990s, the Chinese government has emphasised the development of an innovation system to promote high-tech industries. As such, it has increased its focus on establishing an infrastructure to promote the creation of new companies. The formations of start up and spin-off companies, originating both from universities and established companies, were encouraged in order to support the commercialisation of science. With an increased industrial focus, the Chinese government also encouraged research institutes and universities to sell scientific discoveries to companies as a way of increasing the funding opportunities for biotechnology research and development (R&D).

In the following sections, two empirical examples of start up companies in the Chinese biotechnology industry are presented, representing two specific sectors within the industry; one being the newly developed monoclonal antibody sector,[1] and the other the more established vaccine sector. How Chinese policy actors are involved in business networks and start up companies' developments will be followed, including their steering activities of the broader landscape.

10.4.1 The Establishment and Development of A Monoclonal Antibody Producer

The development and production of drugs based on monoclonal antibodies are technically difficult and as such are centred on large and complex molecules which require refined techniques, along with high-end equipment and highly experienced expertise. Taken together, drugs based on antibodies are extremely uncertain and result in high development costs. Since the late 1980s and the early 1990s, there has been

[1] Monoclonal antibodies are antibodies that connect to a specific antigen and thus through monoclonal antibody technology it is possible to grow large quantities of them to combat cancer or other diseases.

an increased interest worldwide in establishing new drugs based on monoclonal antibodies with China being no exception. During the 1990s, only MNCs supplied the Chinese market with drugs based on antibodies. MAB Pharmaceutical was formed in 1998 with the aim to supply cheaper antibody drugs and compete with MNCs on the Chinese market. The company was established by two SOEs, yet neither of them had any experience in biotechnology or pharmaceuticals. However, the majority owner was one of China's largest state-owned business groups and appointed by the state government as "national champion" already by 1979. The policy initiative was a conscious way of the Chinese state government to appoint both state-owned companies and large business groups to support various industries through the creation of new small- and medium-sized companies within prioritised industries. Hence, due to the policy, the large public business group started to invest in variety of industries, biotechnology being one of them.

The start up company was located at the Zhangjiang High-tech Park in Shanghai, a park that was established and sponsored by the Shanghai Municipality. By being located in the science park, MAB Pharmaceutical received tax reductions along with a full reimbursement of development costs after drug approval from the municipality. It was decided that the company would establish a position in producing drugs based on monoclonal antibodies. This decision by the owners was made in response to the government's aim to establish a domestic antibody sector. As the new company was established without any drug projects in the pipeline, the main issue was to connect to a supplier with promising drug projects. It was therefore important to establish a long-term relationship with an experienced research institution with several existing drug projects. MAB Pharmaceutical decided to turn to the most distinguished research organisation in China with regard to antibody research: the Shanghai 2nd Military Medical University (SMMU). SMMU had many drug projects based on monoclonal antibodies under development, which MAB Pharmaceutical found interesting. The company wanted to establish a long-term relationship so that it could gain access to several drug projects. Moreover, as MAB Pharmaceutical's core activity would be the manufacturing of drugs, the company searched for a project in late development with market potential. A bio-similar[2] drug project in late clinical 2 trials fitted the description. The drug was similar to an American blockbuster targeting rheumatoid arthritis. This project became the reason for MAB Pharmaceutical to initiate a production platform. The first agreement with SMMU also initiated the transfer of several drug development projects between SMMU and MAB Pharmaceutical. MAB Pharmaceutical employed researchers from SMMU to work part-time to be able to commercialise and create the clinical production of the drugs.

MAB Pharmaceutical focused on establishing production at the facility located in the Zhangjiang High-tech Park, and invested in equipment along with hiring employees with R&D and production experience. In being able to conduct clinical trials, MAB Pharmaceuticals needed to form relationships with public hospitals. This was realised with help from SMMU that acted as an intermediary actor between MAB Pharmaceutical and hospitals. Therefore, through the assistance from the developing partner, the new company could connect to the "crucial" users. In further developing the drug projects, MAB Pharmaceutical was dependent on the state regulator of pharmaceutical drugs, the Chinese State and Drug Administration (SFDA). SFDA reviews and approves new drug applications along with the good-manufacturing practice of production facilities. The company received its first new drug approval by the SFDA in 2005, which was the bio-similar drug supplied by SMMU. The drug was launched on the market in 2006, the same year the company received a national award for "new technical innovation" from the Chinese state government. Already by 2008, MAB Pharmaceutical achieved blockbuster status with sales of more than RMB 140 million. Between 2000 and 2008 more than ten drug projects were transferred from the SMMU to MAB Pharmaceutical. With more drugs being relocated to the company, the already established relationship between MAB Pharmaceutical and Shanghai Municipality (through Zhangjiang High-tech Park) was intensified. Shanghai Municipality suggested a joint R&D Centre focusing on monoclonal antibodies. The purpose behind the R&D Centre was to enhance the knowledge of antibodies within the Shanghai area. It

[2] A bio-similar drug shares some structural similarities with an existing drug.

was the municipality's ambition to create a national centre of excellence, with regard to monoclonal antibody R&D. The Centre would belong to MAB Biopharmaceutical but the Science and Technology Commission of Shanghai Municipality (STCSM) would finance it, given that other research organisations and companies could use the facilities for drug screenings. MAB Pharmaceutical saw this as an important opportunity to strengthen its position in China and gain access to high-tech R&D equipment along by connecting to other organisations with potentially interesting new drug development projects in the pipeline. Moreover, the R&D Centre could give MAB Pharmaceuticals access to potential employees with antibody expertise. The R&D Centre was established in 2007 with the ability to screen more than a dozen drugs simultaneously and the director was handpicked from the SMMU. In 2008, the company was the largest monoclonal antibody producer in China and it was estimated that more than RMB 1.2 billion (USD 144 million) was invested in the organisation until 2007. These investments came mainly from state-related sources, through the two main owners, from MOST's 863-programme and the Shanghai Municipality. The following figure (Fig. 10.1) summarises the network of actors and relationships connected to MAB Pharmaceutical.

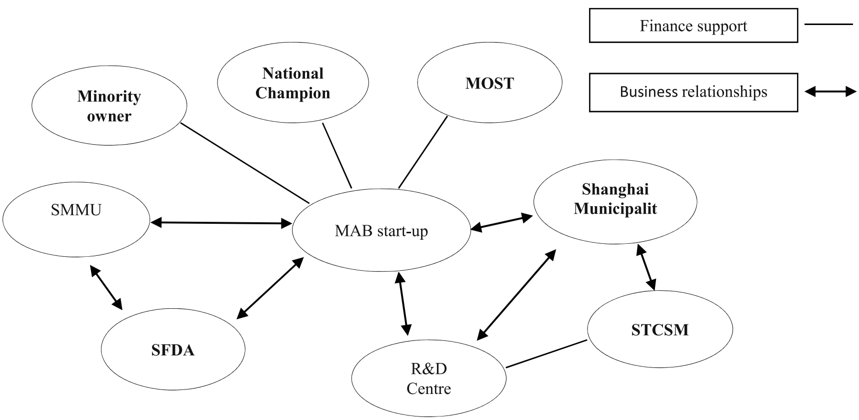

Fig. 10.1 Illustration of the network of actors related to MAB. Policy actors highlighted in bold

10.4.2 The Establishment and Development of a Vaccine Producer

The Chinese vaccine sector is an established sector with a history dating back to the 1930s when the state government established a number of research institutes to be in charge of the development of Chinese vaccines. During the late 1980s, the research institutes became incorporated within the large state-owned China National Biotech Group (CNBG) to further strengthen the future supply of domestically developed vaccines. Until 2001, CNBG was the only producer of vaccines in China, while the Chinese Centre of Disease Control and Prevention (CDC) was the only buyer of vaccines. From 2001, the Chinese government initiated a reformation of the vaccine sector to dismantle the monopoly situation in the Chinese vaccine sector. The reason was the big shortage of domestically developed vaccines. As a consequence, new vaccine companies were established which could directly supply vaccines to users such as CDC clinics and hospitals all over China. One of these companies was Wison Bioengineering, a start up company established in 2003 in the Shanghai Zhangjiang High-tech Park. The company originated from a large private business group from the petrochemical industry, the Wison Group. Encouraged by Chinese policy, the business group turned towards high-tech sectors and thus hoped to reap future benefits within the emerging Chinese biotechnology sector. Wison Bioengineering was established as a spin-off from the parent business group as it was outside the business groups' core activities and the group had no prior experience from biotechnology or pharmaceuticals.

The employment of a General Manager with experiences from the vaccine sector set the direction of the company. He had earlier been employed within the CNBG at the Wuhan Institute of Biological Products (WIBP), one of six original research institutes developing vaccines. The government had encouraged research institutes to commercialise research and the WIBP decided to create start ups from the early 2000s. One of these start up companies was centred on a drug project targeting Hepatitis A[3] virus, developed by researchers from the

[3] Hepatitis A is an inflammation of the liver due to the Hepatitis A virus. The spread of the virus is mostly common in poor sanitary areas.

WIBP. The development of the vaccine was rather simple and straight forward as it was based on an existing technology and developed by experienced personnel. The start up company took the new vaccine through clinical trials 1 and 2, and initiated phase 3. For this last stage, the WIBP spin-off searched for a financially strong counterpart to take the drug through clinical phase 3 along with addressing the manufacturing. The newly established Wison Bioengineering was established with the aim to create a production platform for vaccines and hence could provide production of the new Hepatitis drug project. As such, Wison Bioengineering and the WIBP spin-off saw benefits in cooperating to commercialise domestically developed vaccines. The decision to sign a collaboration agreement was however not in the hands of the two companies. The cooperation between the spin-off and the start up needed to be formally approved by the CDC, the public user that had requested WIBP to develop a Hepatitis A vaccine in the first place. As a consequence, the survival of Wison Bioengineering was dependent on the CDC.

The CDC decided to approve the business relationship between the two parties, a decision made mainly due to the financially strong business group owning the start up. The CDC believed a financially strong owner would have better chances of succeeding in providing the large-scale production of the Hepatitis A vaccine. Consequently, in late 2004 the two companies signed a formal contract where the rights to the vaccine project were transferred over from the spin-off to Wison Bioengineering. The contract not only decided the future direction of Wison Bioengineering, but also resulted in the establishment of a crucial relationship with the final user of the vaccine, the CDC. Within CDC's control is the China National Immunisation Programme (CNIP). The state agency is actively working for an increase in production of domestically developed and manufactured vaccines to be included in the programme. As the CDC was the only buyer of vaccines before 2001, the organisation has an established network in China, including cold-chain transportation, 140 hospitals and clinical trials expertise in developing new vaccines. CDC's aim to include more vaccines in the CNIP resulted in the Hepatitis A vaccines becoming incorporated in the CNIP as of 2008. The central role of the CDC in the Chinese vaccine sector, as well as being the only buyer of Hepatitis A vaccines in China, resulted in Wison Bioengineering being highly dependent on CDC. For instance, the CDC set a unit price per vaccine dose of 4.7 US dollars which was non-negotiable, meaning the profit margin was very low. However, by establishing a relationship with the CDC, Wison Bioengineering could embed within an established vaccine network. The company established clinical production for the last clinical phase 3 which resulted equipment investments and personnel when appropriating the drug project. To initiate the clinical production the WIBP spin-off assisted Wison Bioengineering with information about earlier clinical trials. In the earlier phases, CDC-owned hospitals had conducted the clinical trials. After clinical phase 3, Wison Bioengineering applied for a new drug licence from the SFDA in 2007. The company received current Good Manufacturing Practices-approval in 2009. After this, Wison Bioengineering was able to sell its new vaccine on the market.

Wison Bioengineering has turned to other markets abroad to sell the HAV vaccine. In 2010, the company signed a sales agreement with an Indian customer. However, this has not been profitable enough and the company has broadened its product portfolio. It now includes other vaccine projects targeting diseases outside the scope of the CNIP. These projects have potentially higher profit margins. For example, the company has been developing a drug targeting HPV (Human papilloma virus) along with vaccines targeting HMF (hand, foot and mouth disease) from 2007. The projects originated from the spin-off that developed the Hepatitis vaccine. In 2012, Wison Engineering was sold to the large Chinese private vaccine company, Walvax Biotechnology with more than 1000 employees and 12 approved vaccine products on the market. By selling Wison Bioengineering, the Wison Group could exit the biotechnology and pharmaceutical sector. Notwithstanding, it is estimated that the large business group had invested more than US$300 million in Wison Bioengineering between 2003 and 2012. The following figure (Fig. 10.2) summarises the network of actors and relationships related to the development of the start up.

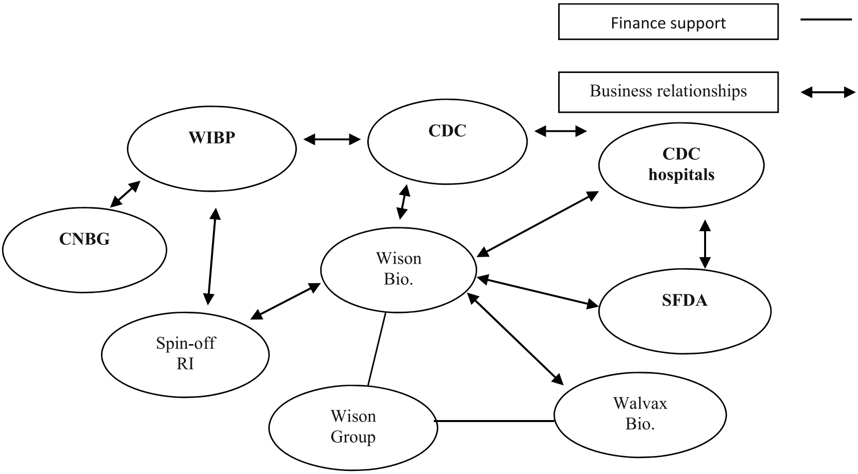

Fig. 10.2 Illustration of the network of actors related to Wison Bioengineering. Policy actors highlighted in bold

10.5 Steering Chinese Biotechnology Start ups and Industrial Development: Role of Chinese Policy

The aim of the chapter was to reveal how policy actors affect start up companies in the Chinese biotechnology industry. In the subsequent section, policy actors and their engagement will be discussed in the two presented cases further. First, the discussion compares the two cases and their particular sectors with the aim to understand how policy intervenes among various relationships (to customers, suppliers and complementors), related to the "value net" (Ritter et al., 2004) of the start up companies. Thereafter, the section ends with a discussion of policy actors' power and their ability to steer business networks.

10.5.1 Comparing the Involvement of Policy in the Two Cases

Four main differences of the two sectors can be identified which are related to how policy engagement in the two cases can be interpreted.

Table 10.1 Identified differences between the sectors and the two cases

Antibody case	*Vaccine case*
New emerging sector—no actors with powerful network positions	Established sector—one actor holds a powerful network position
Open network	Closed network
High uncertainty: technical, complex and costly	Low uncertainty: rather simple technology and development process, not too costly
Locally embedded	Nationally embedded

The following table (Table 10.1) summarises the main differences of the sectors and the two cases.

The antibody case reveals development in an emerging sector lacking no powerful and established actors. The case shows how Chinese policy actors aimed to create a new industry and for this goal, provided resources to develop a business network. The antibody start up, MAB Pharmaceutical, became an influential actor in the network. Policy actors aimed at developing the start up into a powerful actor with a position possible to attract, influence and activate other actors in the network. It is evident that the start up was established as a consequence of policy intervention. Here, the relationship between the national government and the national champion was critical for the establishment of the start up company. Given the high uncertainty of the business potential of antibody research, only the national champion was willing to make the initial investment in forming the company. Hence, MAB Pharmaceutical started with an established relationship to a financially strong business actor, initiated by the government.

Another critical relationship for the start up was the one to SMMU, the supplier of antibody drug projects. The formation of this relationship was triggered by the policy that encouraged research units to license out, spin-out or sell off their research in order to increase the commercialisation rate of domestically developed scientific research. The relationship was not only critical in order for the start up to access new drug projects, but also served as a platform to access customers such as hospitals, and complementors such as the SFDA. This observation suggests the importance for start ups to form relationships with established industry actors to access network resources, something that is also emphasised in the literature (e.g. Hoang & Antoncic, 2003; Low & Johnson, 2008; Zhao & Aram, 1995).

To develop the start up further, the relationship to the complementary actor, the Shanghai Municipality, was critical. The municipality provided tax reductions and reimbursement of R&D costs. The municipality additionally invested, through the STCSM in MAB Pharmaceutical's R&D Centre. This investment illustrates the deepened relationship between the two actors. Shanghai Municipality wanted MAB Pharmaceutical to take an active role in interfacing development and production structures. Thus, the local government sought to turn the company into a central actor in establishing a national antibody hub. This reveals how policy actors are steering the open and emerging sector to establish central actors that have the ability to attract more entrants.

The vaccine case similarly illustrates strong policy involvement. This however differs from the antibody case as its structure was already established. For example, vaccine development, production and use was heavily regulated and controlled by the CDC, which set the conditions for the whole business network. Compared to the antibody case, the vaccine sector displays less uncertainty due to pre-existing technologies and expertise. Some changes were nevertheless introduced, with the policy to allow new vaccine producers due to the lack of domestically developed drugs.

The low uncertainty and policy support made it easier to attract private investments in the vaccine sector. This was also displayed in the case, where the start up company Wison Bioengineering was established through the financial support of a recognised business actor. In addition to the important relationship with the supplier of capital, the start up's relationship with the powerful customer is critical. This relationship was integral for the start up in order to access other relationships. Similarly, this observation is in line with the understanding of scholars describing the necessity of ties to established actors (e.g. Hoang & Antoncic, 2003; Low & Johnson, 2008; Zhao & Aram, 1995). It was through the ties with the customer, CDC, that the start up could establish other relationships such as those with suppliers (supplier of drug projects) and customers (hospitals, distribution), along with complementors (the SFDA). Due to the necessity of all new entrants to be approved by the policy actor, CDC, this resulted in a closed business network. Basically, one powerful policy actor was controlling and limiting interaction among the others. The formal approval of the relationship between the Wison Bioengineering and the spin-off from the research institute were examples of how the CDC could steer and control the network.

By establishing a business relationship with the customer, the start up company gained legitimacy within the sector, and could secure future sales along by accessing the necessary relationships. The relationship however displays a power asymmetry between the parties. For example, where the start up was dependent on the CDC for its survival and could, for instance, not affect the price or the quantity of the drugs. Ritter et al. (2004, p. 178) describe such a situation as a "followship relationship" for Wison and a "leadership relationship" for the CDC. To become less dependent on the CDC, the start up developed its business in another direction by establishing new customer relationships, as well investing in new projects outside of the established network. As a consequence of widening its portfolio, the start up gained attention from larger producers and the merger with an established Chinese vaccine producer became a reality.

10.5.2 Powerful Policy Actors and the Steering of Business Networks

It is evident that the start up companies discussed above are both indirectly and directly steered by policy actors. In some cases, the policy actors are counterparts in relationships, while in others policy actors affect critical relationships indirectly. Thus, in establishing and developing the "value net" or "network position" of the start ups policy, actors play a crucial role. By taking on a variety of roles, policy actors try to reduce uncertainty and risks associated with business activities, especially related to production in the Chinese biotechnology industry and thereby promote development in a prioritised industry.

As suggested by the development state literature (Mathew & Cho, 2007; Nolan, 2001; Besson, 2009), national champions are important actors in developing economies. They lead industrial development through financial investments in new industrial areas and undertake business activities. The cases in this chapter show that national champions undertake investments in new high-tech sectors and establish start up companies. Thus, the findings are in line with Su and Hung (2009), as well as Lazonick (2004), who argue that policy actors act as main investors in new business ventures within Chinese high-tech industries.

The findings also draw attention to the power of some actors in steering business networks in certain directions. Several scholars have noted this phenomenon (see e.g. Olsen, 2011; Ritter et al., 2004; Welch & Wilkinson, 2004) and discussed power relations in business networks. Håkansson et al. (2009, p. 237) confer that "network effects are more likely to favour those who have the ability to effectively mobilize their own and others' resources." Actors thus, have different abilities to influence others within the network; the way in which power is distributed among actors affects the dynamics of the network to a large extent. Here, Olsen (2011, p. 95) emphasises the lack of studies on power in networks, and especially the negative effects that power patterns impose on the network. The findings herein reveal the Chinese biotechnology industry as imbued by powerful policy actors with the ability to steer relationships in the network. This was especially visible in the established vaccine sector. Olsen (2011) also highlights that power patterns are more apparent in established sectors developed through long-term investments. Thus, power is intimately linked to the established and activated network of actors, activities and resources. With this in mind, it is easier to understand why and how new entrants are encountered differently in the two cases; one case is open to new entrants as it is emerging and lacking established structures, while the other is an established sector limiting new entrants due to the changes it exposes to established structures. The power to control and limit actors within a sector may result in disadvantages such as hindering the best suitable actor to access the network. Moreover being accepted as a new entrant means that the start up company need to accept a position where the company has little possibility to affect and direct its business without the interference of powerful policy actors. However, although the policy actor enjoys considerable influence of the business sector, it is only possible to control the network to a certain extent. For example, as in the vaccine case Wison Bioengineering initiated relationships outside the realms of the powerful customer to develop its business.

Against this background, it is important to note that policy involvement has its described benefits, but its influence over business is not always positive. Historically, Chinese policy engagement has resulted in a number of less flattering outcomes such as extensive corruption which has plagued the close relationship between politics and business in China (see e.g. Huang & Snell, 2003). Moreover, Sun (2004) describes corruption as affecting Chinese business development and innovation in negative ways. Chinese policy engagement in financing unprofitable SOEs has proven to cause power asymmetries among actors in business networks (Nee, 1992). Håkansson et al. (2009) however, note the role of policy actors as actually having the ability to change such power imbalances. Nevertheless, putting this in the Chinese start up context, it appears not to be the case. The antibody example demonstrates how Chinese policy actors deliberately develop the start up into an actor with a powerful network position. In the vaccine case, Chinese policy actors actively support to maintain the network position of one powerful player.

It is important to understand China as a special case with its own context and history that to a large degree affect contemporary business networks. Due to its authoritarian context, it is not surprising that the Chinese business landscape is imbued by policy actors. However, the chapter provides some implications. For instance, policy actors have the possibility to affect relationships and power distributions among actors in networks. These actors can especially provide more long-term financing, or as Lazonick (2004) describes it: "patient capital", which can provide conditions for start up companies to survive "the valley of death". Thus, providing long-term financing from policy actors start up companies would allow time and ability to focus on developing relationships to suppliers and customers, while less time would be spent on searching capital for its survival.

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Index

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