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MARKET ORIENTATION IN MARKETS FOR TECHNOLOGY – EVIDENCE FROM BIOTECHNOLOGY VENTURES

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> *"And certainly there were many others… from whom I had assimilated a word, a glance, but of whom as individual beings I remembered nothing; a book is a great cemetery in which, for the most part, the names upon the tombs are effaced."* (Marcel Proust, Time Regained)

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Maija Renko

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1 INTRODUCTION

Do small high-technology firms actually care about their customers? How about competition? Or do they just focus on science and technology, and hope that innovative products will sell themselves? And in the end, does any of this really matter for firm performance?

These are the kinds of managerially-oriented questions that are the focus of this research. In more academic terms, this research focuses on *market orientation of small and medium-sized enterprises (SMEs) in markets for technology*.

Even science-based companies do not subsist solely due to research and development activities aiming to create something in the future; it is essential to take inventions to the market and turn them into successful innovations (Costa, Fontes & Heiror 2004). This study develops a conceptualization of market orientation in small and medium-sized firms in markets for technology based on extant literature concerning market orientation of a firm (marketing domain), technology management literature, and entrepreneurship literature, as well as primary empirical data from biotechnology SMEs.

By showing that even small, young firms in an extremely technology driven environment do exhibit market-oriented behaviors, this study expands the domains where market orientation has been studied. These market-oriented behaviors, however, are partly different from those typically observed in more traditional consumer and industrial markets. For example, SMEs in markets for technology do not always conduct in-house market research, but they do collect market data by informal means through links with various external stakeholders. The contribution that this study makes to marketing literature comes from re-defining the components of market orientation in markets for technology. In addition, through theoretical triangulation this study makes contributions to entrepreneurship and technology management literature; market orientation can contribute to entrepreneurial opportunity recognition, and it can also be viewed as a valuable resource in line with a resource-based view of a firm. From a managerial perspective, the main contribution of the study comes from demonstrating the consequences of market orientation for firm performance.

1.1 Market orientation

Market orientation was first defined within marketing literature as an organization-level culture comprising values and beliefs about putting the customer first in business planning. Since then, market orientation has been studied both as (1) a cultural phenomenon and (2) as a set of behaviors relating to (a) organization-wide market intelligence generation through decision support systems, marketing information systems and marketing research efforts, (b) dissemination of the intelligence across functions in a firm, and (c) organization-wide responsiveness (actions) based on this intelligence (Kohli & Jaworski 1990). Market intelligence covers both customers and competitors, and market orientation has attracted a significant amount of academic and practitioner interest in the current marketing literature (Han, Kim & Srivastava 1998; Kohli & Jaworski 1990). In this study the *behavioral view of market orientation* is the one adopted. Thus the focus is on actions and doing, not mind-set and culture.

For the current research, market orientation is defined as the *organization wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organization-wide responsiveness to it* (Kohli & Jaworski 1990, 6). Thus, there is a clear focus on market information and behavior.

There is a large body of literature that is dedicated to studying whether market orientation results in superior organizational performance. Some studies have verified a positive link between the concepts (Matsuno, Mentzer & Öszomer 2002; Deshpandé, Farley & Webster 1993; Kohli & Jaworski 1990; Ruekert 1992; Narver & Slater 1990), while others did not find support for a direct positive relationship between market orientation and performance (Han et al. 1998). For example, Greenley (1995) found no direct influence of market orientation on performance in his sample of British firms, and Pelham & Wilson (1996) found that market orientation did influence new product success but did not impact on other performance indicators, namely growth or market share. Hart & Diamantopoulos (1993) found no direct link between performance and conducting marketing research. This interest of researchers in linking market orientation with organizational performance shows the connectedness to the strategy literature. The field of strategy is, in general, interested in determining the sources of performance differences between firms.

Market orientation and market knowledge are closely related concepts. Based on Li & Calantone (1998), I define market knowledge as "*organized and structured information about the market*". Organized means it is the result of systematic processing (as opposed to random picking), and structured implies that it is endowed with useful meaning, as opposed to discrete items of irrelevant data (Li & Calantone 1998, 14). The term refers to a stock of knowledge, and this study focuses on the set of processes that generate the stock, disseminate it within an organization, and the actions that are taken based on the knowledge. In this study the two terms "market intelligence" and "market knowledge" are used interchangeably. Market knowledge is a more widely used term, but within market orientation literature, the term market intelligence has also been used.

Market knowledge, which this study addresses, is inherently organizational knowledge, not an individual's knowledge. This organizational knowledge entails scope and context (Von Krogh, Roos & Slocum 1994), and both of these dimensions vary remarkably between firms, even within the same industry (King & Zeithaml 2003). Furthermore, organizational knowledge resources consist of firm-specific routines and skills that differentiate the organization (Nelson & Winter 1982). As knowledge resources vary not only by industry but also by organization, studying the content of market knowledge is not the aim of this study. Rather, I study the *central actions and processes of market knowledge generation, dissemination, and responsiveness*, i.e. market orientation.

Even though there is plenty of literature on market orientation and its components have been tested in a variety of empirical settings, the literature is very silent on what constitutes market orientation in markets for technology. Some hints on the potential components of market orientation in markets for technology can be derived from studies on market orientation in a small firm context (Verhees & Meulenberg 2004; Pelham 2000) or product development literature that emphasizes the importance of market orientation (e.g. Atuahene – Gima 1995; Cooper & Kleinschmidt 1993, 1994, 1995; Langerak, Hultink & Robben 2004; Li & Calantone 1998; Salomo, Steinhoff & Trommsdorff 2003; Sandberg 2002). However, neither of these two research streams provides a comprehensive picture of market orientation in markets for technology. Through my focus on this neglected research area I am able to contribute to both (1) a managerial understanding of how a firm can be market oriented in a market for technology, and (2) a theoretical understanding of the market orientation construct, its components, and the consequences of adapting a market orientation.

1.2 Markets for technology

Firms that specialize in the creation of new technology are an important part of many technology-intensive industries today. There is a wealth of scholarly research in economics that addresses the nature and working of markets for technology, namely intermediate technological inputs (See, for example, Serrano 2006, Lamoreaux & Sokoloff 2003). Statistics on European patents show that 25.3% of small firm patents and 9.0% of large firm patents are offered for licensing (Gambardella, Giuri, & Luzzi 2006). Markets for technology thrive when the environment is germane to the formation of smaller technology-based firms and when there are such smaller technology specialists that are more likely to find it profitable to sell the technology rather than to invest in the downstream assets to become a fully-fledged final producer (Gambardella et al. 2006; Arora, Fosfuri, & Gambardella 2001). Despite the importance of markets for technology, *there is little guidance in the management literature on how managers should behave in the presence of markets for technology* (Arora et al. 2001). The research reported here aims to contribute to this research gap.

The scope of markets for technology has been defined by Arora et al. (2001, 3-5). In line with their definition, I list the characteristics of markets for technology as follows:

1. *Technology* is useful *knowledge* mostly rooted in engineering and scientific disciplines.
2. The principal *focus of trade* is *knowledge* rather than the physical artifact.
3. However, sometimes knowledge can be embodied in physical artifacts (e.g. a method for rapidly screening biological compounds may be embodied in the chip that performs the screening). In this case the cost of developing the knowledge embodied in the artifact should significantly exceed the cost of creating the artifact.
4. Technologies can be existing or still in development.
5. The term “market” is used in a broad sense. Transactions in markets for technology do not always involve an exchange of goods for money but involve *detailed contracts* and may be embedded in a *technological alliance* of some sort.
6. However, corporate mergers and acquisitions, as well as the movement of people, are not part of markets for technology.

The reason why corporate mergers and acquisitions are not part of markets for technology is that they not only compass the acquisition of existing technology but also the capabilities and competencies to develop new technologies. The same – but on a smaller scale - is true for the movement of people across firms' boundaries (Arora et al. 2001, 4-5).

Market for technology includes transactions of full technology packages (patents, other intellectual property, and know-how) and patent licensing. Furthermore, market for technology includes transactions involving knowledge that is not patented and, perhaps, not even patentable, like many non-patented designs (Arora et al. 2001, 6). On the one hand, economists talk about technology transactions - and, for example, Gans and Stern (2003) talk about markets for technology under the title of "markets for ideas". On the other hand, from a resource perspective, markets for technology are just one example of strategic factor markets (Barney 1986) - that is, markets where firms buy and sell the resources necessary to implement their strategies (Hirshleifer 1980).

In the following I want to emphasize two features of markets for technology that, for their part, justify the relevance of investigating market orientation in this context. The first feature is about the sources of new product ideas, and the second is about the nature and scope of demand.

Sources of new product ideas. Idea generation is often considered a critical activity for the development of new products. Gagliano (1985) makes the point that idea generation sessions should never look for the best way, one should always look for 100 ways. In support of this notion, researchers have shown that the number of new product ideas generated in a firm is highly correlated with measurements of firm performance (For a review, see Troy, Szymanski & Varadarajan 2001). Greater amounts of market information, as well as the key organizational structure and climate characteristics of a firm, contribute towards enhancing idea generation (Troy et al. 2001). To say this in other words, one of the reasons for companies to be market oriented is that this orientation helps them in generating new, more successful ideas for future products.

In markets for technology, ideas for new products or technology platforms seldom have anything to do with market- or customer-derived initiations. As the notion of "markets *for* technology" implies, the business is about searching for utility and commercial possibilities for technologies. It is not about "markets *of* technology", something that exists "out there" *de facto*. Ideas for new technologies and products in this context stem from basic science and research, not from customer needs. Consequently, the marketing effort is viewed as a necessary consequence of the product or technology, and not vice versa, as it "should be" (Levitt 1960, 8).

Demand conditions. The second point I wish to make here is about the nature and scope of demand. Most businesses today face a highly competitive market situation. End-user demand is declining in many sectors and companies are having to struggle with diminishing markets. End users simply do not need and cannot afford all the goods available to them, so customers are selective in what they buy.

Often, the demand side of markets for technology is somewhat different. New technologies and solutions that stem from science and research rather than customers' wishes have a potential to create new markets. As an extreme example, there are dozens, probably hundreds, of medical conditions and illnesses for which there are no cures today. These unmet medical needs do not constitute markets as of today because there are no suppliers in the markets, hence no exchange. However, if a new product is launched that addresses such an unmet medical need, it has "all the demand in the world" for a while, thanks to patent protection.

Gathering information on markets that do not yet exist is mostly based on educated guesses. For illnesses, the numbers of patients affected by various diseases worldwide can often be estimated rather exactly. However, evaluating customers' and third-party payers' willingness to pay for a new drug is already a lot harder. And asking patients' opinions on features of remedies that are totally imaginary as of today is yet another guessing game. Even though this example of unmet medical needs is an extreme one, technology markets are full of examples of products and concepts that have created totally new and profitable markets upon their introduction.

As a science- and technology-driven field, any market for technology represents an "extreme environment" for market orientation; *if it can be demonstrated that market orientation matters even in a market for technology, we are one step closer to concluding that market orientation is important in all fields of economic activity*. The field of biotechnology is a prime example of the functioning of markets for technology, and it is also the context of the empirical study in this thesis. Due to strong contact with professionals like medical doctors and customers, market leaders in biotechnology can often utilize their superior position to collect leading information on the market and technology (Takayama, Watanabe & Griffy-Brown 2002). However, young, small, science-driven organizations in biotechnology especially are not "naturally" exposed to market knowledge. For these firms, the network of existing customers is often non-existent; a large number of small innovator firms operate totally in the field of

R&D and have no products on the markets for the time being. This is why being market oriented is especially challenging for these young, small organizations.

In summary, markets for technology have distinctive features that make demand conditions, sources of new product ideas and the resulting competition different from other, more traditional markets. This study provides an in-depth analysis of market orientation in markets for technology. Because these markets are typically populated by small and medium-sized enterprises (SMEs), it naturally follows that those kinds of firms are also the focus of this study. Given the increasing importance of markets for technology as well as market-oriented thinking in today's business world, this analysis is worthwhile and presents a contribution to the marketing literature as well as the technology management literature.

1.3 Organization of the study

In many ways this research reflects the change in the ways academics think about and study marketing and market-related phenomena. Initially, marketing inherited a model of exchange from economics, which had a dominant logic based on the exchange of "goods", i.e. manufactured output. Marketing was focused on tangible resources, embedded value and transactions. Today, however, marketing is more about intangible resources, the co-creation of value and relationships. The items exchanged in today's markets are increasingly about the application of specialized knowledge and skills through deeds, processes and performances (Vargo & Lusch 2004).

Figure 1 shows the focal phenomenon of this study, i.e. market orientation of SMEs in markets for technology in relation to other relevant research areas. Theoretical triangulation - that is, combining different theoretical perspectives - is needed in order to understand the contribution of previous literature to the focal phenomenon.

Chapter 2 (bottom right corner of the figure) starts with a description of the biotechnology (life sciences) field as a typical example of the functioning of markets for technology. Typical for such a science- and technology-intensive field, companies operate in a truly global environment.

Chapter 3 (top right corner of the figure) presents a review of previous research on market orientation in the marketing domain. Market orientation as a research stream within marketing is expanding rapidly, and both conceptual and empirical studies on the topic are available.

Chapter 4 presents the contributions of entrepreneurship literature, technology management literature, and literature on inter-firm collaboration to the understanding of the focal phenomenon. Inter-firm collaboration (top left corner of the figure) has been studied from a variety of perspectives, the most prominent of which are transaction cost economics (Williamson 1975), the resource-based view (Barney 1986, 1991; Wernerfelt 1984; Penrose 1959), the interaction approach (Håkansson 1982; Turnbull, Ford & Cunningham 1996), and lately also organizational learning (Hamel 1991; Shan 1990). Of these perspectives, organizational learning and the resource-based view tend towards an understanding of market orientation (Baker & Sinkula 1999a, 1999b; Farrell & Oczkowski 2002). The specific features of SMEs (bottom left corner of the figure) have been documented in the entrepreneurship literature. For example, the importance of key individuals' social capital on a firm's success has been studied extensively (Nahapiet & Ghoshal 1998; Grundstén 2004).

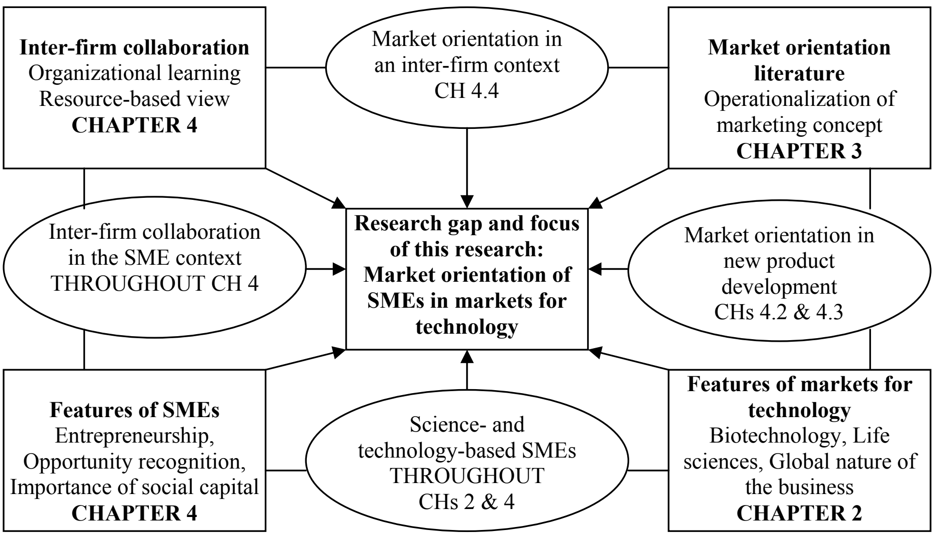

Figure 1: Focal phenomenon of the study and its positioning in relation to extant research

The above-described four main cornerstones, on which this study is built, are thoroughly researched areas. However, the focal phenomenon of my study – market orientation of SMEs in markets for technology – has remained on the periphery of academic interest. In addition, market orientation in an inter-firm context represents a gap in current academic knowledge. The increasing importance of networks and partnerships in the economy suggests that theories originally developed at the level of a firm need to be explored to determine their application to partnerships and networks of organizations (Dyer & Singh 1998). The research on market orientation to date takes a single firm perspective; what is missing in the present conceptualization of market orientation is a firm's "partnering orientation". Firms that partner with other organizations to create customer value must develop a strategy of market orientation that is of an inter-firm rather than intra-firm nature (Hunt & Lambe 2000, 28). The current research is an attempt to widen the scope of the traditional market orientation towards inter-firm market orientation. This, combined with reflecting on market orientation in the light of the entrepreneurship and technology management literature provides the basis for the previously mentioned contributions of the research, namely (1) a managerial understanding of how a firm can be market oriented in a market for technology, and (2) a theoretical understanding of the market orientation construct, its components and the consequences of adapting a market orientation.

As illustrated above, the first four chapters of this thesis are dedicated to the theoretical background of the research topic. After this, Chapters five through eight describe the empirical data collection efforts and present the results of the empirical data analysis. The last chapter of the thesis (Chapter 9) presents a discussion of the empirical research findings in light of the existing research.

2 RESEARCH SETTING AND QUESTIONS

The purpose of this chapter is twofold. First, the industry setting of the current research is described. This is necessary since markets for technology and, more specifically, biotechnology, the field chosen for the empirical research, are likely to be unfamiliar settings for most readers. Also, providing readers with an understanding of the specific features of the field of biotechnology gives them a basis for an informed evaluation of the generalizability of the arguments and findings presented in the chapters that follow. Second, the objectives of the research are described in this chapter, and exact research questions are formulated. Figure 2 describes the contribution of Chapter 2 as part of the whole theoretical background of the research.

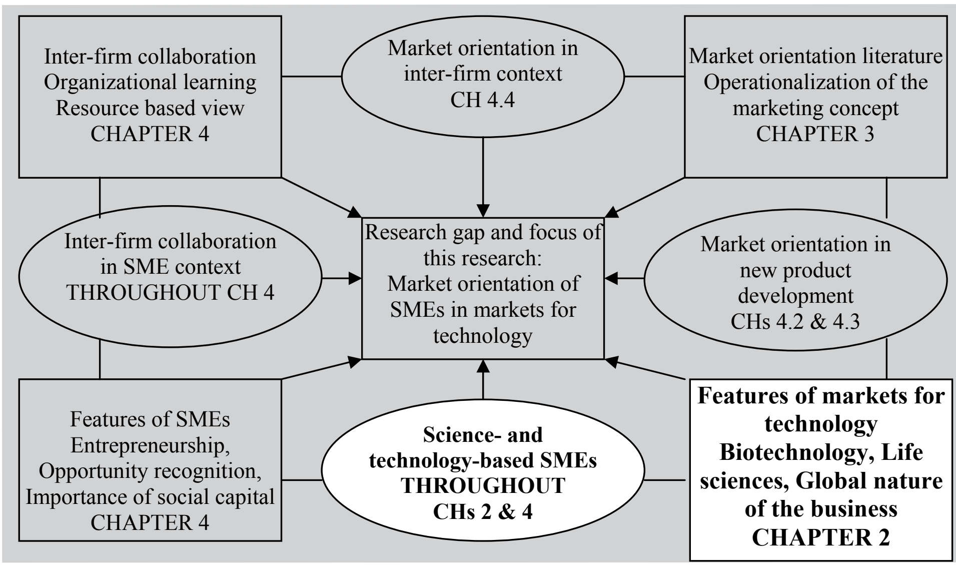

Figure 2: Focus of Chapter 2

Typical of markets for technology, technological ideas are for sale in many industries. This is predominantly true in new, emerging and technology driven fields like software and biotechnology. Finding usage for inventions that stem from science often requires a good deal of imagination and positive visioning. Quoting March (1991, 85-86):

> *"But it may be instructive to reconfirm some elements of folk wisdom asserting that (...) the development of knowledge may depend on maintaining an influx of the naïve and ignorant, and that competitive victory does not reliably go to the properly educated."*

Could it be that in the most innovative fields of economic activity paying little or no attention to what others – like customers, competitors, and investors – say about your business is actually beneficial for the development of knowledge and innovations? Biotechnology is, without doubt, one of the most innovative industries of today. The empirical data in this study is collected from small and medium-sized firms in the international biotechnology industry. Biotechnology is probably the field that most clearly represents the dynamics of markets for technology, which should allow theoretical generalizations from this research to be applied to other sectors of markets for technology. Have companies in the field of biotechnology achieved success because of listening to their customers, reacting to their competitors' moves, and being responsive to customer needs? If not, then what have been the forces that have fueled the global growth of the biotechnology field? The next pages briefly describe the evolution of the biotechnology field and its current state as a global growth industry.

2.1 Research setting: Biotechnology

Biotechnology as a business developed out of the research laboratories of universities, a process that accelerated in the US in particular during the 1970s with advances in recombinant DNA (deoxyribonucleic acid) research. The first patent on a genetically engineered life form was granted to Exxon by the United States Patent and Trademark Office in 1980 for an oil-eating microorganism. This marked the beginning of the economic incentive to invest in genetic research (Bergeron & Chan 2004). During the early 1980s major corporations and the federal government in the US began to provide substantial research funds for the expansion of existing and the establishment of new biotechnology research institutes at universities. At this stage, large pharmaceutical as well as chemical firms were among the leading corporate funders of biotechnology (Kenney 1995; Llobrera, Meyer & Nammacher 2000).

2.1.1 Defining biotechnology

Roughly speaking, biotechnology is defined as the application of knowledge of living organisms and their components to industrial products and processes[1] (Brink, McKelvey & Smith 2004). In discussing the biotechnology field, the focus is usually on the six dominant, interdependent categories: pharmaceuticals, medicine, agriculture, biomaterials, computing, and military applications. The common thread that runs through these categories is dependence on the function of genes at the molecular level (Bergeron & Chan 2004). *This study focuses on pharmaceuticals, medicine and the application of biomaterials for medical purposes.*

Many biotechnology and life sciences companies develop science-based products. Two characteristics are typical of these products. First, at the launching of a project, a product still requires functional definition. Second, the development requires a program of scientific research of the main phenomena associated with the product. Consequently, development of these products is different from applied research in new product development because the scientific research work has yet to be done and learning is needed on the phenomena that are essential to the product. Science-based product development is also different from basic science, which is typically concerned with phenomena with no clearly identified application goal. Science-based product development clearly aims at developing a commercial outcome (Hatchuel, Lemasson & Weil 2004, 728). The discovery, design and development of new drugs is a good example of science-based product development.

In virtually every industry there is a considerable time lag between the invention of a new technology and a practical, marketable product based on the technology (Hansén 1981). The promise of reduced time to market and new, custom drugs continues to fuel investment in medical biotechnology. Rapid drug development through rational drug design, in which computer methods are used to design custom drugs, is viewed by the pharmaceutical industry as the irresistible lure of biotech. However, biopharmaceuticals (pharmaceuticals created using biotechnology) only represent about $35 billion of the quarter-trillion-dollar global pharmaceutical market. Furthermore, most of these products are from a handful of companies, notably Amgen, Boehringer Ingelheim, Biogen, Genetech, and Idec Pharmaceuticals (Bergeron & Chan 2004).

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[1] For a list of exact definitions of biotechnology, see Brink et al. pp. 22-23

2.1.2 Biotechnology as an information science

A great number of books and articles have been written that describe the emergence of biotechnology from the recombinant experiments by Herbert Boyer and Stanley Cohen, and from Milstein's monoclonal antibody work. (For some recent descriptions of the state of biotechnology field, see e.g. Bergeron & Chan 2004; McKelvey, Rickne & Laage-Hellman 2004; Oliver 2003; Robbins-Roth 2000). Interesting though it may be, a description of the history of modern biotechnology is not the purpose of my study. Thus I limit the number of pages dedicated to describing the biotechnology business to minimum. However, in order to understand the idea of this study and to interpret the empirical results correctly, it is important that the reader has an idea of the current stage of the industry and the key forces affecting its development. This is why a short description of modern biotechnology business here is justified.

Biotechnology is, in fact, another type of information science (Löffler 2002). Instead of using the 1s and 0s of information technology, modern biotechnology is based on the four letters of DNA, namely A-C-G-T (Adenine, Cytosine, Guanine, and Thymine). The information of these letter combinations in our genes is encoded into proteins. The key to understanding the actual functioning of a living organism derives from how these proteins relate to each other and the environment. Research activities in the biotech field are characterized by a variety of sciences and technologies. Areas such as genetics, biochemistry, immunology, cell biology, general medicine and computer science are all involved in biotechnology. The process of researching and developing new biotech products is very expensive, whereas the industrial production is usually not very costly. Biotechnology and, especially, genetic research is highly speculative and there is little guarantee of a return (Chiesa & Toletti 2004).

Biotechnology firms use this "information science" as a basis for their R&D and aim at developing solutions for health care, agricultural and environmental markets. Besides being science-driven, most biotechnology firms are very small and they may adopt different commercialization routes for their innovations: either take their technology direct to the market as a final product or channel it through large established companies that will then apply their know-how and resources to commercialize it. Some firms follow a hybrid model and combine research services and licensing with research for their own product development in order to survive while aiming for an integrated activity in the future (Pfirrmann 1999; Costa et al. 2004). The deals between smaller, upstream inventors and larger, downstream marketers are often structured as licensing agreements, and functional complementarity is the driving force behind such alliances. It is not surprising that the motivations for alliances differ significantly between licensors and licensees (McCutchen & Swamidass 2004).

The two notable and widely researched characteristics of the field of biotechnology are the dominance of small firms and the dense inter-organizational networks within the small firm community as well as between small and larger firms (Barley, Freeman & Hybels 1992) and individuals (Liebeskind, Oliver, Zucker & Brewer 1996). Organization level ties among new biotechnology firms have been studied by Barley et al. (1992), Kogut, Shan & Walker (1992), Powell, Koput & Smith-Doerr (1996), and Shan (1990). Relationships between biotechnology firms and large pharmaceutical firms have been covered by Pisano (1990), Arora & Gambardella (1990), and McCutchen & Swamidass (2004). Liebeskind et al. (1996) looked at scientific knowledge transfer through individual-level ties, and Oliver & Liebeskind (1998) combined the individual and organizational network levels. The overall contribution from all these studies seems to be that the embeddedness of small biotechnology firms in collaborative inter-firm networks is essential for the development of competitive advantages. In addition to networks, the competitive advantages of biotechnology firms have been linked to the existence of vibrant academic institutions (Kenney 1986), venture capital and other forms of risk financing (Lerner 1995; Powell et al. 1996), managerial talent (Gulati & Higgins 2002), and dynamic geographical clusters (Saxenian 1994; Casper & Murray 2004).

Market orientation in biotechnology can be observed in the process that leads from an idea and its testing in a laboratory setting to the commercialization of the innovation in markets. Market orientation in the biotechnology setting is an interesting research topic for two intertwined reasons. First, biotechnology is a representative of markets for technology, where knowledge is the most important trading good: a typical business model of a small, dedicated biotechnology firm aims at making money out of licensing inventions to downstream companies - typically, large pharmaceutical companies. Second, “technology seeds” that can be developed into biotechnological products emerge from scientific advances. As a science-driven field, biotechnology represents an “extreme case” for market orientation; if it can be demonstrated that market orientation matters even in this highly scientific sector, we are one step closer to concluding that market orientation is important in all fields of economic activity.

2.2 Research setting: International dimension of markets for technology

Unlike markets for physical goods, markets for technology are seldom bound to a certain physical location. Codified knowledge is easily transferable via the various means of communication available today. Patent rights travel across country borders without much extra cost, and scientific communities within various disciplines are increasingly international. This is an interesting reality, but few authors have written on the specifics of markets for technology from the point of view of firm internationalization.

To address this deficiency, let us look back to the general literature on firm internationalization. Internationalization of firms has been a topic for an increasing number of scholarly studies since the 1950s. Over the past decades scholarly contributions to understanding the subject of international business have become multi-disciplinary and geographically diffuse (Dunning 2001). The international business literature is largely based on an assumption that stems from the work of Stephen Hymer (1976): foreignness may be a liability for a firm. This has become such an integrated part of the way of thinking about foreign markets that – despite the widespread implications of this notion – it has remained largely unquestioned among scholars (Zaheer & Mosakowski 1997). Hymer (1976) proposed that firms setting up operations abroad face unavoidable costs that firms operating in their home environment do not. These costs arise from various sources, such as higher coordination costs, the foreign firm's unfamiliarity with the foreign culture, the lack of information networks or political influence in the host country, or the foreign firm's inability to appeal to nationalistic buyers (Zaheer & Mosakowski 1997). Thus a foreign firm would, *ceteris paribus*, be at a competitive disadvantage relative to a local firm in a country. This burden has been labeled the liability of foreignness.

Without this distortion caused by the liability of foreignness, much of the international business literature would be rather obsolete, since competitive advantages of firms in the markets would depend on factors other than being domestic or foreign. However, empirical research has proven that liabilities of foreignness do exist and they do make a difference (Zaheer & Mosakowski 1997; Zaheer 1995). Much of the liabilities of foreignness has been attributed to the "psychic distance factor", which disturbs the flow of information and knowledge between firm and market (Johanson & Vahlne 1977) and thereby invokes the higher cost of doing foreign business (Hymer 1976).

Most of the theoretical and empirical attention in the international business literature has been directed at how multinational enterprises (MNEs) may compensate for the liability of foreignness. Researchers have highlighted the advantages of the MNE, such as economies of scale and scope, superior technology, brand recognition, or managerial skills (Zaheer & Mosakowski 1997). This research has – until recently – almost completely been carried out within the context of large, incumbent types of MNEs. Firms that offer their ideas for sale in markets for technology are typically small or medium sized. Hence, from the point of view of this research, the literature on the internationalization of SMEs (rather than MNEs) is of interest.

The attention of international business and entrepreneurship researchers has been drawn to the phenomenon of international new ventures[2] following the seminal article on the topic by Oviatt and McDougall in 1994. Oviatt and McDougall (1994, p. 47) provide evidence from various sources compiled since 1989 of a growing incidence of international new ventures. As the empirical phenomenon of international new ventures has now been established (Turnbull 1987; McDougall, Shane & Oviatt 1994; Bloodgood, Sapienza & Almeida 1996; Coviello & Munro 1997; Autio, Sapienza & Almeida 2000; Autio & Sapienza 2000; Madsen, Rasmussen & Servais 2000; Shrader, Oviatt & McDougall 2000; Zahra, Ireland & Hitt 2000; Aspelund & Moen 2001; Moen 2002; Moen & Servais 2002), one should take into account the advances in this literature as far as they help in understanding the phenomenon of interest of this study, i.e. market orientation in markets for technology.

The new theories on the internationalization process of young, small firms (McDougall et al. 1994; Oviatt & McDougall 1997), as well as the more traditional process (stage) model of internationalization (Johanson & Weidersheim-Paul 1975; Johanson & Vahlne 1977), treat market knowledge as a central enabling resource for internationalization. Much of the liability of foreignness relates to the foreign firm's lack of local market knowledge (Lord & Ranft 2000). The more traditional internationalization process theory emphasizes the accumulation of *foreign organizing knowledge* (Johanson & Vahlne 1990), whereas the new venture internationalization "theory" (McDougall et al. 1994; Oviatt & McDougall 1997) views international *market knowledge* as more of an enabling resource than as a regulator of resource commitments. In the literature on new venture internationalization, the inherent mobility of knowledge allows for an early and rapid internationalization of new ventures (Yli-Renko, Autio & Tontti 2000). In process models of internationalization, a firm will consider switching from an initial low-resource commitment mode to a high-resource

[2] An international new venture is defined by Oviatt and McDougall (1994, p. 46) as "a business organization that, from inception, seeks to derive significant competitive advantage from the use of resources and the sale of outputs in multiple countries."

commitment mode as it accumulates more knowledge on international operations (Johanson & Weidersheim-Paul 1975; Johanson & Vahlne 1977).

In viewing international market knowledge as a key resource that enables internationalization of a small, young firm, international new venture "theorists" actually call for more research on the role of market orientation in a firm's internationalization. This emphasis placed on market knowledge, and hence, market orientation, is exciting. However, before deciding on "internationalization" as a research topic in markets for technology, let us look back to the basics of the internationalization literature. In the following I discuss three basic cornerstones of internationalization literature as we know it today. A closer examination of these thoughts in the context of markets for technology shows that, by nature, markets for technology may require a novel approach to internationalization that is yet to be established in the literature.

2.2.1 Internalization

As described by Dunning (2001), international business scholars in the 1970s and 1980s became interested in explaining the foreign *production* of firms as a market-replacing activity. Essentially, in their argumentation for internalization, researchers have been claiming that it would occur whenever and wherever firms perceived that the net benefits of using cross-border markets to organize the transactions of intermediate goods and services were lower than those of hierarchical control (Dunning 2001, 40). For much of the past decades, the internalization paradigm (Buckley & Casson 1976; Rugman 1985) has been the dominant explanation for the existence and growth of MNEs, and it is also an integrated part of the Oviatt & McDougall (1994) accelerated internationalization model.

Internalization provides a limited explanation of the international scope of operations of a firm that produces and trades knowledge rather than physical goods. The source of competitive advantage in markets for technology is not the cost-efficient transfer of intermediate goods and final products or services over country borders. Rather, the "cross-border" transactions of interest in markets for technology occur over the borders of organizations - transfer of knowledge from a university laboratory to a commercial firm – from a small commercial R&D firm to further development in a larger company – from this larger company to a user organization - and so forth. The physical location of these organizations has a much smaller role to play in the production of knowledge than has the capability of organizations to communicate and transfer all the relevant knowledge from one stage to another in the process. Sometimes, rather than using "cross-organizational markets" to organize knowledge transactions, organizations involved in the commercialization of knowledge may choose to implement hierarchical control over the process. In a typical example, a larger company downstream in the value chain would buy a smaller player upstream. However, again, the reason for this arrangement is not replacing markets (country markets) by hierarchies, but internalizing knowledge, irrespective of its domestic or international location.

Even for manufacturing firms, internalization of operations may not be a part of the internationalization process. This is especially true in the case of small and young firms. As pointed our by Coviello & Munro (1995) and Jones (2001), internationalization of these firms is more likely to occur, at least initially, through links and transactions with organizations and individuals in the external environment. Even though the internationalization paths of small, young firms vary remarkably, Jones (2001), for example, shows that only very few small high-technology firms make direct investments in overseas production activities. Internalization of markets is seldom a feasible option for resource-constrained SMEs. Instead, Liesch and Knight (1999) propose that internationalizing small firms internalize information about foreign markets prior to entering those markets. Even though they use the terminology of information internalization, it is hard to see how their argumentation differs from the organizational learning literature. What is more, the information internalization of Liesch and Knight (1999) is certainly not used in the meaning of internalizing the "products" in market for technology.

2.2.2 Liability of foreignness: gaining recognition

As mentioned above, the relevance of the internationalization literature rests on the assumption that firms suffer from liabilities of foreignness when they operate outside their domestic markets. An important source of costs of foreignness, which was highlighted by Hymer (1976) and in many discussions ever since, lies in the preference of local customers for domestic firms, with whom they have long-established relationships (Grönroos 1990a) and who are usually perceived to have more stable and reliable links to their home country. Multinational enterprises are often able to overcome this liability of foreignness with their global branding and market communication strategies (Caves 1982), but for internationalizing SMEs, gaining recognition among customers in a foreign market can be a lengthy endeavor.

In markets for technology, however, this liability is significantly lighter (if at all existent) than in more traditional business or consumer goods markets. This is not to say that the reputation of a firm does not play a role in markets for technology. For example, empirical studies have shown that alliances with prominent partners can provide access to external legitimacy and status similar to that provided by legitimating institutions. Alliances can thus give advantages to startups; the "right" alliance partners can signal the perceived quality and reliability of a firm's products and services among potential customers, employees and investors (Hannan & Freeman 1984; Stuart, Hoang & Hybels 1999). So the ways to signal reputation – physical location in a science park with a reputation of excellence (Westhead & Batstone 1998), having star scientists involved in a firm's operations or decision making (Murray 2004), or having prominent large firms as alliance partners – as well as ways to read these signals in markets for technology have little, if anything, to do with the country aspect.

2.2.3 Liability of foreignness: culture clash

Entrepreneurship researchers have characterized entrepreneurial organizations as innovative, proactive and prone to risk-taking (Covin & Slevin 1989; Miles & Arnold 1991; Lumpkin & Dess 1997). A bulk of the liabilities of foreignness stems from a firm's unfamiliarity with a foreign culture. The constant innovativeness and proactiveness typical of a young, entrepreneurial organization in markets for technology can actually assist in dealing with the unfamiliarity of a foreign culture. Autio et al. (2000) actually introduce the concept of "learning advantages of newness"; based on panel data from the Finnish electronics industry, they conclude that as firms get older they develop learning impediments that hamper their ability to successfully grow internationally. The relative flexibility of newer firms allows them to rapidly learn the competencies necessary to pursue continued growth in foreign markets (Autio et al. 2000, 919). This is another demonstration of how the traditional way of thinking about liabilities of foreignness does not necessarily apply in markets for technology, which are typically populated by young, entrepreneurial firms.

Given the forces of globalization and technology that increase firms' and individuals' knowledge and reach of far-away markets, one can legitimately question the existence of liabilities of foreignness, and hence, the legitimacy of much of existing international business literature. Also, as pointed out by Jones (2001, 193), internationalization in today's context is less about entering foreign markets than it is about increasing the firm's exposure and response to international business influences. For those involved in the management of biotechnology ventures, it goes without saying that both the markets for technology as well as the markets for end products are truly global. Actors in the field of biotechnology take global stakeholders into account in planning and carrying out their strategies. The peculiarities of patent protection, as well as the regulatory bodies that determine the marketability of end products to consumers, vary from one geographic area to another. However, a geographically focused strategy is close to impossible in a world where knowledge, technologies and consumer information cross country borders much faster than new strategies can be formulated in boardrooms. Biotechnology firms need to recover the huge R&D investments they make in their innovations, and in order to gain maximum profits from products on the markets the geographical scope of marketing and distribution activities has to be as wide as possible.

In conclusion, the international business literature today emphasizes market knowledge as a key enabling factor behind the international operations of firms. Nevertheless, the same international business literature has focused on the trade of physical goods or services, and little has been written on knowledge trade from a micro (firm) perspective. As the discussion on internalization and liabilities of foreignness above illustrates, some of the basic assumptions made about firm internationalization may not be accurate in markets for technology. Both internalization theory (Buckley & Casson 1976; Rugman 1985) and stage models of internationalization (Johanson & Wiedersheim-Paul 1975; Johanson & Vahlne 1977) imply that a firm exhibits some form of strategic decision-making behavior over time concerning its internationalization (Coviello & McAuley 1999). Markets for technology are extremely international by nature, and the mere physical location of customers or suppliers in these markets does not typically reflect strategic decision making. Hence both internalization and stage theories offer very limited explanations for the geographical scope of firms' operations in these markets. As a more recent area of internationalization research, the network perspective focuses on non-hierarchical systems, where firms invest to strengthen and monitor their positions in international networks (Johanson & Mattsson 1988, 1992; Coviello & McAuley 1999). However, the network perspective of internationalization has little to offer for the study of market orientation as a potential source of competitive advantage of a firm. The perspective sees that a firm's internationalization depends on an organization's set of network relationships rather than a firm-specific advantage (Coviello & McAuley 1999). This perspective actually contrasts the propositions that this study makes about the importance of market orientation - i.e. a firm-specific advantage - for an organization.

It is clear that biotechnology SMEs operate in a truly global environment, where factor markets as well as markets for ideas and innovations have little to do with country borders. Hence these firms develop their market orientation in a global environment. Bearing this in mind, let us next specify the objectives of this research.

2.3 Research questions

Dozens, even hundreds of studies have been conducted on the subject of market orientation in recent decades, reflecting the growing interest of practitioners and scholars in understanding markets and marketing as sources of competitive advantage in the intensifying global competition. However, research on the subject suffers from a number of deficiencies: (1) It is too fragmented and scattered, often neglecting the potential contributions of disciplines other than marketing - like management and sociology – in the understanding of market orientation; (2) It is often driven by practitioners' needs, resulting in handbook-like guides to development of market orientation, which lend little to theory development; (3) It provides only a partial examination of market orientation, in many cases neglecting a plethora of organizations that face "non-traditional" markets consisting of multiple stakeholders; and (4) it does not offer a detailed understanding of the specific nature of market orientation in the context of small, technology-intensive firms.

This research attempts to fill these gaps in the literature by offering a comprehensive and insightful analysis of the market orientation concept based on the extant literature and an in-depth analysis of six case companies as well as another sample of 85 biotechnology SMEs.

The existing research on market orientation can be classified in a number of ways. Following the categorization by Becherer, Halstead & Haynes (2001), some key contributions in market orientation research come within the following categories:

1) Theoretical/conceptual issues and the development of market orientation research frameworks,

2) Market orientation measurement development and validation,

3) Antecedents of market orientation,
4) Performance outcomes of market orientation, and
5) Moderators of the market orientation-performance relationship.

This study addresses and makes a contribution to a number of these fields. First, the theoretical and conceptual development of market orientation concept in markets for technology is based on contributions from existing market orientation research as well as research in the entrepreneurship and technology management domain. Second, this theoretical and conceptual development leads to some suggestions on issues that need to be included in valid measurements of market orientation in markets for technology. However, this study does not aim at scale development and validation in the traditional quantitative sense. That development requires large samples, and in this study the requirements for high-quality in-depth data override large sample size. Third, selected independent variables will be regressed on performance outcome variables in order to find out about the performance implications of market orientation in the target population.

The purpose of this research is twofold: (1) to consolidate practitioners' understanding of market orientation using existing academic literature to describe market orientation in markets for technology; and (2) to assess selected performance implications of a firm's market orientation. When formulated as research questions, I aim to answer the following:

1. What are the components of behavioral market orientation in markets for technology?

2. What are the performance implications of market orientation in markets for technology?

As the latter question implies, I assume that the degree of market orientation has performance implications for firms. In fact, some proactive aspects of market orientation may be even more relevant for firm performance in markets for technology than in more traditional markets. For example, the diffusion of radically new innovations may be slow, particularly if the target is markets where current solutions are very different from new ones. For example, Nobel Biocare, a successful company providing dental implants, had to struggle for more than 10 years to reach a significant share of the potential market despite the favorable clinical results for its innovative titanium-based implants. Over the years the company has spent large resources on training dentists all over the world, turning them into lead users (Rickne 2000).

The unit of analysis in this research is a firm. In a recent contribution, Tyler and Gnyawali (2002) study market orientation on the level of individual managers, but the vast majority of market orientation studies adopt a firm perspective. Market orientation is especially relevant for knowledge commercialization, where firms, rather than individuals, are the relevant units of analysis.

As an answer to the “so what” question - i.e. why worry about market knowledge and orientation - I refer to two complementary explanations. First, researchers in the marketing domain have mainly been preoccupied with linking market knowledge and orientation to firm performance. Even though the results from these studies are somewhat mixed, the general belief is that being market oriented enhances firm performance. Performance implications of strategic resources are also the main interest of strategy researchers. Second, an answer based on entrepreneurship research suggests that information gaps present sources of entrepreneurial opportunities waiting to be discovered (Kirzner 1997). Given that firms face the information asymmetry problem in the market, how do they acquire more information that has the potential to lead to discovering new opportunities?

2.4 Methodological choices

A paradigm is a “basic set of beliefs and assumptions that guide” research (Creswell 1998, 74). Every researcher brings to his or her research a set of ontological, epistemological and axiological[3] beliefs. These beliefs about reality, knowledge and values guide the choice of research methods. At one extreme, a researcher may believe that reality can be objectively known and causal linkages can be legitimately claimed. This approach leads to the use of deductive logic and, typically, quantitative methods in research. At the other extreme, reality can be believed to be socially constructed and only knowable from subjective points of view. In this case, a phenomenon is studied within its social context using inductive logic and qualitative methods (Arbnor & Bjerke 1997; Rocco, Bliss, Gallagher & Pérez-Prado 2003).

This research is not based on such purist worldviews as those described above. Instead, the guiding principles behind choosing certain methods for this study can be described with the term *pragmatism*; I use “whatever philosophical and / or

[3] The study of value or quality. Often thought to include ethics and aesthetics—philosophical fields that crucially depend on notions of value.

methodological approach works for the particular research problem under study" (Tashakkori & Teddlie 1998, 5). In this study I use *mixed methods* because I believe it makes the data collection and analysis more accurate and the inferences more useful.

The central thought of pragmatism is that philosophy must be connected to practice, and, as described in the articles in the Canadian Journal of Philosophy issue that was dedicated to pragmatism in 1999[4], there is much contemporary interest in what this thought implies for the notions of truth and objectivity. The founders of the pragmatism position - Charles Peirce, William James, John Dewey - argued, in different ways, that the notion of truth should not be disconnected from the practices of belief, assertion, and inquiry (Misak 1999).

In agreement with anti-positivists, pragmatism rejects the privileged status of science. However, it would be foolish to believe that reality or the world is only an illusion in which people can do whatever they choose. Pragmatism distinguishes between causality and description; while causality may not be in question, description and interpretation are. The key question of pragmatism is whether or not information, like scientific data, is *useful* in the sense of helping people to better cope with the world or to create better organizations. This criterion of usefulness applies across the two dimensions of epistemology and normative criteria; is the information credible and reliable (epistemological) and does this help advance our knowledge (normative)? (Arbnor & Bjerke 1997; Wicks & Freeman 1998). Explicit from this brief description of pragmatism, a researcher has a key role in judging how to answer research questions. The tools - methods - available to a pragmatist researcher are *not* limited to quantitative *or* qualitative, as is often the case for researchers with strictly subjectivist – relativistic or objectivist – rationalistic worldviews.

In line with Harrison and Leitch (1994, 112), I believe that the conscious and critical transfer of theories and methodologies from one research area to another may stimulate creative advances in both and can help in resolving "old problems in new ways". In accordance with this belief, I take advantage of multiple theoretical views when canvassing market orientation in markets for technology. My research problems have not arisen with the issues and problematics of a single discipline, but rather in a context-of-application. Within the framework of Gibbons, Limoges, Nowotny, Schwartzman, Scott & Trow (1994) with respect to the nature of knowledge production systems, Mode II (as opposed to Mode I) describes my research: The research is characterized by a constant flow back and

[4] Pragmatism. Canadian Journal of Philosophy. Supplementary Volume, 24, edited by Misak, C. J. Calgary: Alta University of Calgary Press, 1999.

forth between the fundamental and the applied, theoretical and practical (Gibbons et al. 1994, 19).

I believe that management research should adopt an approach that is both theory-sensitive and practice-led; managerial insights do not result from knowledge being produced in a laboratory and then applied to a real-life problem. Thus, even though this research is academic and aims at developing exiting a theoretical base in the fields of marketing and technology management, the knowledge is produced through directly addressing the empirically relevant problems, i.e. the research questions (Muller & Subotzky 2001, 167). As a result, the current research is trans-disciplinary as it cuts across existing discipline boundaries in the search for solutions. This contextual (rather than discipline-based) nature of this research calls for the use of multiple methodological approaches, which will later be described in more detail under the "mixed methods" topic.

The axiological beliefs behind any research also include those concerning ethics (Rocco et al. 2003, 21). The ethical aspects of biotechnology are seldom discussed in academic studies that use biotechnology as an empirical field for testing hypotheses on, e.g., organizational forms, networks and institutions. At "best", "ethics is seen as something to be added on or fit in after the law-like generalizations of positivist science are found" (Wicks & Freeman 1998, 127). Wicks and Freeman (1998) claim that this marginality of ethics is the result of assumptions about the nature of business which tend to isolate the ethics (seen primarily as altruism) from business (seen primarily as self-interest). This is called a separation thesis (Freeman 1994).

Wicks and Freeman (1998) remind us that ethics is an essential part of the very foundations of organizational studies. Since the goal of marketing research – including my research – is to both understand and evaluate organizations with the purpose of improving their function, ethics becomes an inseparable part of research. This is particularly true when the research contains implications for practice.

My research topic actually brings together two somewhat colliding fields. Market orientation, the operationalization of the marketing concept, is ultimately concerned with company growth and profitability through understanding customers. In contrast, biotechnology is a field with the potential to spin products that can cure illnesses and enhance the quality of life for millions of people. Bringing money and healthcare, profits and equality, to the same table is a guaranteed recipe for ethical debates. Controversies continue to abound over the negative versus positive societal impacts of biotechnology. On the one hand, modern biotechnology is often claimed to be crucially important to many industrial sectors and to address basic human needs and societal problems. On the other hand, modern biotechnology is also the centre of controversies about the modification of nature, food safety, animal welfare, environmental protection and impacts on global poverty. Deep chasms divide those who focus on the potential benefits from those who debate the potential problems (Laage-Hellman, McKelvey & Rickne 2004).

The status of biotechnology companies as commercial entities raises a number of ethical issues, like product safety, corporate social responsibility and corporate governance. In product safety, companies face particular challenges in determining what counts as a "safe" product, given the contentious nature of what might count as "harm" in biotechnology. In corporate social responsibility, an attempt to manage the social consequences of products poses special challenges for biotech companies. In corporate governance, biotech companies need to follow best practices regarding the ways in which information, authority and influence flow between a company's shareholders, managers and Board of Directors (MacDonald, 2004).

The ultimate ethical question in life sciences research is the question of ownership; who owns the knowledge that can benefit patients in the end? A related question is who has the motivation to use that knowledge so that something concrete will eventually come out of it. The key milestone in the biotech revolution was the decision of the US Supreme Court on the patentability of human, animal and plant genes. Many think that the privatization of life forms through the extension of patent protection represents a new and perhaps more subtle form of appropriation of social resources. However, only the possibility of patenting their discoveries provides firms with the adequate incentives to carry out R&D activities in the biotech field (Chiesa & Toletti 2004).

The choice of biotechnology as an empirical field of this study is simply based on my previous understanding of business models in that field, and my conviction that it is the most viable representative of the functioning of markets for technology. The choice of biotechnology is not an expression of my opinion concerning the societal benefits of biotechnology. I believe - again, in line with a pragmatist paradigm - that the focus of ethical considerations should be on the concerns of managers, communities and other key stakeholders rather than the abstract discourse of philosophers (Wicks & Freeman 1998).

2.5 Mixed methods approach

Quantitative and qualitative methods have become the focus of rather entrenched ideological or epistemological positions, i.e. paradigms, in social sciences. There are researchers who choose quantitative methods that are compatible with methods used in the natural sciences. For some of these “quantitative” researchers, using qualitative methods means debasing a social science like marketing as a “science”. A researcher that chooses qualitative research methods (compatible with methods used in the humanities) may argue that those who adhere to the quantitative “camp” devaluate the human being that should be at the centre of marketing as a discipline (Zazie 2004). From a pragmatic point of view, the choice of methods is not based on “camping” on the quantitative or qualitative side. Rather, methodological choices are justified by the kinds of research questions we are asking.

Sometimes, the best answers to research questions come out of a combination of using both quantitative and qualitative methods in a single study. In the social sciences this combination of methodological approaches has been discussed in various terms, such as multiple methods, mixed methods, multi-method research, methodological mix and methodological triangulation (Hurmerinta-Peltomäki & Nummela 2004, Tashakkori & Teddlie 1998). The two objectives of this study, i.e. understanding the components of behavioral market orientation in markets for technology and investigating the performance implications of this orientation, require very different kinds of data and analysis techniques. The first objective calls for a qualitative research approach (more exploratory approach), whereas the second objective can be reached through an analysis of quantitative data. Hence I use both quantitative and qualitative (i.e. mixed) research methods in this study.

All research falls somewhere within a cycle of an inference process, often referred to as the research cycle or the cycle of scientific methodology (Tashakkori & Teddlie 1998). The cycle may be seen as moving from grounded results through *inductive logic* to general inferences and generalizations (theory), and then from theory or a conceptual framework through *deductive logic* to tentative hypotheses or predictions of particular events. This chain of reasoning is graphically depicted in Figure 3.

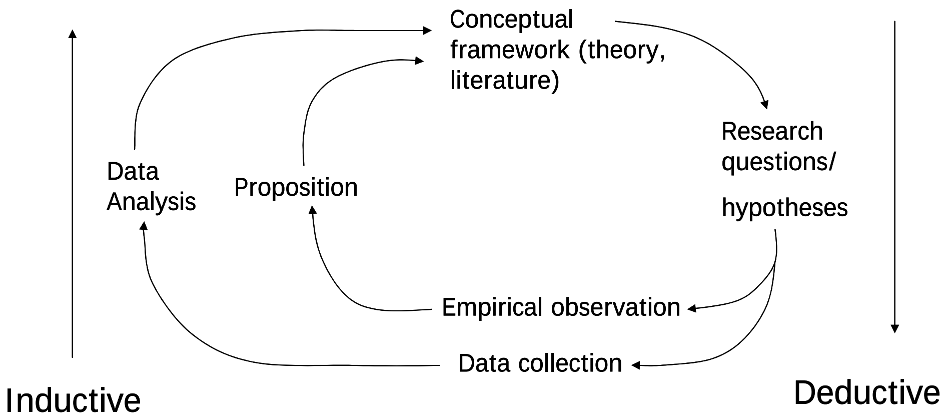

Figure 3: The Research Wheel (Rudestam & Newton 2001)

This research process started with my empirical observations of the science-driven nature of small, young biotechnology firms in Finland. Some of these empirical observations are reported in Renko, Carsrud, Brännback & Jalkanen (2005). From these observations I derived rather general propositions, which basically suggested that even though young biotechnology firms do not seem to pay much attention to end markets, there are processes embedded in the functioning of these firms that are geared towards understanding competition, licensors and other stakeholders. These processes certainly do not manifest themselves in ways described in the mainstream marketing literature. With these "propositions" on my mind, I not only studied literature in the marketing domain but also in technology management and entrepreneurship. I also conducted qualitative case studies of six biotechnology firms in the Philadelphia area. In the process of this literature review and preliminary research my understanding of the focal concept of this research, i.e. market orientation in markets for technology, increased and I eventually developed hypotheses that I wanted to test in a more comprehensive dataset than that of the six case companies. This led to empirical data collection from 85 biotechnology companies in the USA, Finland and Sweden. The analysis of this data is reported in the chapters that follow, and the research results summarize the key aspects of market orientation in markets for technology, creating a theoretical basis for future research.

This description of the research process shows that I have gone through phases of both inductive as well as deductive reasoning. This has required data that is comprehensive enough to allow induction but also rigorous enough to allow for the testing of hypotheses and deduction. The use of both quantitative and qualitative data in this process has, I believe, allowed me to construct solid research with valid and reliable results. In addition to using both quantitative and qualitative methods in data collection and analysis (methodological and data triangulation[5]), I also use theory triangulation in order to achieve a comprehensive understanding of the focal phenomenon, i.e. market orientation. Even though the "purest" form of market orientation research has been conducted within the marketing discipline, there are multiple inputs from technology management as well as entrepreneurship literature that are helpful in building the theoretical foundation of this research.

As is clear form the above, the empirical data collection was divided into two phases. The first phase involved qualitative data collection (interviews) from the six case companies. This preliminary empirical study is reported in Chapter 5 after describing the theoretical background of the research and before specifying the hypotheses. In the second phase (the main study), both quantitative and qualitative data were collected simultaneously from firms (n=85) to allow hypothesis testing. In this second phase some of the qualitative data was codified into quantitative form for the analysis and some was analyzed in the original, qualitative form. Figure 4 illustrates these different phases of data collection and their relationship to the research questions presented earlier.

[5] Triangulation refers to the use of multiple methods in the study of the same object (here: a firm and its market orientation) (Denzin 1978).

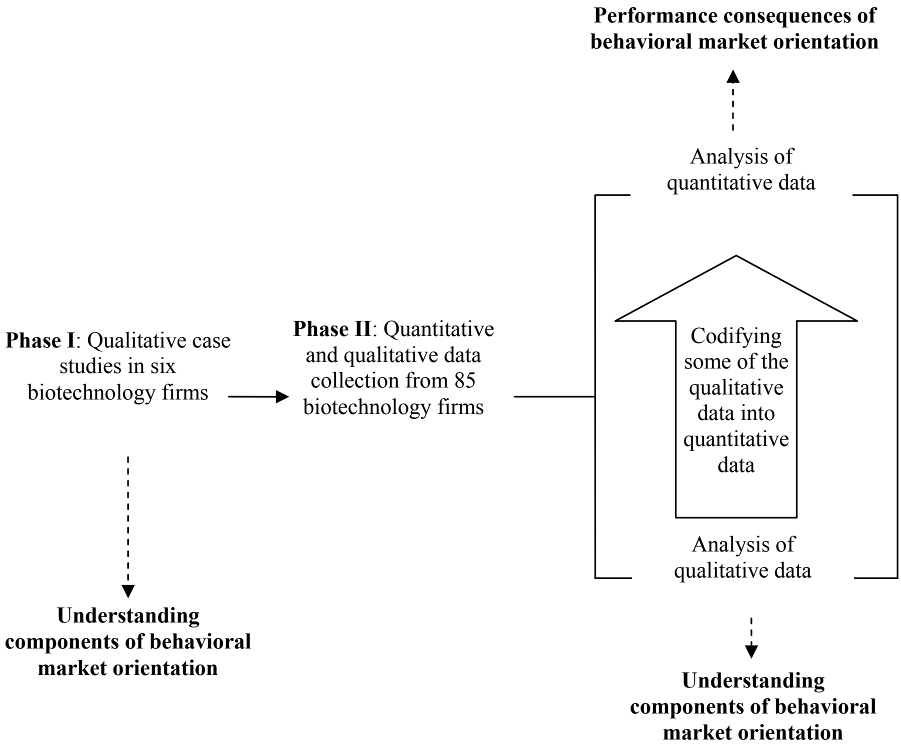

Figure 4: Phases of data collection

The first phase of the study, as illustrated in Figure 4, is a purely qualitative one. The purpose of that phase is “topic-related” (Hurmerinta-Peltomäki & Nummela 2004); some information on the empirical phenomenon was available from the existing literature but there was a need to acquire a better understanding of the components of market orientation in markets for technology. The second phase of the research involved the use of an “equal status mixed method design”; I conducted that part of research using both quantitative and qualitative approaches about equally to understand the phenomenon being studied (Tashakkori & Teddlie 1998, 44). Conceptually, the whole research process, although being substantially grounded in previous theories regarding market orientation (deductive), was also open to the development of a new conceptualization (inductive) regarding the role of this construct in the market for technology. Inductive logic is most prominent in the first phase of the empirical study (preliminary study, cases) and also in the first parts of the empirical data collection (interviews) in the second phase. In both the preliminary study (Phase

I) and the qualitative part of the main empirical study (Phase II), the purpose of data collection and analysis is to answer research question number 1, as indicated in Figure 4. The quantitative data collected in Phase II, is analyzed in order to answer the second research question, which concerns the implications of market orientation.

The purposes of using mixed methods in this research can be summarized as (1) the search for triangulation and seeking convergence of results using various methods, (2) the search for complementarity and examining overlapping and different facets of the phenomenon (i.e. the content as well as the consequences of market orientation), and (3) development of the research process; using the methods sequentially so that the results from the first phase (and method) of the study inform the use of the second method (Greene, Caracelli & Graham 1989).

All scientific enquiry and empirical research should be based on existing knowledge and theories. Before the empirical data collection and data analysis are described, the following chapters (3 and 4) are dedicated to a literature review that covers various relevant aspects of market orientation. First, Chapter 3 describes the evolution of market orientation within marketing literature. After this, Chapter 4 integrates insights from technology management and entrepreneurship literature with the understanding of market orientation.

3 MARKET ORIENTATION OF A FIRM

The concept of market orientation has emerged within marketing literature. The fact that market orientation literature emerged at the beginning of the 1990s is not surprising given the general developments in the field of marketing research. Since the beginning of the 1980s the field has experienced increasing interest in interactions between buyers and sellers and the relationships they build. Scholars have increasingly used sociology and social exchange literature for understanding market behavior, and the applicability of economics-based theories has been questioned (Hedaa & Ritter 2005).

In order to answer the research questions presented, one of the purposes of the current chapter is to review the brief history, strengths and weaknesses of market orientation literature. This is done with the previously described context in mind; how can market orientation literature in its traditional form help in understanding market orientation of SMEs in markets for technology, for example, in the field of biotechnology? (See Figure 5).

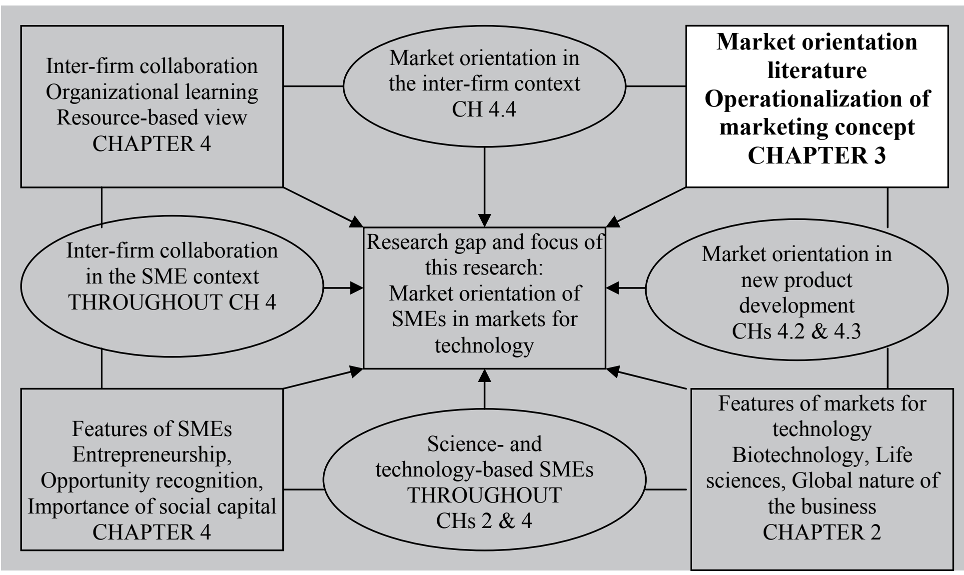

Figure 5: Focus of Chapter 3

The market orientation literature departs from both economics and the social exchange view of markets; the underlying assumption is that profit maximization and long-term profitability are ultimate goals of sellers. At the same time, however, these goals can only be achieved by understanding customers' needs and problems as well as competitors' strategies. Also, the rationale behind the study of market orientation presupposes that analyzing a firm's competitive environment can generate exceptional advantages that lead to above-normal returns. This opposes the economics assumption that both the methodologies for collecting environmental information (Porter 1980) and the conceptual models for analyzing it (Porter 1980; Henderson 1979) are in the public domain, which would lead to firms reaching similar conclusions about the potential of strategies (Barney 1986, 1238-1239).

3.1 Theoretical background of market orientation

Theories "*increase scientific understanding through a systemized structure capable of both explaining and predicting phenomena*" (Hunt 1991, 172). Hunt (1991, 172) continues that because of this nature of a theory it must be a systematically related set of statements, including some law-like generalizations, that are empirically testable. In the marketing discipline there has historically been a debate on what precisely is the proper domain or what are the boundaries of marketing theories (Sheth, Gardner & Garrett 1988). Kotler and Levy (1969) suggested that marketing is a societal activity, not only a phenomenon limited to traditional business arena. Hunt (1976) limited the scope of marketing with regard to three dimensions, namely nonprofit/profit, micro/macro and positive/normative. Marketing scholars have tended to address a very limited area of the marketing domain when developing new and improved marketing theories. As a result, the marketing discipline nowadays hosts an array of theories that "have considerable depth but also an appalling lack of breadth" (Sheth et al. 1988, 15).

Since the emergence of marketing as an independent discipline at the beginning of 1900s, a number of schools have dominated the field, typically one at a time. In studying marketing's "schools of thought", Sheth et al. (1988, 19) recognize that the "schools of thought" may be considered "theories" or "marketing thought processes", depending on the semantics. In line with the definition of a theory presented above, my understanding is that within each of the twelve marketing schools of thought listed by Sheth et al. (1988) there are a number of interrelated theories with systemized structures for both explaining and predicting phenomena.

The research into market orientation (MO) of a firm clearly falls into the category of “managerial school of thought”. It is based on economic principles and concepts, and is only marginally influenced by the social or psychological variables inherent in marketing transactions. At the same time, it recognizes the interdependent relationship between the seller and the buyer, unlike earlier schools of thought that believed in the dominance of suppliers in transactions (Sheth et al. 1988, 73). However, it is important to note that although the market orientation literature in the marketing domain can be described as being based on economic principles, the approach adapted in this study takes more of a social view of market orientation.

Market orientation is closely linked to the marketing concept that was developed in the 1950s and 1960s (Drucker 1954; McCarthy 1960; Levitt 1960). Being a measurement of the behaviors and activities that reflect the marketing concept (Levitt 1960; Kotler 1984; Webster 1988; Kohli & Jaworski 1990), market orientation is the cornerstone of the marketing management and marketing strategy paradigms (Hunt 2002).

Even though, to my knowledge, no scholar has written on “the” theory of market orientation, the bricks for putting together a comprehensive theory of market orientation of a firm are available in the literature. This comprehensive theory would need to recognize both the cultural and behavioral aspects as antecedents of market orientation. The “systemized structure” of market orientation would include the four synthesis dimensions identified by Lafferty and Hult (2001), namely emphasis on customer, importance of information, interfunctional coordination and taking action. In addition to explaining the level of market orientation in a firm, these dimensions have been employed to explain the performance of an organization.

The problem for academic enquiry in market orientation is - as described in the introduction to this manuscript – that each of these dimensions manifests differently depending on the organizational and industrial context of the study. As research in this area is often driven by managerial focus – typical for the managerial school of thought overall – the theory of market orientation has remained underdeveloped. The practical implications of being market oriented have led to a wealth of suggestions for practitioners on how to steer their organizations towards market orientation. In this process the development of a more general theory of market orientation has remained incomplete.

The managerial school of thought has established itself as a comprehensive school within marketing because of its integrative capability. The two key concepts under its domain – marketing concept and marketing mix - are perhaps the most fundamental concepts of the whole marketing thinking. The marketing concept urges practitioners to analyze customers' needs, and the marketing mix has integrated the functional tasks of marketing (Sheth et al. 1988).

In their evaluation of the twelve marketing theories[6] – or rather the collections of theories in each of the twelve schools of thought – Sheth et al. (1988) employ the meta-theory criteria of syntax, semantics and pragmatics (Halbert 1964). As far as the managerial school of thought is concerned, its rankings on these meta-theory criteria (Sheth et al. 1988) are actually higher than those of any other school of thought. More specifically, the theories within the managerial school typically represent "extremely well-defined concepts and relationships"; "excellent operational definitions at the functional level"; "very comprehensive empirical testing at both the scientific and practice levels" and are, in addition, "rich" and "easy to understand and implement in practice" (Sheth et al. 1988, 107). As typical representatives of this managerial school, widely cited market orientation studies represent these very features. Thus, even though there is no consensus for the time being on the general theory of market orientation, the roots of this concept go back to the very foundations of marketing thinking. In addition, a wealth of literature proposing more or less comprehensive models for understanding market orientation has emerged over the past two decades. Given this, I am convinced that building my research on market orientation literature provides a solid foundation for this study. Nevertheless, the emerging and dynamic nature of this research area also provides a possibility to make an important, novel contribution.

The Marketing Science Institute has recognized the importance of market orientation for many years. Over time, scholars have acknowledged that market orientation research has significantly influenced the development of marketing knowledge (Rodriguez Cano, Carrillat, and Jaramillo 2004). Hunt and Lambe (2000, 25) go as far as saying that "*if there were any contribution that marketing could make to business strategy that might be considered universally to be uniquely marketing, it would be that of market orientation*".

[6] Sheth et al. (1988) classify marketing schools of thought into 1) interactive and non-interactive, and 2) economic and non-economic. Economic and non-interactive schools of thought are a) commodity, b) functional, and c) regional schools of thought. Economic and interactive schools of thought are a) institutional, b) functionalist, and c) managerial schools of thought. Non-economic and non-interactive schools of though are a) buyer behavior, b) activist, and c) macromarketing schools of thought. Finally, non-economic and interactive schools of thought are a) organizational, b) systems, and c) social exchange schools of thought.

According to Hunt and Morgan (1995, 11), the marketing concept maintains that (1) all areas of a firm should be customer oriented, (2) all marketing activities should be integrated, and (3) profits, not just sales, should be an objective of a firm. It is the customer orientation components of the concept, i.e. knowing one's customers and developing products to satisfy their needs and wants, that has been considered paramount. Even though the marketing concept has been considered the cornerstone of marketing for decades, this was not addressed in empirical studies until the 1990s. This lack of empirical research on the effect of the marketing concept on business strategy and success gave rise to the research on MO (Hunt & Lambe 2000, 25).

From a mere measurement of the extent to which a firm implements the marketing concept, MO has evolved into a dual focus on both customers and competitors. Based on Kohli and Jaworski (1990) and Narver and Slater (1990), Hunt and Morgan (1995, 11) define MO as (italics added):

"(1) the systematic *gathering of information* on *customers and competitors*, both *present and potential*, (2) the systematic *analysis* of the information for the purpose of developing market *knowledge*, and (3) the systematic *use* of such knowledge to guide *strategy* recognition, understanding, creation, selection, implementation, and modification."

Taking into account the concerns about "customer-led" firms presented by Hamel & Prahalad (1994), Hunt and Morgan (1995) emphasize including potential customers and not just the articulated needs, wants and desires of present customers. Potential competitors, as well as the present ones, also have to be included to "guard against the hazards of changing technology resulting in new competitors" (Hunt and Morgan 1995, 11).

The purpose of this research is to understand the nature of market orientation in markets for technology. In the following, a number of conceptualizations for market orientation will be presented. The discussion reflects the various foci that the concept of market orientation has been assigned over the past fifteen years or so. Indeed, whether or not the construct of a market orientation is equivalent to *culture* (Narver & Slater 1990) or a set of *behavior*s (Kohli & Jaworski 1990) is subject to debate (Deshpandé & Farley 1998a, 1998b; Narver & Slater 1998; Narver, Slater & Tietje 1998). I study market orientation as a behavioral phenomenon. For example, Deshpandé & Farley (1998a, 226) suggest that more than a culture, market orientation is a set of activities - i.e. a set of behaviors and processes related to continuous assessment of serving customer needs. This focus on market orientation as a behavior is also reflected in my choice of measurement scale for market orientation, described later in Chapter 7.

3.2 Current academic domains within market orientation literature

Even though the two major streams of thought in market orientation literature, namely cultural market orientation and behavioral market orientation, are presented separately in the following, I would like to emphasize that a holistic, conceptual framework of market orientation consists of two building blocks: behavior and cognition. Kok, Hillebrand & Biemans (2003) make an important contribution in describing organizational cognitive elements, how they influence organizational behavior, and how information processing activities in turn influence cognitive elements. In line with their conceptual framework, as well as earlier studies by Baker and Sinkula (1999a, 1999b) and Homburg and Pflesser (2000), I want to emphasize that even though the cultural and behavioral aspects of market orientation are sometimes presented as competing views in the extant literature, instead of being substitutes they actually complement each other. Also, Mavondo and Farrell (2000) noted that the cultural and behavioral approaches share the notion that the consumer is central in the manifestation of market orientation, and stakeholders shape the needs of consumers.

Dividing market orientation literature into cultural and behavioral streams is not the only way to categorize the existing research in this field. According to Hurley and Hult (1998), researchers have approached market orientation from a strategy perspective (Corey & Star 1971; Day 1994), an organizational design perspective (Webster 1992, 1994), and a market information processing perspective (Deshpande & Zaltman 1982; Menon & Varadarajan 1992; Moorman 1995). Lafferty and Hult (2001) identify five major attempts to conceptualize the concept of market orientation in the existing literature: (1) the decision-making perspective, (2) the market intelligence perspective, (3) the culturally-based behavioral perspective, (4) the strategic focus perspective, and (5) the customer perspective. What I call “behavioral market orientation” below, i.e. the stream of market orientation research originated by Kohli and Jaworski (1990) (Also Kohli, Jaworski & Kumar 1993; Jaworski & Kohli 1993) that focuses on actions and behavior, is actually in the category of “market intelligence perspective” of Lafferty and Hult (2001). The “decision-making perspective” and “strategic perspective” of Lafferty and Hult (2001) are closely related to the market intelligence perspective, whereas the two other perspectives (i.e. “culturally-based behavioral perspective” and “customer perspective”) focus more on organizational culture than behavior.

As the previous paragraph demonstrates, dividing market orientation literature into cultural and behavioral streams is not the only way to categorize the existing research. However, it is certainly the most prominent one in the literature. Also, the two widely used measurement scales for market orientation, namely MARKOR for the measurement of behavioral market orientation (Kohli and Jaworski 1990, Kohli, Jaworski and Kumar 1993) and MKTOR for the measurement of cultural market orientation (Narver and Slater 1990), reflect the behavioral vs. cultural division. This is why the cultural and behavioral market orientations are described in more detail in the following. Also, the learning orientation is presented as an extension of the cultural market orientation, and the export market orientation as a special case of the behavioral market orientation.

3.2.1 Cultural market orientation

The concepts of market orientation, strategic orientation and culture are closely intertwined. Differences between the concepts have not been well established, partly because of different definitions and treatments of the constructs in the literature. It has been suggested that culture centers on embedded values and beliefs that guide behavior; culture guides the behaviors that ultimately influence the performance of a firm (Deshpandé & Webster 1989, 4; Noble, Sinha & Kumar 2002, 26).

Narver and Slater (1990), the originators of the cultural perspective (i.e. what Lafferty and Hult (2001) call the "culturally-based behavioral perspective"), see market orientation as "the organizational culture that most effectively and efficiently creates the necessary behaviors for the creation of superior value for buyers and, thus, continues superior performance for the business" (Narver & Slater 1990, 21). Deriving from Narver and Slater (1990), Deshpande et al. (1993) propose a more divergent, yet culturally-based, view of market orientation suggesting that it is synonymous with customer orientation.

Messikomer (1987) argues that the principal barrier to market orientation development is the values, beliefs and assumptions (that is, the culture) of the organization. Messikomer's argument is extended by Slater & Narver (1995) who claim that the key challenge facing organizations is the creation of a culture that maximizes organizational learning on how to create superior customer value.

3.2.2 Learning orientation

The cultural market orientation has been linked to organizational learning (Slater & Narver 1995; Hurley & Hult 1998; Baker & Sinkula 1999a, 1999b; Farrell & Oczkowski 2002; Mavondo, Chimhanzi & Stewart 2005). The assumption inherent in this linkage is that information-processing activities are a product of a market orientation rather than a part of this orientation per se. Hence, within the context of examining how organization's learning orientation relates to market orientation, the literature has a bias toward the use of the Narver and Slater (1990) conceptualization and operationalization of MO instead of behavioral MO (Mavondo et al. 2005).

Based on previous research on learning orientation in the marketing context, Mavondo et al. (2005) describe a learning orientation as a wide concept that embraces many aspects of adaptation and change. Mavondo et al. (2005, 1237) define a learning orientation as the manifestation of the organization's propensity to learn and adapt accordingly. Because of the similarities between the market orientation and the learning orientation, comparisons have been drawn between the two concepts. They both help to explain the critical organizational capability of market sensing, and both have to do with relationships as well as the use of resources in an organization (Bell, Whitwell & Lukas 2002, 79). However, Mavondo et al. (2005, 1241) point out that an examination of the disciplinary basis for organizational learning suggests that the learning orientation encompasses a much broader idea than the market orientation.

According to Day (2001, 10), the market-oriented learning process must include the ability of managers to absorb what is going on in the environment into their mental model of how the market behaves, to share this understanding with members of the management team and to act decisively. Day (2001, 10) describes the building blocks of a market-driven learning process as open-minded inquiry, informed interpretation and accessible memory. With these descriptions, Day (2001) actually shows that the "market-oriented learning process" in an organization has the same components as the behavioral market orientation; the behavioral perspective originated by Kohli and Jaworski (Kohli & Jaworski 1990; Jaworski & Kohli 1993; Kohli, Jaworski & Kumar 1993) sees market orientation as an active process of gathering information about the external environment, distributing that information in a firm and responding to it. Next, this behavioral market orientation is described in more detail.

3.2.3 Behavioral market orientation

In line with the behavioral views on market orientation, I adhere to the approach that views market orientation as something a firm *does* and not what a firm is. Because I do not view market orientation as a state of being, I also do not need to try to pin down the inner qualities and intentions of market-oriented organizations.

The behavioral orientation perspective came into focus after problems were experienced in implementing the marketing concept. Silkoset (2004) traces the origins of behavioral market orientation to Felton (1959), who provided an extensive discussion regarding the implementation of the marketing concept. Later, Bell and Emory (1971), as well as Shapiro (1988), wrote on the implementation of the marketing concept. However, it is the work of Kohli and Jaworski (1990) that marked the beginning of behavioral market orientation research in the way it is understood and conceptualized today. The contribution of Kohli and Jaworski (1990) is important in three ways (Silkoset 2004). First, they establish a link between market orientation and positive economic performance. Second, they demonstrate that market orientation can be researched as an observable phenomenon, i.e. behavior. Third, through minimally abstract constructs and measures they are able to offer implications that are managerially relevant. In summary, the behavioral perspective originated by Kohli and Jaworski (Kohli & Jaworski 1990; Jaworski & Kohli 1993; Kohli et al. 1993) sees market orientation as an active process of gathering information about the external environment, distributing that information in a firm and responding to it.

Behavioral focus is also evident in the works of Shapiro (1988) and Ruekert (1992); Shapiro (1988) conceptualizes market orientation as an organizational decision-making process and Ruekert (1992) maintains that the most critical external environment in developing a market orientation is the customer. This focus is different from the perspective of Kohli and Jaworski (1990), who emphasize the role of competitors in addition to customers.

In this study, I adhere to the behavioral view of market orientation as first proposed by Kohli and Jaworski (1990). This perspective is superior to the other behavioral perspectives; for example, the decision-making perspective places a lot of importance on decision making, neglecting the actual actions that are performed. Equally, the strategic focus perspective is limited because of its ignorance of competitors and other external market forces as players in markets. Following Kohli and Jaworski (1990, 6), market orientation is defined as *the organization wide generation of market intelligence pertaining to current and* *future customer needs, dissemination of the intelligence across departments, and organization-wide responsiveness to it* (Kohli & Jaworski 1990, 6). Thus there is a clear focus on market information and behavior.

Market intelligence generation. According to Kohli and Jaworski (1990), the first key element in market orientation is the generation of market intelligence. This covers formal and informal mechanisms such as customer surveys, meetings and discussions with customers and trade partners, analysis of sales reports, formal market research and so on. Market intelligence goes beyond the verbalized needs and preferences of customers. Kohli and Jaworski (1990) state that market intelligence includes monitoring competitors' actions and their effect on customer preferences as well as analyzing the effect of other exogenous factors such as government regulation, technology and environmental forces. Kohli and Jaworski (1990) also indicate that effective market intelligence involves not just current needs but future ones.

Intelligence dissemination. The second subconstruct of behavioral market orientation focuses on interfunctional integration and openness in communication. This intelligence dissemination can be managed through various integration mechanisms, including the frequency of committee meetings (Aigen & Hage 1971; Kim 1980), the number of face-to-face contacts in horizontal and vertical relationships (Aigen, Bacharach & French 1980), and the degree to which units share decisions (Hull & Hage 1982). In describing market intelligence dissemination within an organization, it is also helpful to consider the dimensions of formalization and centralization (Zaltman & Deshpandé, 2001). Formalization is the degree to which rules define roles, authority relations, communications, norms, sanctions and procedures. The centralization dimension is concerned with the extent of authority that is percolated throughout an organization and the amount of participation allowed in decision making (Aigen & Hage 1968; Hall, Haas & Johnson 1967; Zaltman & Deshpandé 2001).

In smaller, entrepreneurial firms, and especially in firms populated by specialists and professionals, we can expect to see less centralization (Caruana, Morris & Vella 1998). Reductions in centralization have been associated with growing uncertainty in the external environment of firms (Davis, Morris & Allen 1991). Also, Olson, Walker & Ruekert (1995) claim that successful projects involving new and innovative concepts must rely on organic structures and participative co-ordination, where a supportive climate for risk taking and a greater flow of information exists. Given the uncertain and dynamic environment in which biotechnology firms operate, these organizations are likely to have low levels of centralization.

Environmental turbulence can lead to more formalization in decision making, but such turbulence is also associated with higher levels of entrepreneurship (Covin & Slevin 1989). Formalization may actually foster external information gathering and dissemination within an organization. However, Jaworski and Kohli (1993) did not find a relationship between formalization and a firm's market orientation.

Maltz and Kohli (2001) study intelligence dissemination as a function of dissemination frequency and dissemination formality. Dissemination events that are either verifiable by third parties or are non-spontaneous, or both, represent formal dissemination. Events that are both spontaneous and not verifiable reflect informal dissemination. Maltz and Kohli (2001) conclude that managing the dissemination process entails shaping the frequency and formality of dissemination to optimum levels.

Responsiveness. The third element of behavioral market orientation is responsiveness to market intelligence. Responsiveness, as described by Kohli and Jaworski (1990, 6), is the action taken in response to intelligence that is generated and disseminated. In traditional markets this responsiveness takes the form of selecting target markets, designing and offering products or services that cater to the current and future needs of customers, and organizing production and distribution so that favorable end-customer response is elicited. In markets for technology the end-customer dimension may remain blurry as companies market their knowledge to other organizations downstream in the industry value chain. Since the operations of firms in markets for technology typically focus on research and development activities, these are also the areas where the responsiveness dimension of market orientation can be demonstrated.

3.2.4 Export market orientation

It has been claimed that in many firms the degree to which activities are market-oriented in the domestic and export settings differs (Cadogan, Paul, Salminen, Puumalainen & Sundqvist 2001; Rose & Shoham 2002). Hence some researchers have studied export market orientation as a construct on its own (see, for example, Cadogan et al. 2001; Cadogan, Cui, Li & Kwok 2003; Akyol & Akehurst 2003). The focus of a firm's export market orientation behavior is towards the firm's export markets, not its domestic markets. Export market-oriented behavior has been defined as consisting of export market intelligence generation, dissemination and responsive activities (Cadogan et al. 2003), i.e. the components of behavioral market orientation but only in an export setting. Export intelligence generation concerns the activities associated with generating information about the firm's export customers' current and future needs and wants, competition in the firm's export markets and other exogenous factors; export intelligence dissemination concerns the distribution of this information to the appropriate export decision makers, and export market responsiveness is the design and implementation of strategies and tactics in response to the information gathered about export markets.

As described in the introductory chapter, the nature of markets for technology in many fields, and especially in biotechnology, is truly global. Knowledge transfer across country borders does not represent "exporting" in the traditional sense of the word. Also, when talking about small and medium-sized firms, their foreign and domestic activities are so intertwined that it is hardly possible for different levels of market orientation to exist for foreign vs. domestic operations. Hence, export market orientation in the context of this study is not a meaningful concept for further analysis. Instead, the focus of this study is on behavioral market orientation as a company-wide construct.

3.3 Market orientation and firm's performance

Market orientation has emerged as a predictor of a firm's performance; it is presumed to positively contribute to long-term success. The notion that market orientation has a positive impact on business performance is well documented in scholarly research (e.g., Baker & Sinkula 1999b; Harris, 2001; Matsuno & Mentzer, 2000). Although some studies report a negative or non-significant relationship between MO and a firm's performance, overwhelming evidence shows a positive relationship between the two (Rodriguez Cano et al. 2004).

A possible explanation for the lack of a clear relationship between market orientation and performance in some studies is that it is a more complex relationship than those tested for in previous studies (Pelham 1997). For example, the research results of Hult and Ketchen (2001) suggest that the linkage between market orientation and performance is not linear but embedded within a more complex web of relationships. Market orientation, entrepreneurship, innovativeness and organizational learning all contribute to positional advantage, which has a positive effect on performance indicators (Hult & Ketchen 2001).

Prior to the 1990s and before the introduction of the current market orientation concept, authors were already arguing that the adoption of a marketing concept inhibits firms from developing truly breakthrough innovations. Kohli and Jaworski (1990) refer to Bennett and Cooper (1981), Kaldor (1971), and Tauber (1974) as the authors behind such claims. Later, Atuahene- Gima (1996) even found that market orientation had a negative effect on product newness. In fact, market orientation may both promote and inhibit breakthrough innovations, depending on the innovativeness of the company in the product domain (Verhees & Meulenberg 2004). On the one hand, entrepreneurs who are keen on new technologies and products are mitigated by customer market intelligence. On the other hand, entrepreneurs who are less driven by technologies in a specific domain are stimulated to innovate by customer market intelligence (Verhees & Meulenberg 2004).

Most studies that look at the relationship between a firm's market orientation and its performance have implicitly made the assumption that all three market orientation components have an equal and direct influence on firm performance. However, this may not accurately capture the market orientation/performance relationship. For example, it can be argued that the generation and dissemination of market information will not directly impact on performance. Rather, these sub-components of market orientation are likely to influence the responsiveness component of market orientation, which, again, has an impact on firm performance. Thus market intelligence generation and dissemination may only influence performance indirectly (Hart & Diamantopoulos 1993). Contradictory evidence is provided by Veldhuizen, Hultink, and Griffin (2004), who find that the acquisition of customer information in a high-technology context is directly[7] associated with product advantage. Veldhuizen et al. (2004) hypothesize that this could be due to intuitive (rather than formal) use of market information in the development of innovative products.

Related to the potential differences in performance effects of various components of market orientation, the research results of Greenley (1995) illustrate that firms represent different forms of market orientation. Greenley (1995) analyzed survey responses to a Narver-Slater battery of market orientation items by clustering them, and found five distinct clusters of firms. The largest cluster of firms exhibited high levels of each of the three components of Narver-Slater market orientation (customer orientation, competitor orientation and interfunctional coordination). The second cluster of firms was characterized by competitive focus and responsive actions to competitors' moves. Firms in the third cluster represented high focus on customer needs: identifying and satisfying customer needs and monitoring customer satisfaction. The "undeveloped market

[7] Without disseminating or using information in new product development processes.

orientation" cluster firms had low levels of all three components of market orientation, and, finally, the fifth cluster exhibited a fragmented orientation with various combinations of high vs. low levels of different components (Greenley 1995).

As a conclusion, previous research has demonstrated that firms exhibit different forms of market orientation. Furthermore, even though not supported by empirical research, it is possible that the performance effects of these different forms of market orientation are distinct.

A comprehensive review of research that has looked at the market orientation-performance relationship is provided in the meta-analysis of Rodriguez Cano et al. (2004). Their findings reveal that the disattenuated weighted mean effect size (Pearson's correlation coefficient) of the relationship between market orientation and business performance is 0.35 (95% confidence interval about the mean was 0.33–0.37). Thus the degree of market orientation of a firm explains about 12% of the variance in business performance (Rodriguez Cano et al. 2004). Table 1 lists some published studies on the market orientation-performance relationship that were not included in the meta-analysis of Rodriguez Cano et al. (2004).

Table 1: Recent examples of market orientation-performance research studies

Reference	Industry context	MO measurement[8] (NS = Narver-Slater; KJ = Kohli-Jaworski)	Market orientation (MO) – perf relationship	Effect size (adjusted R2 or equivalent)
Appiah-Adu and Ranchhod (1998)	Biotechnology	NS	Positive for 3 out of 4 dependent variables	0.23-0.31
Siguaw, Simpson, and Baker (1998)	Supplier-distributor relationships	KJ	Supplier's MO affects its distributor's MO, which in the end affects distributor's satisfaction with its financial performance.	
Kwon and Hu (2000)	Korean exporters	KJ	Positive for three export performance outcome variables, but results are mixed for high-growth export markets and highly competitive market conditions.	(only F statistics reported)
Harris (2001)	Mixed	NS	In some environmental conditions the relationship is positive, in other conditions negative.	0.13-0.26
Farrell and Oczkowski (2002)	Manufacturing	NS	Positive	0.45
Helfert, Ritter and Walter (2002)	Software companies and advertising agencies	On a relationship level: (1) resource availability, (2) relationship management task performance.	Positive effect of relationship management task performance on relationship effectiveness, non-significant for resource availability.	0.24-0.34
Matsuno, Mentzer, and Özsomer (2002)	Manufacturing	KJ	MO positively related to all three performance outcomes.	0.379 - 0.724
Noble, Sinha, and Kumar (2002)	Discount retailing	NS	Only the competitor orientation dimension is significantly related to performance across all models,	0.10-0.24 for competitor

[8] Two of the most extensively used measures of market orientation are the ''MARKOR'' scale developed by Kohli and Jaworski (1990) and Kohli, Jaworski, and Kumar (1993) and the ''MKTOR'' scale developed by Narver and Slater (1990).

			the customer orientation variable is not related to performance.	orientation.
Perry and Shao (2002)	Advertising	KJ	MO has no direct effect on performance, nor does the interaction of market orientation and perceptions of new competitors. Perceptions of traditional competitors directly affect performance and interact with market orientation to affect performance.	0.13-0.22
Frambach, Prabhub, and Verhallen (2003)	Manufacturing	Adapted from KJ	Mixed. Customer orientation has a positive influence on new product activity but competitor orientation has a negative influence on new product activity.	
Lai (2003)	Firms with operational quality management implementation.	KJ	Positive for all four dependent variables	0.46-0.76 (correlation coefficients)
Im and Workman (2004)	High-technology manufacturing	NS	Mixed results on MO's effect on new products and their marketing programs	
Kyriakopoulos and Moorman (2004)	Packaged foods	KJ	MO has a direct effect and interaction effects with exploration and exploitation strategies on new product financial performance.	For main effects only, 0.13-0.18. With interaction effects 0.18-0.23.
Sin, Tse, Yau, Lee, and Chow (2004)	Mixed	NS	Positive	0.035- 0.422
Verhees and Meulenberg (2004)	Rose growers	Mixed	Positive effect of customer intelligence on product innovation. Interaction effect of domain-specific innovativeness and customer intelligence is negative.	0.26
Hult, Ketchen and Slater (2005	Mixed	NS adapted	Positive effect mediated by organizational responsiveness	0.57-0.61
Kara, Spillan, and DeShields (2005)	Small and medium-sized firms	KJ	Positive on all three performance measurements	0.36
Matsuno, Mentzer, and Rentz (2005)	Manufacturing	NS and a new scale	Positive for all seven performance measurements.	0.10-0.25

Even though some studies have had mixed results concerning the market orientation-performance relationship, it is clear from Table 1 that most of the studies reviewed here have found a positive relationship between the two concepts. Also, as the industry contexts reveal, market orientation research has started to depart from its early focus on manufacturing and consumer goods firms and moved into service industries and even small and medium-sized firms. The effect sizes in Table 1 vary a lot, from as low as 0.035 for Sin et al. (2004) to over 0.7 in Matsuno et al. (2002). The positive relationship between market orientation and firm performance is also established by the meta-analysis of Kirca, Jayachandran, and Bearden (2005). Their results show that the market orientation-performance relationship is largely robust across various measurement characteristics. Furthermore, their analysis shows that market orientation affects performance through innovativeness, customer loyalty and quality (Kirca et al. 2005).

Overall, as indicated by the literature references above, the popular notion has been that a proper execution of market orientation brings about superior performance. However, Deshpandé et al. (1993) suggest that the most important manifestation of market orientation may be the success of innovations en route to the success of an organization. Because of the multifaceted nature of the market orientation-performance relationship, it is important to assess the impact of market orientation on multiple performance indicators. In this study the chosen indicators are innovativeness, capital invested in the firm, subjective performance assessment of the manager, and sales. These will be discussed further when carrying out the empirical study is described in Chapter 7.

3.4 Expanding the domain of market orientation

Even though the focus of most market orientation studies has been on establishing a link between market orientation and firm performance, and finding constructs that moderate this relationship, some researchers have focused on the content of the concept (market orientation) itself. The knowledge side of market orientation has been emphasized by Darroch and McNaughton (2003). Based on Kohli et al.'s (1993) market orientation scale, they develop a scale[9] for measuring the knowledge management orientation of a firm. The results of their study show that firms that adopted more knowledge management practices were more innovative and had superior financial performance than firms with less knowledge management practices.

[9] The scale consists of three components (knowledge acquisition, knowledge dissemination and responsiveness to knowledge) that represent 16 underlying factors measured with a total of 59 variables.

Furthermore, knowledge management-oriented firms performed better than simply market-oriented firms in The Darroch and McNaughton (2003) sample of New Zealand-based firms (n=443).

The merit of Darroch and McNaughton (2003) is the expansion of the market orientation concept beyond the limited range of types of knowledge covered by the earlier market orientation instruments. The knowledge management orientation instrument is "*deeper and wider in its coverage and embraces both market driven and driving market organizations, thereby addressing some of the critics of earlier market orientation work and perhaps more aptly reflecting the retrospective intention of early market orientation writers*" (Darroch & McNaughton 2003, 589). However, this depth is also the potential weakness of the knowledge management orientation scale; the knowledge acquisition factors of Darroch and McNaughton (2003) include, for example, "organization has well developed financial reporting systems", "science and technology human capital profile", and "organization values employees' attitudes and opinions". These factors are well beyond the traditional scope of market orientation. If knowledge management orientation is contrasted with technological orientation, for example, the inclusion of "science and technology human capital profile" as a factor in knowledge management orientation is problematic. Given that Darroch and McNaughton (2003) introduce the knowledge management orientation scale as an umbrella concept comprising, for example, market orientation, it is not surprising that it has a stronger effect on financial performance. However, even if the purpose of scientific research can be the explanation of a maximum share of variance in a dependent variable (like financial performance) with wide constructs (like knowledge management orientation), sometimes the more exciting results come from narrower concepts (like market orientation) being able to account for still a significant share of variance of the dependent variable.

With a goal similar to that of Darroch and McNaughton, i.e. expansion of the domain of market orientation, Narver, Slater & MacLachlan (2004) studied the components and role of proactive market orientation. This can be viewed as a continuation to Slater and Narver (1998) drawing a distinction between customer orientation and market orientation. Firms that adopt the former emphasize customers' expressed needs, while those pursuing the latter develop long-term thinking and a desire to satisfy customers' latent needs. By developing and empirically validating a measurement for proactive market orientation, Narver et al. (2004) respond to the critique that the traditional market orientation scales have failed to incorporate the measurement of satisfaction of customers' latent needs. Narver et al. (2004, 336) define a responsive market orientation as "a business's attempt to understand and to satisfy customers' expressed needs", whereas a proactive market orientation is "the attempt to understand and to satisfy customers' latent needs". In a sample of 120 managers representing 25 business organizations they find that the strength of the proactive market orientation relationship to new-product success is larger than that of responsive market orientation. The items of the Narver et al. (2004) proactive market orientation scale are listed in Table 2. They helped in adapting the market orientation measurement scale for the empirical part of this study. The development of this scale is described in detail later in Chapter 7.

Table 2: Proactive market orientation items (Narver et al. 2004)

We help our customers anticipate developments in their markets.

We continuously try to discover additional needs of our customers of which they are unaware.

We incorporate solutions to unarticulated customer needs in our new products and services.

We brainstorm on how customers use our products and services.

We innovate even at the risk of making our own products obsolete.

We search for opportunities in areas where customers have a difficult time expressing their needs.

We work closely with lead users who try to recognize customer needs months or even years before the majority of the market may recognize them.

We extrapolate key trends to gain insight into what users in a current market will need in the future.

Somewhat contrary to the Narver et al. (2004) efforts, Kyriakopoulos and Moorman (2004) suggest that market orientation does not necessarily guide the firm to be reactive or proactive - only to focus on customers. Therefore, they do not locate the firm's reactive or proactive marketing strategies in a firm's market orientation. Instead, they try to understand how market orientation impacts on the joint effects of exploitation (reactive strategy) and exploration (proactive strategy) (March 1991). The empirical evidence of Kyriakopoulos and Moorman (2004) from the packaged food industry provides support for the argument that high market orientation organizations can benefit[10] from simultaneously pursuing the seemingly contradictory strategies of exploration and exploitation.

The expansion efforts by Narver et al. (2004), as well as by Darroch and McNaughton (2003), focus on market orientation at the seller-buyer interface. With a stronger focus on processes within the seller firm, Becker and Homburg (1999) have suggested the expansion of market orientation towards a system-based perspective. Becker and Homburg (1999) conceptualize "market-oriented management in terms of the degree to which management systems are designed in such a way as to promote a business organization's orientation towards its customers and competitors" (Becker and Homburg, 1999, 18). They argue that in order to be market orientated, all parts of a firm's management system (organization, information, planning, controlling, and human resource system) need to exhibit market-oriented thinking and behavior.

These recent attempts to redefine the content of market orientation illustrate how researchers have started to look for ideas from fields outside traditional marketing theory to further develop the construct. Becker and Homburg (1999) draw on organizational behavior, Kyriakopoulos and Moorman (2004) on strategy literature, and Narver et al. (2004), as well as Darroch and McNaughton (2003), on technology and knowledge management in their research efforts. Chapter 4 is devoted to the nature (content) of market orientation in markets for technology. As already mentioned, I study market orientation as a behavior demonstrated in the actions of a firm and its managers. Based on entrepreneurship as well as technology management literature, I will argue that the traditional behavioral market orientation (outlined in this chapter) has to be redefined in the context of SMEs in markets for technology.

[10] The dependent performance variable in Kyriakopoulos and Moorman (2004) is new product financial performance.

4 MARKET ORIENTATION IN MARKETS FOR TECHNOLOGY

This chapter first reviews the relevant literature highlighting the key issues that have to be taken into account when researching market orientation in markets for technology. After this literature review and analysis, the next chapter describes the carrying out and results of an empirical, qualitative preliminary study. The two parts together, i.e. the literature review and the preliminary qualitative study, outline the specific nature of MO in markets for technology. Later, this understanding will be used in the development of a survey instrument.

The models that business researchers develop must attempt to understand the contingencies that affect the observed outcomes. For example, do culture, industry dynamism and age of the firm moderate the effect of market orientation on market share and profitability? Simple studies that do not capture real-life contingencies seem naive to the practitioner community. Hence studying a phenomenon such as SMEs' market orientation in all its complexity requires an understanding of the theory and practice of marketing, and also of the same dynamics for the related fields of organizational behavior, management and strategy (Kinnear 1999).

This Chapter employs theoretical triangulation for the study of market orientation in markets for technology. By combining and contrasting ideas from various paradigms and theories to illuminate the focal empirical phenomenon, i.e. market orientation in markets for technology, I hope to be able to shed light on novel aspects of market orientation. This will contribute to "an improved dialogue between marketing and other disciplines [that] will enhance the efficiency and effectiveness with which the body of knowledge on business strategy grows" (Hunt & Lambe 2000, 37). Market orientation literature in the marketing domain is based on economic principles. The contributions of fields and disciplines other than marketing for understanding market orientation in markets for technology are evaluated in this chapter. The ideas are mostly based on technology management and entrepreneurship literature. Thus, through theoretical triangulation the approach adapted in this study takes more of a holistic view of market orientation than has been suggested by the economically driven market orientation literature in the field of marketing. Despite the obvious contributions, combining theories developed based on various kinds of ontological and epistemological assumptions can also be confusing and challenging. The theoretical approaches considered in this chapter are roughly summarized in Figure 6.

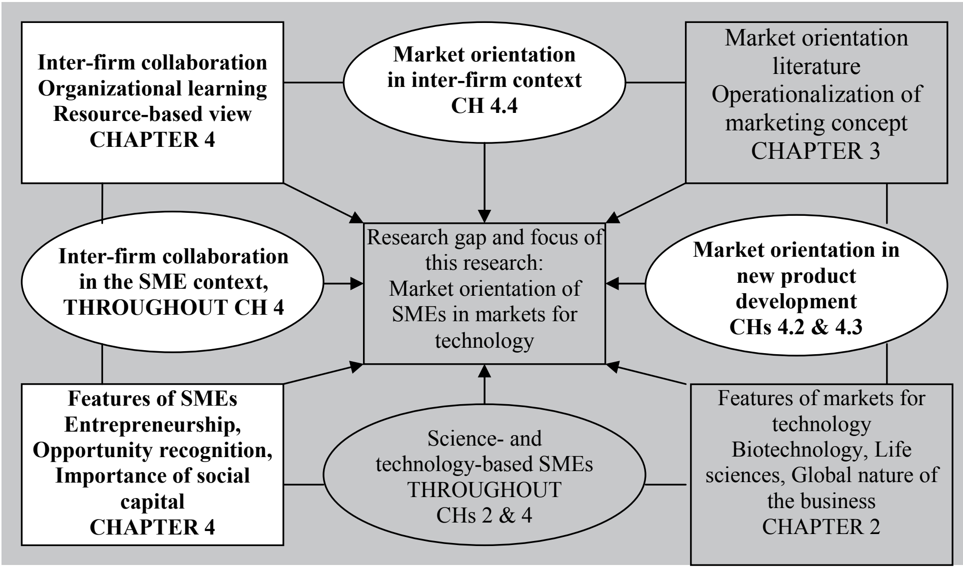

Figure 6: Focus of Chapter 4

This chapter takes off with an assessment of knowledge as a resource of a firm. As described in the previous chapter, market knowledge is a key component in a firm's market orientation. However, few market orientation scholars have made an effort to look into the management literature to appreciate the contributions of organizational learning theories and resource-based view of a firm (in both of which market knowledge can play a key role) for the market orientation literature. This research gap is addressed in Chapter 4.1 and highlighted in the upper left hand corner of Figure 6. Chapter 4.2 and its subchapters are dedicated to the contributions of entrepreneurship as well as technology management literature for the understanding of the role of market knowledge in an organization. As illustrated in the lower left hand corner of Figure 6, opportunity recognition literature within entrepreneurship is of relevance when market orientation is considered in SMEs. Market knowledge in Chapter 4.1 is viewed as a contributor to a firm's resource base and learning, whereas Chapter 4.2.1 presents the contributions of market knowledge to identifying business opportunities (entrepreneurship literature). After this, the subchapters 4.2.2. through 4.2.4, as well as Chapter 4.3, discuss the role of market orientation and knowledge in new product development activities of firms (circle on the right hand side of Figure 6). As is clear from Figure 2 and from the introduction to this thesis, one of the contributions of this study concerns the role of inter-firm relationships for the development of a firm's market orientation. These contributions are addressed in detail in the light of the existing literature in Chapter 4.4 and its subchapters. The constructs of absorptive capacity, channel relationships, and social capital, even though based on different research traditions, all help in understanding the mechanisms through which a firm's partners can contribute to its market orientation (upper middle circle in Figure 6).

4.1 Knowledge as a key resource of a firm

The conceptualization of market orientation as market intelligence generation, dissemination and responsiveness emphasizes the role of intelligence, i.e. knowledge. Thus the links to management and strategy literature addressing the development and role of knowledge in organizations are evident. However, market orientation in the literature has been studied within the marketing discipline and knowledge management has remained a topic for management scholars, who often divide knowledge into tacit and codifiable knowledge (Polanyi 1966) or into information and know-how (Kogut & Zandler 1992; Grant 1996; Ryle 1984).

Tacit knowledge is based on the idea that "we can know more than we can tell" (Polanyi 1966, 4[11]), whereas codifiable knowledge can be expressed in various forms and disseminated, even through dispersed communities. Because of its nature, tacit knowledge tends to be context dependent, facilitated by a common language, culture and value system (Pinch, Henry, Jenkins & Tallman 2003). Even though the original authors of the market orientation texts did not make it explicit, it is clear that the cultural market orientation (Narver & Slater 1990) is more interested in the tacit market knowledge embedded in an organization. The behavioral view of market orientation (Kohli & Jaworski 1990; Kohli et al. 1993; Jaworski & Kohli 1993) emphasizes the acquisition and dissemination of codified knowledge of the markets. I believe that insights from the management literature can help in understanding market orientation and *vice versa*.

In the management literature the knowledge-based view of the firm is an extension of both resource-based theory (Wernerfelt 1984; Barney 1991) and the dynamic capabilities approach (Teece, Pisano & Shuen 1997). The resource-based view of a firm defines resources as those attributes of physical and knowledge-based assets that enable a firm to conceive and implement strategies that lead to better performance (Wernerfelt 1984). Thus

[11] Polanyi (1966) was opposed to the prevailing positivist account of science, arguing that it failed to recognize the part played by tacit knowledge and the creative role played by the imagination. However, Polanyi was not a believer in absolute objectivity either, but acknowledged the importance of inherited practices.

heterogeneous resource positions explain why firms perform differently (Henderson & Cockburn 1994; Knott 2003). The underlying assumption of the knowledge-based view is that knowledge is the principle productive resource of the organization (Kogut & Zandler 1992; Nonaka 1994). Like the dynamic capabilities approach, the knowledge-based view stresses organizational learning and innovativeness. *When market orientation is approached from a knowledge-based view, organizational learning becomes a key issue*. Organizational learning refers to the development of new knowledge or insights in an organization, which have the potential to influence the firm's behavior (Olavarrieta & Friedmann 1999, 222). An organization learns about its markets through a series of sequential information processing activities, namely acquisition, distribution, interpretation, utilization and evaluation of market information, i.e. the behavioral part of market orientation. In this process of learning, market *information* is communicated, interpreted and accumulated, resulting in *knowledge* (Kok et al. 2003, 142). Researchers have suggested that organizational learning is an important determinant of competitive advantage and resulting superior business performance (Slater & Narver 1995; Sinkula 1994; Levinthal & March 1993).

A firm's technological capability is a major component of its knowledge base. Each of the above-mentioned streams of literature – resource-based view (Wernerfelt 1984; Barney 1991), dynamic capabilities approach (Teece et al. 1997) and knowledge-based view (Kogut & Zandler 1992; Nonaka 1994) - either explicitly states or implies that a firm's technological capability can be a source of competitive advantage and above-normal performance (Coombs and Bierly, 2001). *Like a technological capability, market orientation can be a key resource in a firm*; firms that are market oriented can utilize knowledge of their competitors and knowledge of customer segments – present and future – to develop and produce a market offering more efficiently and effectively than their competition (Hunt & Lambe 2000; Olavarrieta & Friedmann 1991). Hunt and Morgan (1995, 11) define resource as "any tangible or intangible entity available to the firm that enables it to produce efficiently and /or effectively a market offering that has value for some market segment(s)". Given that MO is a resource (Hunt & Lambe 2000; Hult & Ketchen 2001), the factor that determines the degree to which market orientation allows a firm to develop competitive advantage is the degree to which MO is unique, or rare, among competitors (Hunt & Lambe 2000). Like other knowledge-based resources, MO holds a special promise for the generation of economic rents for a firm because firm-specificity and social complexity (Coff 1999) make it hard to imitate. Adopting a resource-based view, Hult and Ketchen (2001) actually propose that market orientation, entrepreneurship, innovation and organizational learning do not constitute unique resources independently, but rather that they can collectively contribute to the creation of a unique resource. The view of market orientation as a resource of a firm is illustrated in the bottom part of Figure 7.

Adopting a cultural view of market orientation (Slater and Narver, 1995), Olavarrieta and Friedmann (1999) do not see market orientation of a firm as a resource *per se*. Instead, they view market orientation as an antecedent to the knowledge-related resources a firm possesses. More specifically, in their model, a market-oriented culture in a firm is expected to positively influence the knowledge-related resources of imitation capability, market sensing capability and organizational innovativeness (Olavarrieta and Friedmann, 1999, 220). This is basically a repetition of the argument put forward by Slater and Narver (1995, 67), who indicate that market-oriented culture is the principle cultural foundation of a learning organization. This cultural view of market orientation as an antecedent to the knowledge-related resources of a firm is illustrated by the upper half of Figure 7.

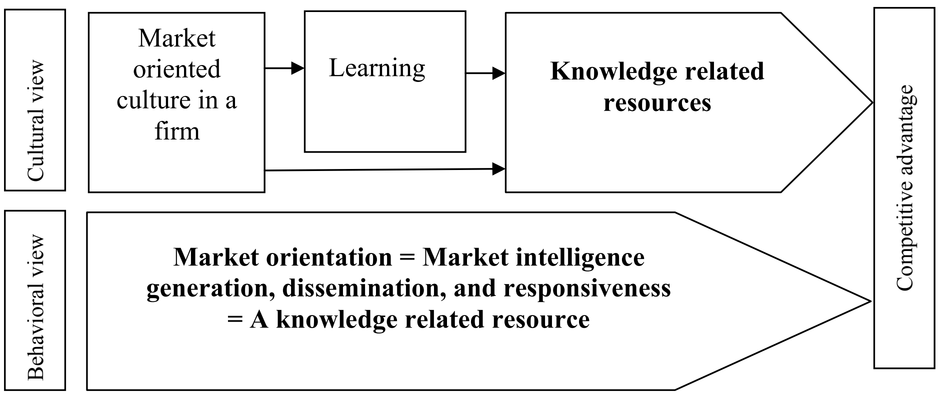

Figure 7: Behavioral view and cultural view of market orientation, learning and knowledge.

Conceptualizing market orientation from a knowledge-based view emphasizes the importance of market information processing and organizational learning (Hult & Ferrell 1997; Sinkula 1994; Slater & Narver 1995). In line with the behavioral view of market orientation (lower part of Figure 7), learning about markets can be understood as a process involving the acquisition, dissemination and interpretation (Slater & Narver 1995) or utilization of information (Adams, Day & Dougherty 1998, 405). In conventional markets, acquiring market information comprises collection of primary and secondary information about the needs and behavior of customers. In markets for technologies, this initial step in organizational learning should allow for ambiguous information gathering as well. Market information related to new technologies and future products is ambiguous by nature as customers cannot articulate their needs clearly. The approach to market information in markets for technology is more about exploration for new knowledge instead of or in addition to exploitation of established routines (March 1991; Rothaermel & Deeds 2004).

4.2 Market knowledge

Market intelligence, i.e. market knowledge, is at the heart of the market orientation concept. As described in the introductory chapter, the new theories on the internationalization process of young, small firms (McDougall et al. 1994, Oviatt & McDougall 1997) as well as the more traditional process (stage) model of internationalization (Johanson & Weidersheim-Paul 1975, Johanson & Vahlne 1977) treat market knowledge as a central enabling resource for a firm's internationalization. In the following I will describe how market knowledge also has a central role in the discovery of entrepreneurial opportunities and in the development of new technological products. Even though the consequences of market orientation have typically been measured on the bottom line (profitability), the following discussion shows that market orientation may also have important contributions that do not directly materialize as monetary benefits for a firm.

4.2.1 Market knowledge and discovering opportunities

Before technological change leads to new products or markets, entrepreneurs have to discover the technological opportunities and exploit the new technology. Consequently, after Schumpeter (1934) drew attention to the central role of entrepreneur in the innovation process, technology entrepreneurship research has emphasized the roles of entrepreneurs in the process of bringing technologies to markets (Roberts 1991; Klofsten 1997; Kelley & Rice 2001). Even though this focus on an entrepreneur is different from the unit of analysis of this study, i.e. a firm, in the earliest stages of firm development, the company basically equals the entrepreneur or start-up team.

The concept of entrepreneurial process has been widely accepted in entrepreneurship research to represent the chain of events that lead to the formation of a new venture (Grundstén 2004, 13). In the research stream drawing on Austrian theories, opportunity perception is often mentioned as the first step in the entrepreneurial process (Kirzner 1979, 1997; Shane &

Venkataraman 2000; Shane 2000). More than the other two major schools of thought in entrepreneurship, namely neoclassical equilibrium theories and psychological theories, Austrian theories emphasize the role of individuals' information in seeing entrepreneurial opportunities (Hayek 1945). Psychological theories propose that entrepreneurship is a function of stable characteristics possessed by some individuals (e.g. Begley & Boyd 1987; McClelland 1961; Rotter 1966) and neoclassical economists (e.g. Khilstrom & Laffont 1979) have proposed equilibrium theories of entrepreneurship. Austrian economists believe that a viable theory of market system – and entrepreneurship – cannot assume equilibrium but must explain how a market achieves equilibrium starting from disequilibrium initial conditions (Kirzner 1997, Shane 2000). Disequilibrium enables entrepreneurs to discover market imbalances that offer ways to earn economic rents, provided entrepreneurs can protect their discoveries from imitation by others (Fiet 2002, 48). The Austrian economists' focus on information and knowledge provides an interesting link to behavioral market orientation research in the marketing domain.

Austrian economists (Hayek 1945; Kirzner 1979, 1997) believe that the possession of information that is appropriate to a particular opportunity leads to discovering this opportunity; people and firms recognize those opportunities related to information they already possess (Denrell, Fang & Winter 2003). Fiet (2002) proposes a proactive model of an entrepreneur as a person that can be viewed as an investor in specific information. From this, Fiet's (2002) focus moves on to an attempt to uncover how entrepreneurs can most efficiently invest in the acquisitions of signals – like market signals - to uncover valuable venture ideas.

Shane (2000) finds that three major dimensions of prior knowledge are important to the process of entrepreneurial discovery in the high-technology context: prior knowledge of markets, prior knowledge of ways to serve markets and prior knowledge of customer problems. New information about a technology may be complementary to an individual's prior information about how particular markets operate; the discovery of an entrepreneurial opportunity related to a specific technology requires prior information about markets. This information may be achieved through previous work in a certain organizational unit (Shane 2000; Aldrich & Wiedenmayer 1993). Shane's (2000) in-depth case studies of eight entrepreneurs / entrepreneurial teams show that in every case prior knowledge led entrepreneurs to see the usefulness of a technology[12] in solving different customer problems. Similar paths were also found in the study by Sarasvathy (2001), and Hills, Singh, Lumpkin & Baltrusaityte (2004) found that industry and market experience were a source of opportunity for 56 per cent of nascent entrepreneurs in the

[12] Three-dimensional printing technology developed at MIT.

PSED[13] database. Since research has established the value of market knowledge for opportunity recognition, it follows that market orientation could be operationalized as a predictor of opportunity recognition in a corporate setting.

4.2.2 Market knowledge and developing technology

Innovation is typically the lifeblood of biotechnology SMEs. When talking about market orientation in technology ventures, the orientation is not only an attribute of an organization, a firm being studied. Market orientation is also a characteristic of the projects within the firm that aim at development and commercialization of those crucial innovations.

In the recent years the locus of new product development research has shifted from characterizing the process as being a dichotomy between a manufacturer / technology-led or customer-led to an interaction perspective. According to this perspective, new product development results from the interplay between actors, typically manufacturers and customers (Slater & Narver 1995; Becherer & Maurer 1997; Gatignon & Xuereb 1995, 1997). Integration of customers' needs to product development has been studied extensively in new product development (NPD) literature, and extant research in new product development supports the claim that NPD projects, which rely on carefully defined customer needs, are more likely to succeed than those that are "only" based on new technological opportunities (See e.g. Holt, Geschka & Peterlongo 1984; Cooper 1993; Rothwell 1992). Furthermore, recent research suggests that the degree to which a firm is involved in new product activity depends on the extent and nature of its market orientation (Athuene-Gima 1995, 1996; Hurley & Hult 1998; Tyler & Gnyawali 2002; Frambach et al. 2003).

Developing a product that delivers superior value to customers presupposes an understanding of customer needs and wants, a process that should ideally be undertaken prior to the commencement of any actual new product development (Cooper 1988; Stevens, Burley & Divine 1999). Two major reasons have been advanced in the new product development (NPD) literature to explain why listening to customers and partnering with them in NPD is beneficial (see, e.g., Campbell & Cooper 1999). First, customers can provide major inputs that improve the quality of innovation. Second, especially in the settings of industrial markets and high-technology products, close partnerships

[13] Panel Study of Entrepreneurial Dynamics, a large-scale study of nascent entrepreneurship in the USA.

with customers during product development may provide access to resources that the focal firm lacks in-house.

However, information on customer needs can be too costly or complex to access, especially for smaller technology ventures. In addition, especially in developing radically new products, conventional market research tools are often of limited utility; many firms do not incorporate users' or customers' opinions in their NPD processes because of the customers' limited domains of expertise, their inability to articulate their underlying needs, and the belief that user-developed concepts tend not to be innovative or creative (Leonard-Barton 1995; Leonard-Barton & Rayport 1997; O'Connor 1998; Adams et al. 1998; Berthon, Hulbert, and Pitt 1999). For example, Im and Workman (2004)[14] found that customer orientation influences new product novelty significantly but negatively. From their study, it appears that enhancing customer orientation is less likely to help a firm create truly innovative, novel products because current customers may not approve novel product ideas due to their inertia towards existing products in the market. In industrial markets, instead of collecting information on the needs of a large customer base companies tend to involve individual important customers in the new product development (NPD) processes (Tidd, Bessant & Pavitt 2001; Von Hippel & Katz 2002).

The new product development literature studies the attributes of specific projects. Technology-based SMEs mostly focus all their development activities on one or some core project(s). Looking at companies that are small and involved in biotechnological R&D, one soon realizes that the organization roughly equals its new product (or service) development projects. In this context, the project level of analysis corresponds to the firm level (Heirman & Clarysse 2004). Managerial tasks are assigned based on the development pipeline typical for biotechnology products; the projects evolve from discovery and scientific development via clinical development and commercialization. Similarly, managerial tasks reflect science, product development, business development and the few administrative functions necessary to keep any organization running. Small R&D firms are typically heavily dependent on the success of their lead development projects. In biotechnology, the huge costs of R&D effectively limit the number of projects that can be run within one firm. Failures in the lead projects can break the whole company, whereas success in them can attract investors and speed up the development process.

Despite this importance of projects in managing and understanding small R&D firms, "traditional" project or new product development management literature is of limited use within the context of this study. This is because in

[14] Im and Workman (2004) used the Narver and Slater measurements for customer orientation.

NPD and the literature that describes it there is typically a clear and identified goal for the project (Hatchuel et al. 2004, 729). This goal guides the project from the beginning on, and project performance measures typically reflect the achievement of milestones on the way to this very goal. This goal-orientedness actually limits the types of innovations covered in the NPD literature. Science-based product development projects in biotechnology firms do not necessarily have a clear goal from the beginning on. Biotechnology firms that are established for R&D and commercialization of applications from a certain technology platform, for example, start with a large number of potential applications and, consequently, potential goals. Focus for the technology development will come at some point, but before this happens the goals and objectives of the R&D work and projects are more vague and abstract than is assumed in the traditional NPD literature.

However, because of the similarities that can be found between new product development projects and biotechnology SMEs, it is important to consider market-oriented product development when trying to identify the ingredients of market orientation of a firm. Even though market orientation and new product development are separate concepts, they are typically highly integrated in a small firm context (Figure 8).

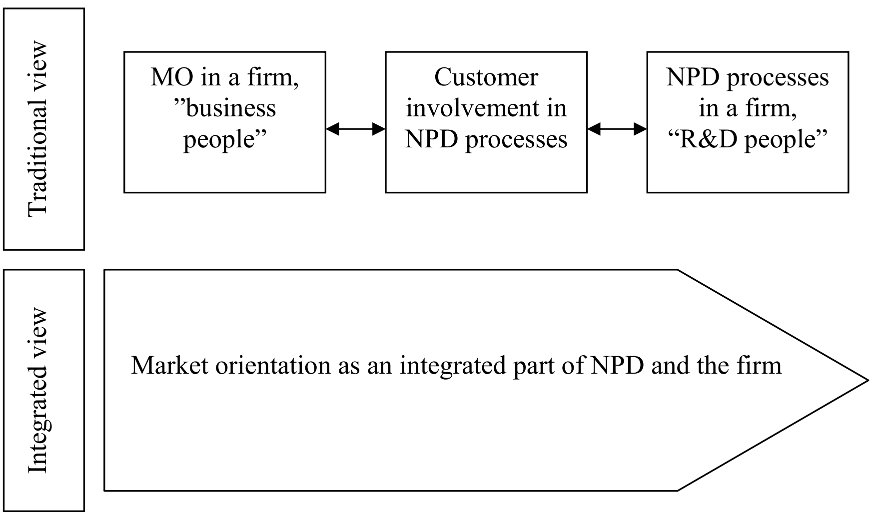

Figure 8: Traditional view and integrated view of combining market orientation (MO) and new product development (NPD)

The R&D-marketing interface has been extensively discussed over the past 20 years (McQuarrie & McIntyre 2001). In a traditional organization, R&D is responsible for invention and the achievement of technical advances, whereas marketing should be expert on the customers and competition faced by the firm. This differentiation is a source of problems of coordination (Van de Ven, Delbecq & Koenig 1976). In a large organization, employees in marketing and R&D do not always get along well or do not coordinate their efforts for the welfare of the firm. R&D scientists have been shown to identify more with their profession, whereas marketing managers identify more with the company and have a rather bureaucratic orientation (Millman 1982; Young 1979). Marketing people also tend to take a different approach to knowledge and learning than R&D personnel; marketers are said to "think with their gut", while scientists approach things from a scientific perspective (McQuarrie & McIntyre 2001). In the light of sociocultural differences and different "thought worlds", it is not surprising to find that there often is a communication barrier between marketing and R&D. Communication may not occur at all, or members of the different functions may be unable to communicate effectively because of the differences in their backgrounds.

In a meta-analysis of new product performance, Montoya-Weiss and Calantone (1994) conclude that a large number of studies have found that factors related to market orientation – in addition to other factors – determine new product performance. Adams et al. (1998, 404) summarize previous research findings by stating that "research has consistently found that the top two success factors [for new products] are a differentiated product that offers superior customer value, and a strong market orientation reflected in a thorough understanding of customers' needs and wants, the competitive situation and the market environment". The studies that have concentrated on market-oriented product development have usually treated the two as an independent and a dependent variable, looking at how the market orientation of an organization influences innovation or NPD. This "traditional" view of combining market-oriented thinking and NPD activities is illustrated in the upper part of Figure 8.

Conceptualization of market orientation as a part of new product development processes has received scant attention (Kok et al. 2003). However, there are some empirical studies that look at MO as a feature of a product development team (Burchill & Fine 1997) and market information tools and processing activities for product development (Adams et al. 1998; Kärkkäinen, Elfvengren & Tuominen 2003; Troy et al. 2001). These researchers follow a behavioral perspective on market orientation, where market intelligence is generated inside and outside an organization, disseminated throughout the organization and used to perform product development activities. In an integrated view of market orientation and NPD (bottom part of Figure 8) the two are seen as overlapping and intertwined concepts.

4.2.3 Market knowledge in biotechnology

Ottosson (2003) concludes that it is of the utmost importance to distinguish between customers and users, even though sometimes they are the same person. Keeping the focus on the wrong category during the product development process will often lead to products with the wrong features and performance. Of importance for the direct customers of medical technology products, i.e. for medical doctors, hospitals, and third-party payers, are issues such as price, quality and ease of delivery. On the other hand, of importance to the end user, the patient, is good function of the products, reliability and potential side effects, as well as the overall cost for using the products. Users acknowledge soft values and image values to a higher degree than just considering the fulfillment of functional values, which is often the case for direct customers.

Takayama and Watanabe (2002) divide the pharmaceutical product development process into four stages: (1) Bibliographic survey stage, (2) Discovery research stage, (3) Development stage (including both preclinical and clinical development) and (4) Marketing stage. The same kind of division applies in the case of most other medical products as well. Even though the two latter stages are the ones that require the most resources, the first two are the ones that determine the probability of success in the process in the first place. The go / no-go decision made after the discovery stage is as much influenced by sales forecasts as it is by the technological and scientific details of the research target. The sales forecasts and estimates of the acceptance of the product in the end markets are at this stage typically based on the input the innovator has gathered from its professional network (see Figure 9).

1) Bibliographic survey stage

Technology seeds ⇦ Professionals network

⇩

(Selected by technology knowledge) ⇦ Professionals (key doctors in the market) ⇔ End users

⇩

2) Discovery research stage
Research target

⇩

(Decision of "go or no-go")

⇩

………………

Figure 9: Factors for the decision making on early NPD in the pharmaceutical industry (Adapted from Takayama & Watanabe 2002, 355)

Large companies and market leaders are generally in the best position to collect "technology seeds" and market needs through a network of customers. In the pharmaceutical industry, due to strong contact with professionals like medical doctors as customers or surrogate consumers[15], market leaders can often utilize their superior position to collect leading information on the market and technology (Takayama, Watanabe & Griffy-Brown 2002). This strong relationship with professionals contributes towards keeping a good position for incorporating the market needs and technology seeds into the early stages of the new product development processes. For smaller firms, however, the network of existing customers is often non-existent; a large number of small innovator firms operate totally in the field of R&D and have no products on the markets for the time being. This is why the question of integrating market needs into NPD and the whole strategic vision of a company is especially worthwhile in the research context of small and medium-sized firms.

[15] Surrogate consumers are third-party decision makers who can dominate the end users' decision-making process to a varying degree (Solomon 1986). For example, a drug purchase decision is often a joint process over which the end consumer does not necessarily retain primary control.

4.2.4 Exploring and exploiting knowledge in emerging technology firms

> *"An organization that engages exclusively in exploration will ordinarily suffer from the fact that it never gains the returns of its knowledge. An organization that engages exclusively in exploitation will ordinarily suffer from obsolescence. The basic problem confronting an organization is to engage in sufficient exploitation to ensure its current viability and, at the same time, to devote enough energy to exploration to ensure its future viability. Survival requires a balance, and the precise mix of exploitation and exploration that is optimal is hard to specify."*
>
> Levinthal & March (1993, 105)

The top management in small high-technology firms are often heavily biased towards technical disciplines such as science and engineering (Knight 1986). Marketing and general management skills are often significant areas of weakness within small high-tech firms, where entrepreneurs tend to over-emphasize the purely technological side of their business and neglect other key strategic issues (Knight 1986; Oakey, 1991). Nevertheless, it is over-simplistic to suggest that a clear-cut distinction exists between either technology innovation or market-driven philosophies in such companies. Rather, there is a continuum along which small high-tech firms -as well as industries - progress as they grow from initial beginnings based on the internal technological competencies towards an outward orientation focusing upon marketing issues (Berry 1996; Berry & Taggart 1998).

The experience curve describes the tendency of companies with a high degree of specialization to organize for efficiency (exploitation) rather than experimentation (exploration). Essentially, the experience curve suggests that as the technology and organization of a company become increasingly focused and complex, the patterns of corporate behavior to increase efficiency, reduce cost and avoid error become more and more rigidly established. This rigidity causes barriers to radical innovation in corporations (Sheth & Ram 1987, 31-32).

A firm has to find a balance between wide focus, specialization, experimentation and efficiency. Berry (1996) and Berry & Taggart (1998) suggest that a technology firm develops from initial beginnings based on technological specialization towards a wider focus and exploration of market knowledge. However, in markets for technology firms often evolve from a wide focus to specialization and exploitation. This kind of a development path would explain why large pharmaceuticals companies that should be able to collect "technology seeds" from the markets (Figure 9) are facing tremendous difficulties in creating and developing new, innovative products.

The differing views on the development paths can be understood if we look at technology firm development all the way from the beginning, i.e. from the early stages when a nascent entrepreneur (or a corporation) has a technological idea and searches for business opportunities to create economic rents based on this idea. The early stages of nascent entrepreneurship and start-up are characterized by an explorative search and low degree of product specialization. As the firm develops and grows over time, the commercial applications for which the technology is being developed are specified in more detail (“sanity check”). Because of the scarce resources of a new firm, very few firms can simultaneously engage in efficient exploitation of the initial technology and an explorative search for new opportunities and innovations. Once the lead technology is commercialized (leveling off of the curve in Figure 10), the firm is less likely to suffer from limited resources (Freeman 1982; Singh, Tucker & House 1986); it now has more resources to venture into exploration of new opportunities. This development path is described in Figure 10.

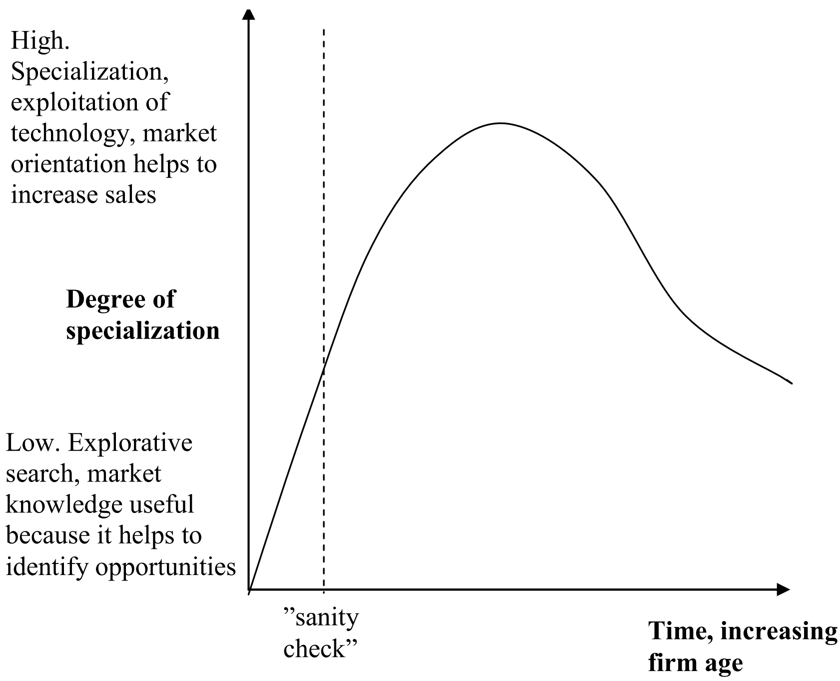

Figure 10: Development from exploration to exploitation to exploration in technology firms (Based on Sheth & Ram 1987; Berry 1996; Berry & Taggart 1998).

In their sample of 239 radical innovation projects Thieme and Song (2002) found that under conditions of increasing market turbulence the impact of market intelligence-gathering activities is negatively related to performance in the early stages of the product development and commercialization process, but steadily progresses towards a positive relationship as the project advances. At the early stages of a project with increasing market turbulence, gathering market intelligence has a detrimental effect on the project's ultimate performance in the marketplace. But, as the project moves through technical development, product testing and product commercialization, the acquisition of market intelligence gradually turns from detrimental to helpful (Thieme & Song 2002).

Research results like the one from Thieme and Song (2002) described above have led researchers to question whether the market orientation paradigm, which encourages listening to current customers as well as consensus and cohesion within an organization, can produce the flexibility and learning required to adjust to turbulent environments such as high-technology fields (Stewart, Mullarkey & Craigh 2003). Outside marketing literature, organizational learning literature has addressed the issue of whether firms learn when they are exploiting current knowledge and skills or when exploring new knowledge and skills (March 1991). Learning achieved through market orientation has been described as incremental and focused on issues or opportunities that are within the traditional scope of the organization's activities (Kohli & Jaworski 1990; Slater & Narver 1995; Baker & Sinkula 1999b). This type of learning is "impeding the search for unconventional business opportunities" (Hamel & Prahalad 1991, 83; see also Adams et al. 1998). The adaptability and creativity that drive especially radical innovations (explorative strategies) cannot be achieved through the components of traditional market orientation like uniformity, cohesion and adapting the majority view (Nemeth 1997). A counterargument is presented by Kyriakopoulos & Moorman (2004), who say that a firm's market orientation actually reduces the tensions between exploration and exploitation strategies and creates the opportunity for cross-fertilization and complementary learning between the two strategies.

Christensen and Bower (1996) provide evidence from the computer disk drive industry in support of their claim that the power of dominant customers contributes to the failure of leading firms. These firms devote so much attention to customers in high margin segments that they miss out on technologies that emerge in low margin, niche markets that ultimately supplant earlier technology. Christensen (1997) subsequently examined a variety of industries and identified the same pattern. Takayama & Watanabe (2002) conclude that in the pharmaceutical context, technology knowledge promotes NPD. In contrast, market knowledge sometimes inhibits NPD. In the case of totally new products, disruptive innovations, successful NPD is not derived from market knowledge creation but is initiated by technology knowledge while "freezing" market knowledge (Takayama & Watanabe 2002, 361).

In addition to customer intelligence, another central element in market information is competitor intelligence. Identifying competitors within a shifting competitive landscape poses special challenges. Competition is not technology-specific or geographically bounded but comes in many forms and from many directions; in markets for technology heterogeneous competitors compete indirectly and on multiple dimensions. When it comes to recognizing rivals, managers are myopic (Levitt 1960). Left to their own science and technology, they only notice competitors that are relatively close in terms of core technology, product type, geography and other salient characteristics (Porac & Thomas 1990). Thus they are likely to be blindsided by rivalry coming from unexpected directions (Zajac & Bazerman 1991). Explanations for this blindness include the lack of managerial resources such as time and attention; when rivals are heterogeneous and the competitive environment is dynamic, keeping track of potential competition consumes time and other resources. Under conditions of complexity and uncertainty typical of markets for technology, bounded rationality and cognitive biases further complicate decision making (Williamson 1975; Kahneman, Slovic & Tversky 1982; Peteraf & Bergen 2003).

4.3 Proactiveness, reactiveness and market orientation

Despite these aforementioned limitations of customer data in proactive new product development, a large number of tools have been developed for customer need assessment (E.g. Holt et al. 1984; Von Hippel 1988). This need assessment and the actions taken based on identification of current customers' needs are typical of reactive market orientation. Basically, market reactiveness means that a firm is driven by its markets, accepts its market structure and does not aim to change this structure (Jaworski, Kohli & Shay 2000).

Based on previous literature, Sandberg (2005, 53-54) defines market proactiveness as "either acting based on the information gathered about the market before the circumstances have had a direct impact on the firm, or deliberately influencing and creating changes in the market". When the focus of market knowledge is placed on future markets and unarticulated customer needs, we come to this domain of a more proactive market orientation. This proactiveness has been gaining increasing interest in the literature (Jaworski et al. 2000; Sandberg 2002; Sandberg and Hansén 2004; Narver et al. 2004; Sandberg 2005). Proactiveness is also a key component in what has been called the *entrepreneurial orientation* of a firm. Miller (1983) describes entrepreneurial orientation as one that emphasizes aggressive innovation, risky projects and a proclivity to pioneer innovations that pre-empt competition. Covin and Slevin (1989) have developed a scale for the measurement of the three components of entrepreneurial orientation, namely innovativeness, proactiveness and risk taking. Innovativeness reflects a tendency to support new ideas, novelty and creative processes, thereby departing from established practices and technologies. Proactiveness refers to a posture of anticipating and acting on future wants and needs in the marketplace, and risk taking is associated with a willingness to commit large amounts of resources to projects where the likelihood and cost of failure may be high (Lumpkin and Dess 1996; Wiklund and Shepherd 2003).

At an extreme, entrepreneurial orientation has been represented as a complete opposite to market orientation; traditional market orientation has been described as an adaptive capability by which firms react or respond to conditions in the market environment, whereas entrepreneurial orientation, in contrast, is an environmental management capability by which firms embark on proactive initiatives to change the competitive landscape (Atuahene-Gima and Ko 2001, 57) (see Figure 11). Foxall (1984) suggests that most firms have an inherent tendency toward either market or entrepreneurial orientation. In addition to entrepreneurial orientation, researchers have contrasted traditional market orientation with a number of other concepts, namely *innovation orientation* (Berthon, Hulbert and Pitt 2004; Narver et al. 2004), *technological opportunism* (Srinivasan, Lilien and Rangaswamy 2002), *technological orientation* (Gatignon and Xuereb 1997) and *organizational innovativeness* (Deshpandé, Farley, and Webster 1993). The common feature in all of these alternative orientations is their focus on technology rather markets as a source of new, innovative product ideas. Instead of generating, disseminating and responding to market intelligence, technologically-oriented firms generate, disseminate and respond to technological knowledge. Atuahene-Gima and Ko (2001, 56) explicitly state that entrepreneurial orientation is "akin to technological orientation because it increases the firm's ability and will to acquire new technical knowledge to build new technical solutions to meet new and latent needs of users". This technological orientation "refers to a firm's value system that promotes technology in new products *at the expense of* customer news or market orientation" (Atuahene-Gima and Evangelista 2000, 1275).

If a firm's market orientation is proactive in nature (Narver et al. 2004), entrepreneurial orientation (or other types of orientations emphasizing innovativeness) cannot be juxtaposed to this market orientation. Instead, a firm that exhibits high levels of proactive market orientation should also rank highly on the components of entrepreneurial orientation. The continuum between reactive market orientation and proactive entrepreneurial orientation with a number of additional flavors suggested in previous research is presented in Figure 11. Proactive market orientation departs from the traditional, more reactive domain of market orientation and is also concerned with customer creation in addition to just serving customers. After all, for example Drucker's (1954) concept of business as a whole embraces more than just customer orientation as mere serving of customers – Drucker (1954) also stressed customer creation.

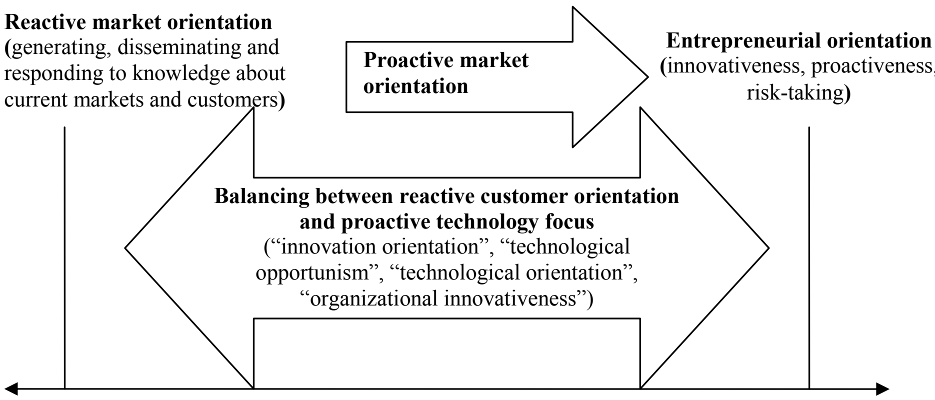

Figure 11: Market orientation and alternative strategic orientations

Each strategic orientation in Figure 11 has been hypothesized as a predictor of superior organizational performance in previous research. Market orientation's performance implications were reviewed in Chapter 3. For entrepreneurial orientation, empirical studies have found that those businesses that adopt a more entrepreneurial strategic orientation perform better (e.g., Wiklund, 1999; Zahra, 1991; Zahra and Covin, 1995; Wiklund and Shepherd 2005). Atuahene-Gima and Ko (2001) confirm the inherent overall superiority of the high-market and high-entrepreneurship orientation combination. Most likely, the effects of market and entrepreneurial orientation are contingent upon the dynamics of the environment and the types of products / services offered by the firm. Both Harris (2001) and Diamantopoulos and Hart (1993) find that market orientation has a positive impact on performance under conditions of low environmental turbulence. Similarly, Wiklund and Shepherd (2005) find that businesses that face a stable environment and limited access to capital can be superior performers if they have a high entrepreneurial orientation. The fact that the positive relationship between entrepreneurial orientation and performance is weaker in dynamic environments leads

Wiklund and Shepherd (2005) to speculate that when the environment is dynamic and the firm has considerable access to capital, business performance might be improved by a more inwardly focused orientation (more efficient exploitation). An alternative explanation -one not considered by Wiklund and Shepherd (2005) - would be that in dynamic environments (typically, high-technology industries) all firms are, by nature, entrepreneurial (technologically oriented). Hence whatever variation there is in the level of entrepreneurial orientation is not enough to translate into performance implications in an empirical model.

Veryzer (1998) concludes that successful discontinuous[16] new product development processes may not be as customer driven as continuous new product development. The limitations in the use of customer input in the discontinuous process arise from a number of technology-related issues. First of all, ideas about new applications for emerging technologies are not apt to come from present customers. In addition, in terms of time and product familiarity, discontinuous innovation is more distant from the end market than continuous innovation; the development spans of new products in, e.g., medical technology take years or decades and in the end an innovation may be incompatible with the cultural values of the customers or with previously adopted ideas (Rogers 1962). These factors, along with secrecy concerns, limit the degree to which discontinuous new product development -an exploratory approach - can be driven by current customers (Veryzer 1998).

It can be concluded that proactive information gathering and analysis are critical in the successful development and execution of innovative strategies and new product development in markets for technology (Barringer & Bluedorn 1999; Matsuno et al. 2002; Rothwell 1992; Ottum & Moore 1997; Li & Calantone 1998). This essential information covers both market information and technological insights. However, researchers have tried to make a case that instead of being responsive to market knowledge (the domain of traditional market orientation), firms would be better off by having a technological orientation. In the early days researchers such as Kaldor (1971), Tauber (1974) and Bennett & Cooper (1981) claimed that too much market information can result in negative effects on innovativeness. Lately, some researchers have clearly contrasted R&D and innovativeness with marketing and market orientation in a firm (Christensen 1997; Hamel & Prahalad 1994; Atuahene-Gima and Evangelista 2000).

Despite these juxtapositions, the approach of the current research is that market and entrepreneurship orientation are synergistic; they both positively affect innovation activities as well as performance. Such an approach is also

[16] Discontinuous innovation / discontinuous new product development refers to radically new products that involve dramatic leaps in terms of customer familiarity and use (Veryzer 1998).

supported by the conclusions of Atuahene-Gima and Ko (2001). By definition, firms in a market for technology possess a technological orientation; they are strongly R&D oriented, proactive in acquiring new technologies and use sophisticated technologies in the development of new products (Cooper 1988). The kind of “either-or” approach explicitly or implicitly adopted in some studies would seem to suggest that because these firms are technologically oriented, they cannot be highly market oriented at the same time. However, this is definitely not the prediction made in this study. Instead, I suggest that high levels of technological (i.e. entrepreneurial) orientation and market orientation can co-exist in an organization and both, simultaneously, contribute to superior innovations and performance. However, the right way to assess this simultaneous existence of MO and entrepreneurial or technological orientation is to measure each construct independently rather than by adapting the Berthon et al. (2004) approach and forcing managers to reflect both the level of entrepreneurial and market orientation of a firm in a single answer.

Market orientation in a high-technology environment must have a strong proactive component. Taking the concerns about “customer-led” firms presented by, for example, Hamel & Prahalad (1994) into account, Hunt and Morgan (1995) emphasize including potential customers in market intelligence generation, not just the articulated needs, wants and desires of present customers. Technology firms need to avoid the trap where acquiring market information becomes “maintenance learning” in which concept tests or focus groups are tasks to be completed rather than opportunities to gain new insights (Adams et al., 1998, 406).

4.4 Contribution of partnerships and networks

The unipolar paradigm of a firm as a central actor in markets has been complemented with a network perspective that emphasizes multipolar distribution of power and control. Networks have been suggested as resulting in the demise of the stand-alone firm as the principal unit of business competition. Networks’ contribution to a number of phenomena, like firm internationalization (Brüderl & Preisendörfer 1998; Coviello & Munro 1995, 1997; Hinttu, Forsman & Kock 2004; Holmlund & Kock 1998; Welch 1992; Johanson & Mattsson 1988, 1992) and knowledge diffusion and learning (Inkpen & Tsang 2005; Bergman, Jantunen & Saksa 2004; Möller & Svahn 2004; Owen-Smith & Powell 2004) have been studied in the management and marketing literature over decades (Axelsson & Easton 1992; Dana & Wright 2004).

Especially in dynamic fields like biotechnology, the traditional boundary activities that bridge the company to its environment are supplemented with a host of collaborative ventures (Owen-Smith & Powell 2004). These collaborative arrangements and divided resources are most visible when they take the form of strategic alliances and other formalized structures. The strategic alliance literature has informed us that direct ties significantly contribute to the exchange of resources and information between partnering firms (e.g., Arora & Gambardella 1990; Barley et al. 1992; Eisenhardt & Schoonhoven 1996; Hamel 1991; Larson 1992; Shan 1990). While strategic alliances are a form of governance structure that enables bilateral exchange for a limited purpose, networking describes the entrepreneurial behavior in building relationships with an expectation to develop mutual trust and reciprocity in the network of firms (Powell 1990).

Although market knowledge and learning play a significant role in inter-firm relationships, Johnson, Sohi & Grewal (2004, 21) state that scholarly work in this area is limited to some conceptual articles, like those by Lukas, Hult & Ferrell (1996) and Mohr & Sengupta (2002). Bierly and Daly (2004) study sources of external organizational learning in a context of small manufacturing firms. The external sources in their study include the scientific community, consultants, customers, suppliers, competitors, partnerships and firms from other industries. Their results indicate that the most common sources of learning for small businesses, in order of importance, are: customers, suppliers and the scientific community; the least common sources are: competitors, partnerships and consultants. They also relate the external sources of learning to innovativeness and the strategic dimension of exploration vs. exploitation (March 1991). Learning from the scientific community and partnerships are predictors of exploration; learning from customers is a predictor of superior product development and innovation speed; and learning from suppliers is a predictor of cost reduction. These findings confirm the conclusion of Veryzer (1998): Successful *discontinuous* new product development processes may not be as customer driven as *continuous* new product development. Customer integration enhances the quality and speed of NPD but in order to explore new strategic opportunities and develop discontinuous innovations, learning from parties other than present customers is more beneficial. Day (2001, 14) talks about "open-minded inquiry" as a component of a firm's market-driven learning process, and states that "open-minded inquiry also requires an ability and willingness to learn from the experiences of others, including customers, competitors, and channel partners".

Recently, the assumption that localized knowledge spillovers are freely available to firms has come under increased scrutiny. Rather than being freely available, knowledge has been suggested as being available primarily through network connections between firms and the sources of knowledge (Coombs, Deeds & Ireland 2004). Network capabilities are not specific to a firm but represent joint gains in coordination and learning. Kogut (2000, 406) defines two kinds of rents from networks: one that accrues to the broker, and another more broadly to the members of a closed group. The informational benefits of a firm's participation in a network (Powell 1990) are easily linked with the "market intelligence generation" part of the behavioral market orientation concept. However, partnerships' and networks' contribution to intelligence dissemination and responsiveness are not as straightforward. Kogut (2000) proposes that a network represents a form of coordination guided by the enduring principles of organization; the network itself is knowledge and provides more than access to distributed information and capabilities (Kogut 2000, 407). Networks have capabilities that are not isolated to any one firm. Cooperation can engender capabilities in the relationship itself, beyond access to information. The parties develop principles of coordination that improve their joint performance (Kogut 2000, 407). Market orientation in a network and partnership context is an example of a domain where these capabilities of relationships can be observed and where they also possibly lead to enhanced joint performance.

The typical benefits associated with collaborating in the domain of new product development include shared risks and costs, access to skills, technologies and markets, and reduced development times (Perks 2000). Improved access to markets often means collaboration with partners that are downstream, i.e. closer to the markets, in an industry where R&D, production and distribution take place in vertically aligned firms. Even though access to markets, as well as access to knowledge and information, are often mentioned as benefits of inter-firm collaboration (Von Hippel 1988; Dyer & Singh 1998; Yli-Renko, Autio & Sapienza 2001), only a limited number of studies have assessed the implications of inter-firm linkages in the market orientation of the collaborating firms. In addition, even though the use of networks to access external resources has been identified as a distinguishing factor between fast- and slow-growth entrepreneurial firms (Jarillo 1989), the mechanisms through which positive growth implications are achieved are not known (Wilson & Appiah-Kubi, 2002).

Three mechanisms through which networks can affect a firm's market orientation are considered in the following. First, the concept of absorptive capacity (Cohen and Levinthal 1989) is stretched to the field of market orientation. Second, channel relationships and a firm's position in a value chain are discussed. Third, the potential contribution of a firm's social capital to its market orientation is addressed.

4.4.1 Absorptive capacity and market orientation[17]

The general perception from studies on inter-firm collaboration is that it is good for firms - and especially small firms - to involve external organizations in their innovation efforts and that the benefits of networking typically outweigh the costs. In the context of technology alliances, Cohen and Levinthal (1989) suggest that in order for a firm to be able to exploit external knowledge it needs to have the internal skills to understand this knowledge and its potential uses. This ability to exploit knowledge from external sources is called absorptive capacity (Cohen and Levinthal 1989, 1990). Focusing on how alliance partners may systematically engage in inter-organizational learning, Dyer and Singh (1998, 665) introduce the concept of partner-specific absorptive capacity. This refers to an idea that a firm can develop an ability to recognize and assimilate knowledge from a particular alliance partner.

The role of absorptive capacity in relation to behavioral market orientation is illustrated in Figure 12. Even though absorptive capacity is a trait of an organization, whereas behavioral market orientation emphasizes doing and action, the two concepts share a similar “filtration” logic at the boundaries of an organization. Absorptive capacity is about a firm’s ability to adapt and exploit external scientific and technical knowledge from the environment. Market orientation also refers to adapting and exploiting external knowledge, but the focus is on market knowledge. In the context of market knowledge, absorptive capacity has been used as a theoretical background by Johnson et al. (2004).

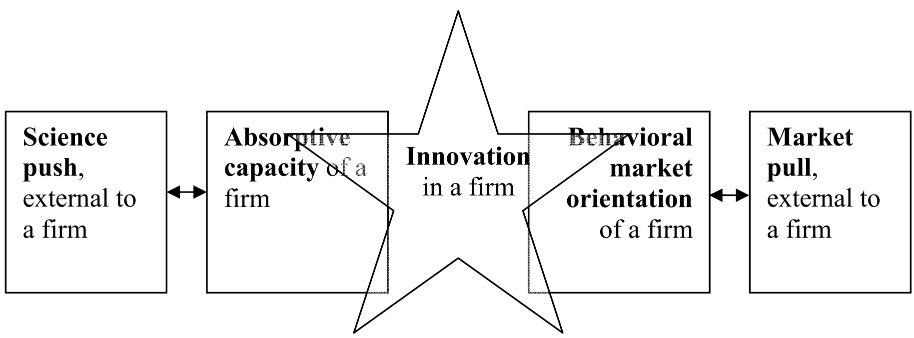

Figure 12: Absorptive capacity, market orientation and innovation

In the real world, unlike in Figure 12, radical, technological innovation is not always a balanced result of science push and market pull. The reluctance and inability of highly specialized companies to employ a breath of technological knowledge often leads them to introduce products that evolve

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[17] Parts of this discussion have earlier been presented in Renko et al. (2005).

“naturally” from their current technology base. This can happen without regard to the needs of the markets (Sheth & Ram 1987).

Research activity in a firm has a dual role of generating new knowledge and enhancing a firm’s ability to absorb new knowledge generated by others (Cohen & Levinthal 1989, 1990). In line with the notion of absorptive capacity, Veugeler (1997) found a link between the level of internal R&D expenditure and the probability of engaging in external R&D cooperation; firms with a higher level of internal R&D expenditure are more likely to be involved in external R&D cooperation. The returns on research activity depend on the richness of the pool of external knowledge and the research activity of other firms. If other firms engage in a high level of exploration activity, the pool of knowledge into which an organization taps will be rich. This results in a self-enforcing cycle, making it attractive for the organization to invest in research at high levels as well. Consequently, a more knowledge-intensive environment tends to beget more investment in knowledge development and companies may find themselves in self-reinforcing spirals of knowledge-generating activity leading to high levels of renewal and growth (Levinthal & March 1993, 104).

Even though the concept of absorptive capacity pertains to the technological knowledge and R&D context, I would like to point out its usefulness when thinking about market information and knowledge. A firm that has a high level of market orientation, i.e. a firm that effectively generates, disseminates and responds to market intelligence, is likely to be more aware of the market-related information available to it through its collaborations with other firms. This is because the existing understanding of markets within the whole organization promotes its alertness to the relevant market information available. Furthermore, if market-oriented thinking is present at all levels and in all functions of an organization through effective dissemination of market intelligence, all of the employees - and not only the business development managers - of a firm can absorb market knowledge from the environment. On the level of an industry, analogies can be drawn from Levinthal and March (1993): an environment that is “knowledge intensive” in terms of market knowledge may encourage a firm to invest more in market knowledge development. An opposite to this kind of stimulus is, for example, an environment that lacks market knowledge and emphasizes scientific achievements instead.

4.4.2 Channel relationships

Some studies have looked at the market information exchanged in inter-firm collaboration (Perks 2000). According to Hernández-Espallardo & Arcas-Lario (2003), in a channel partnership where the downstream firm is the leader there are reasons to believe that this company has superior market knowledge that can be transferred to its upstream partner. This view can also be extended to the context of this research. A large pharmaceutical company with established distribution channels and marketing procedures is a downstream partner compared with its smaller technology partner firms. The larger firm is likely to have routines for data collection from markets and consumers as well as other stakeholders, such as regulatory authorities. Just like the “leader” company described by Hernández-Espallardo & Arcas-Lario (2003), an established pharmaceutical firm is specialized in the marketing of the products; it has a better knowledge of the market demands and detects changes in market conditions faster and more accurately than its upstream partner, i.e. a small technology-based firm.

In addition to superior access to customer data, a large downstream firm also has a broader perspective on all the commercialization processes and the activities carried out by competitive networks. Finally, in line with Hernández-Espallardo & Arcas-Lario’s (2003) notion on downstream partner in a channel relationship, the larger pharmaceutical firm often has a broader portfolio of products and relationships, which allows this firm to accumulate knowledge and experiences that can be translated to different situations and relationships.

Redfern and Davey (2003) studied supply chain market orientation in new product development in the UK textile industry. In this industry, at the start of a supply chain, the end consumer seems far away and the degree to which the raw material, i.e. textile, plays a part in the consumer product is difficult to gauge.

Research on strategic networks has focused more on relations along the value chain, i.e. vertical relations, resulting in a lack of information on the use of horizontal, often competitor-based, networks and partnerships. However, small firms that are constrained by a lack of resources may go to competing firms to look for those resources. Especially in a rapidly changing business environment, competing firms may be the best source of up-to-date information on the markets (Wilson & Appiah-Kubi 2002, 46). As noted by Hunt and Lambe (2000, 28), a firm’s relationship with its market is defined by the constellation of firms of which it is a part and with which it competes against other constellations.

4.4.3 Social capital

Inter-organizational competitive advantages and relational rents can be traced back to four sources on the inter-firm level: relation-specific assets, knowledge sharing routines, complementary resources / capabilities and effective governance (Dyer and Singh, 1998). Both Von Hippel (1988) and Powell et al. (1996) found that firms in learning networks with superior knowledge transfer mechanisms show a higher innovative output than firms outside these networks. Even though Dyer and Singh (1998, 665) propose that inter-firm knowledge sharing *routines* lead to greater potential for relational rents, knowledge within networks is often transferred through more irregular patterns of interactions than the word “routine” implies. Developing routines for the transmission of information does not necessarily entail formalization; knowledge can be conveyed routinely through informal means. Routines without formalization allow partners to spread lessons learned in collaboration in unexpected and unobtrusive ways (Powell 1998, 238).

The concept of social capital originally emerged in sociological research focusing on community and family relationships (Jacobs 1961; Granovetter 1973). Over the past decade it has been extensively employed in economic research, especially in research on entrepreneurship (Grundstén 2004). The central proposition in social capital theory is that networks of relationships constitute a valuable resource for conducting social affairs, providing their members with “collectivity-owned capital” (Bourdieu 1986). Social capital is the sum of the actual and potential resources embedded within, available through and derived from the network of relationships possessed by an individual or a social unit (Nahapiet & Ghoshal 1998). Consequently, social capital is the function of the location of actors in the structure of their social relations (Adler & Kwon 2002).

The relevance of social capital, especially in understanding the functioning of small firms tightly linked with outside organizations, is explicit. Several studies report on the contribution of social capital to resource acquisition of entrepreneurs and new ventures (Birley 1985; Honig 1998; Oliver & Liebeskind 1998; Baron & Markman 2002). Kreiner and Schultz (1993, 192) talk about the barter economy in biotechnology. This labels the patterns of interaction whereby favors and services are exchanged within the biotechnology community. Even though these discussions are not openly negotiated or publicly discussed, such unofficial trading appears to be systematic and recurrent (Kreiner & Schultz, 1993, 192).

An entrepreneur’s high level of social capital can be attributed to features such as favorable reputation, relevant previous experience and direct personal contacts. This social capital assists the entrepreneur in accessing venture capital, potential collaborators and customers (Baron & Markman 2002). Thus social capital has a clear relationship with resource availability (Adler & Kwon 2002) and Ostgaard and Birley (1994) explicitly state that the concept of personal networks is sufficiently general to include the market orientation dimension as well.

The contribution of social capital theory in understanding the market orientation of a small or medium-sized firm remains rather under explored. Market-related issues such as access to customers have been included in the resources that can be acquired through social capital. The research by Deshpandé and Zaltman (1987) suggests that formal market research is a relatively small part of the information collection and utilization activity in industrial product marketing decisions. Ostgaard and Birley (1994) found that "patented and focused production innovation firms" had extensive networks centered on customers, distribution channels, word-of-mouth advertising, product development ideas and market information. Larson (1991, 1992) lists information exchange and market access among the specific benefits gained by a firm from its vertical networks. However, the contribution of social capital of an entrepreneur or that of a firm to market intelligence generation, dissemination and responsiveness has not , to the best of my knowledge, been explored in a holistic study.

When breaking down the behavioral market orientation of a firm into its three components of intelligence generation, dissemination and responsiveness, it is easy to see the contribution of social capital theory in understanding market intelligence generation. Market intelligence generation in a social capital context becomes the function of who you reach and how you reach them as well as the (market-related) assets generated and leveraged through these relationships. Managers of small biotechnology firms who interact with each other and exchange information on trends taking place in the competitor and customer base present a practical example of a situation where both social capital theory and the behavioral market orientation concept are relevant for analyzing the empirical phenomenon. According to the social capital theory, actors maximize their access to information by choosing partners who act as hubs within the social networks. This happens because actors in these central positions have numerous ties to other actors (Burt 1992; Erickson 1996; Granovetter 1973).

The contribution of social capital theory to understanding the other two parts of behavioral market orientation, namely market intelligence dissemination and responsiveness to it, is not as easily identified. The above-mentioned example of managers of various firms coming together describes a situation where market intelligence is generated for some actors when they interact with other, maybe more knowledgeable, actors. It also describes an aspect of market intelligence dissemination that is very relevant in a small firm context: relevant dissemination of market intelligence does not only take place within a firm but also within a network of actors. Social capital theory tells us that there is a network of social relationships that provide individuals with sources of information, i.e. information channels (Coleman 1988), and that there is a structural dimension of social capital that describes the overall pattern of connections between actors (Nahapiet & Ghoshal 1998). These information channels cross boundaries of individual firms. Consequently, the contribution of social capital theory to understanding market intelligence dissemination is the expansion of focus from within-a-firm dissemination to within-a-network dissemination.

Finally, responsiveness to market intelligence, i.e. what firms actually do to respond to customers' wishes and competitors' actions, can be understood in the light of social norms (Coleman 1988). Social norms refer to norms and sanctions that effectively guide human behavior – or that of an organization – by rewarding some forms of behavior and sanctioning others. Naturally, the whole behavioral market orientation concept with its three components can be analyzed from the point of view of social norms. The social norm that rewards engagement in market-oriented behavior should enhance firms' market orientation. I would argue that compared with the other two dimensions of MO, this becomes most visible for behavior that concerns responsiveness to market intelligence. In biotechnology ventures, for example, taking action based on market intelligence can require much larger resources than the actions that led to generating that intelligence or disseminating it. If social norms tell the firm that there are only minimal benefits to be gained from taking these actions, this is likely to guide the organization towards non-responsiveness.

The role of social capital theory in this research is in helping to understand the potential contribution of a firm's network to its market orientation. This research does not aim at developing social capital theory. Instead, social capital theory "just" provides a framework for analyzing the network of a technology-intensive SME. In the empirical study the concepts are operationalized based on the market orientation literature and my understanding of the empirical phenomena studied. The main reason for not exploring further into the social capital theory here is that as the research questions of this study imply, I am interested in networks' contribution to a firm's market orientation, not the other way around. Whether a firm's market orientation lends something to its social capital could be an interesting question for future research, but it is not explored here.

Another reason for refraining from the use of social capital theory as a tool here is that its origins in different sociological traditions make its compatibility with economically oriented market orientation literature questionable. Drawing further conclusions from the integration of these two perspectives, i.e. MO and social capital, would require an extensive enquiry into the foundational concepts and assumptions of both theories. Still, even by using social capital in a tool-like way I do risk trying to "explain too much with too little"; Woolcock (1998) argues that the whole social capital theory is actually guilty of this. Adler and Kwon (2002) are of the opinion that social capital is still in the "emerging excitement" phase and tries to catch everything. By expanding social capital to the field of market orientation I may be guilty of further adding to this emerging excitement. However, the key concepts of social capital theory and the empirical evidence that supports the contribution of social capital to a firm's resource base and success are convincing.

Figure 13 summarizes the approaches considered so far for an improved understanding of market orientation. Social capital theory, the channel relationships of a firm, and interpreting the concept of absorptive capacity from a market knowledge perspective all add to our understanding of what drives the development of market orientation in a technology-based SME. As the beginning of this chapter showed, within the strategy literature a firm's market orientation can be considered a key resource that has potential to be valuable, rare and hard for competitors to imitate. Market orientation can also be approached from an organizational learning perspective. Even though some researchers have claimed that market orientation is a purely reactive approach to the markets, it can be combined with other strategic orientations, such as entrepreneurial and technological orientation, in order to increase the proactiveness aspect of market orientation. Finally, in addition to contributing to a firm's bottom-line performance, as typically measured in market orientation studies within the marketing literature, market orientation also has potential to contribute to identifying new business opportunities in an entrepreneurial firm as well as to new product development processes in a technology-intensive environment. All these aspects discussed in Chapter 4 are now summarized in Figure 13.

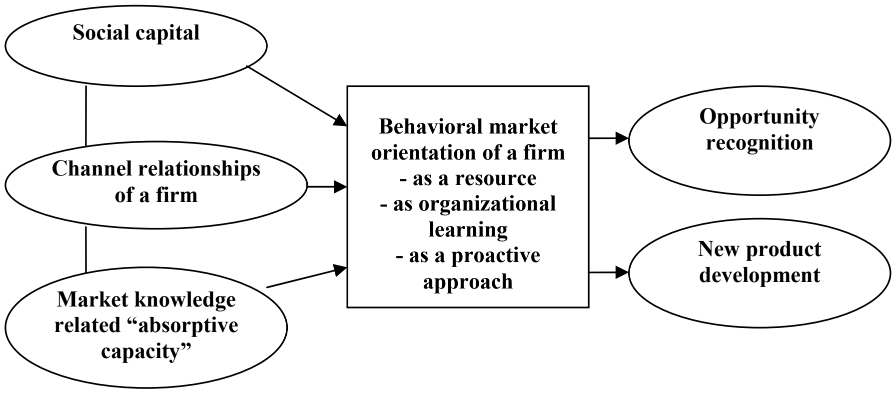

Figure 13: Contributions of management and entrepreneurship literature to understanding market orientation.

So far, market orientation has been described based on the existing literature. Looking back to the research questions, the existing literature has been reviewed in order to understand both the components of behavioral market orientation in markets for technology as well as the performance implications of market orientation in markets for technology.

In the next chapter this theoretical knowledge will be extended with a qualitative, preliminary empirical study. The purpose of this preliminary study is "topic-related" (Hurmerinta-Peltomäki & Nummela 2004); even though information on the empirical phenomenon has been collected from existing literature, there still is a need to acquire a better understanding of the components of market orientation in markets for technology. Later, the literature review presented thus far, as well as the preliminary empirical study described in the next chapter, will help in developing hypotheses that I will test in a more comprehensive dataset.

5 PRELIMINARY EMPIRICAL STUDY: TOWARDS UNDERSTANDING MARKET ORIENTATION IN BIOTECHNOLOGY

As the previous chapters demonstrate, market orientation is a multi-faceted concept. Especially in a technology-driven context like markets for technology, the traditional, marketing literature-based view of market orientation does not always apply. A preliminary qualitative study was conducted to assess the understanding of market orientation among practitioners marketing technologies. This preliminary empirical study is reported in this chapter. Some parts of these study results have also been previously reported in Renko and Carsrud (2004). Together with the literature review, the preliminary study provides a basis for the development of research hypotheses about market orientation in markets for technology as well as for the development of a related survey instrument.

The general purpose of the preliminary empirical study was to investigate the ways in which market intelligence is generated and disseminated in small and medium-sized medical biotechnology firms and also how these firms respond to the market intelligence. Essentially, this means addressing research question number one: What are the components of behavioral market orientation in markets for technology? This was done by applying a qualitative research method. Humanism as an inquiry approach allowed me to explore the arguments entrepreneurs in small and medium-sized biotechnology firms themselves used in assessing the market orientation of their firm (see Hirschman 1986). This was considered essential given the exploratory stage of the research. I did not start with a strict a priori model consisting of discrete variables embedded in a causal network as the goal of the preliminary study was to comprehend and interpret the phenomenon in its own terms (Hirschman 1986). Thus instead of directly addressing certain components of market orientation and their relevance with the informants, I let the informants themselves construct their approach to evaluating the behavioral market orientation of their respective organizations.

The case firms in the preliminary empirical study serve an instrumental purpose; in an instrumental case study the case is used to understand something other than the case itself (here, market orientation). The participants' perceptions are studied because they provide a window on a reality beyond those perceptions (Stake 1995). Based on the results of this initial qualitative research and the comprehension of the phenomenon, I will later operationalize the construct of market orientation for a larger scale quantitative study.

5.1 Biotechnology in the Philadelphia area

The Philadelphia area was chosen as a site for the preliminary study because of its vibrant biotechnology industry. From a large biotechnology company base it was rather easy to identify a number of interesting companies for the interviews. The consulting company Ernst & Young has produced comprehensive annual reports on the biotechnology industry since 1987. According to their 2002 report, there are approximately 1,460 major biotechnology companies in the US. A little over 400 are in California, just over 200 in Massachusetts, nearly 100 in Maryland, about 90 in North Carolina, and approximately 70 each in Pennsylvania, New Jersey and New York. Other than these states, Washington, Georgia, and Texas have about 40 companies each, and Florida and Colorado 30 companies respectively (Ernst & Young 2002). The Philadelphia area (Pennsylvania) is an important hub of biotechnology firms in the US but is still not an extreme case of either a very high concentration of firms like California or a more recent biotechnology state like Florida.

The Philadelphia medical district, with its large pharmaceutical firms, was established by the mid-1950s. Over the past two decades more than 100 biotechnology firms have sprouted in the greater Philadelphia area. This transformation from a traditional drug and pharmaceutical base into biotechnology is a result of several interrelated elements, such as the concentration of academic, medical and research-oriented institutions; the presence of large pharmaceutical companies; the availability of capital; and the coordinated support of government and private organizations. The three-state area around Philadelphia, including eastern Pennsylvania, New Jersey and Delaware, accounts for about 80 per cent of the production of pharmaceuticals in the US (Llobrera et al. 2000; Santomero 2002).

As of the mid-1990s, biotechnology and pharmaceuticals comprised the fastest growing industrial sectors of Greater Philadelphia (McGurty 1994). High-quality academic research institutions and the traditions in the pharmaceutical industry in the area provided a good basis for this growth, but the area has suffered from limited venture capital funds and insufficient support for entrepreneurial activities by individuals. These barriers have been overcome by forging partnerships and building networks of collaboration. Coalitions of academia, corporations and government, such as the Ben

Franklin Partnership and the Greater Philadelphia Partnership, have been hubs in local social networks. They have also given structure and direction to the venture capital accumulation in the area. In addition, other intermediary structures have helped academic institutions translate scientific breakthroughs into commercial products (Llobrera et al. 2000).

5.2 Data collection method

The company information provided on Ben Franklin Technology Partner's Internet pages on Philadelphia area biotechnology companies was studied in detail to identify interesting candidates for the interviews. In order to understand the behavioral market orientation of biotechnology SMEs, I purposefully selected diverse organizations from the population of medical biotechnology SMEs. The aim was to meet with five to seven different kinds of biotechnology managers – firms of different technological foci, varying ages and different stages of development. The firms needed to be product-oriented firms (no pure service providers) active in biotechnology R&D and developing products for medical, diagnostics or biomaterial markets. The firms also needed to be independent companies employing less than 250 people (SMEs)[18]. Theoretical sampling of firms was used. This kind of sampling is often preferred over random selection in qualitative case study settings (Eisenhardt 1989). In order to collect evidence from different types of biotechnology organizations operating in markets for technology, I chose case companies representing various types of business, development stages, size and partnership foci.

The Ben Franklin Partnership, founded in 1982 as a private, non-profit organization funded by the state and the federal government, was designed to support the development of high-technology industries in Pennsylvania. The Ben Franklin Partnership exhibited its hub position in the social networks of biotechnology in the Philadelphia region by creating linkages with key actors (Llobrera et al. 2000). Even today, this organization still has a key role in the area in establishing links between academia and firms and in promoting industry development.

Altogether, 15 firms of the Ben Franklin Partnership list were contacted at the beginning of July 2003. The initial contact was made by sending an e-mail to the company CEO, telling about the nature of the research, the research questions, and the role of interviews in the research process. His / her willingness to participate and to be interviewed was requested. Within a week,

[18] The criteria for choosing companies are described in more detail in the methodology part of this book. The same criteria that were used to identify companies for the main sample to be presented later were also employed in the preliminary study.

replies were received from eight companies, of which four agreed to be interviewed and interview times were set for late July 2003. Three companies that answered the e-mail were not willing to be interviewed and one company did not, despite the company description on-line, actually develop or market biotechnology products but was a service provider and was consequently not interviewed. Those seven companies that did not reply to e-mails were contacted by phone one week after sending the initial e-mail. In two of these firms it was impossible to get through to a CEO or other high-level manager to present the research and ask about their willingness to help. In three other firms, where the CEOs were reached by phone, it was impossible to set a convenient time for the interview because the CEOs were not available at the time I was going to visit the area, i.e. the end of July. Finally, two more CEOs agreed to be interviewed after the phone conversations and with them it was possible to agree on a convenient time for the interview. Consequently, of the 15 firms initially contacted, interviews were scheduled with six companies.

Six companies in the field of medical biotechnology were interviewed. All the interviewees were CEOs of their firms and apart from one firm (A in Table 3) they were also the entrepreneurs that had started the business. The key characteristics of the firms are summarized in Table 3.

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Table 3: Companies in the preliminary study, main characteristics.

Firm	***Type of business***	***Development stage***	***Employees***	***Key partnerships***
A	Drug discovery and development	Lead product to be commercialized in 2005	130	One big pharmaceutical firm (downstream)
B	Drug discovery, development, manufacturing, and marketing	Lead product commercialized in 2003	144	A number of technology partners (horizontal alliances) but no partners in distribution & marketing.
C	Drug discovery and development	Lead product to be commercialized in 2005	85	A number of technology partners (horizontal) and two partners for future distribution & marketing (downstream)
D	Technology platform company	License technology for use in drug discovery	10	A number of technology partners (horizontal) and close relationships with key licensors, i.e. customers (downstream)
E	Medical food development	Lead product to be commercialized in 2004	7	No formal ties to other firms
F	Hybrid: (1) Technology platform, (2) drug discovery and development	Lead product to be commercialized in 2008	26	One big pharmaceutical company (downstream)

I personally visited all the firms (Table 3) and conducted the interviews. During the face-to-face thematic interviews, the CEOs were asked to evaluate and comment on the ways in which market intelligence is generated, disseminated and responded to in their firm. The interview themes were developed based on understanding specific features of the industry as well as knowledge of the extant research in the field of market orientation (Kohli et al.

1993; Deng & Dart 1994; Harris 2001, 2002; Lai 2003; Hernández-Espallardo & Arcas-Lario, 2003). The interview guide is presented in Appendix 1.

Most of the interview time was devoted to the first six pages of the interview guide, especially the open-ended questions. The four last pages of the interview guide had the purpose of pilot testing items I was considering for use in the main empirical study (to be reported in Chapters 7 and 8). These four last pages of the interview guide were further developed based on the comments from the interviewees and appear in an improved (simplified) form again in the questionnaire for the main study. The content of the preliminary study interviewees' answers to the four last pages of the interview guide is not analyzed here since the items were mainly administered for the purpose of further questionnaire development.

In every interview I was accompanied by another doctoral student from the Temple University, Mr. Andrew Mongar. He was collecting data for his dissertation that looks at supplier relationships of technology firms in a number of high-technology industries. In the interviews, background questions about the company benefited us both. After the background questions I asked my questions about market orientation of the firm and Andrew's role at this point was just to listen. Later, after my questions had been answered, Andrew presented his questions to the interviewee. On average, the background part of the interview took about half an hour. After that, the average time for the market orientation part of the interview was about 45 minutes. Andrew's questions on supplier relationships took about another half an hour, resulting in an average length of 1 hour and 45 minutes per interview. Doing the interviews together with Andrew gave us the possibility to brainstorm on each interview after it had been finished. I could sometimes point out things to him that I thought were interesting for his research that he might have otherwise ignored, and he could do the same for me. This allowed the case firms to be viewed from the different perspectives of two observers, which increased the validity of the data collected (Eisenhardt 1989). Even though the fact that we had two sets of questions for each interview meant that there was a bit less time for each individual set, by doing the interviews together we increased the overall validity and reliability of the data. After all, timing was not a problem here because the interviewees were asked to reserve two hours for the interview and this was typically enough for all of our questions.

5.3 Data analysis

Initial data analysis was conducted immediately after each interview. The interviews were not tape-recorded. Instead, I made extensive notes on the interviewees' answers during the interviews. The decision not to record the interviews was based on two reasons. First, I was not interested in capturing every single word of the interviewees' speech. Instead, I was interested in the content of their comments and answers. Summarizing the key comments and issues emphasized by the interviewees was possible with a pencil-and-paper approach during the interview. Second, I wanted the interviewees to feel very comfortable and relaxed in the interview situation and to elaborate on their opinions. Even though tape-recording is preferred in qualitative research interviews to ensure the reliability of the data, the fact that the recorder is present has been demonstrated to deteriorate the interviewees' willingness to express all of their thoughts (Lincoln and Guba 1985). I always transcribed my extensive notes from each interview within three hours of the end of the interview. In this way I not only had the notes but also the actual interview situations fresh in my mind. The notes were coded - that is, divided into analyzable units by creating categories with and from the data in order to characterize what each statement was about in terms of general thematic content (Coffey & Atkinson 1996). These more general categories or themes were compared and linked together in order to identify similarities, deviances and recurring themes in the six interviews. However, the categories were not imposed upon the data arbitrarily; they reflected the data (Dey 1993). In this way the analysis was sensitive to new categories and themes emerging from the data.

5.4 Validity of the preliminary study

In the following I assess the validity of the preliminary study based on the six criteria outlined in Healy and Perry (2000). First, the ontology assumption maintains that the research is dealing with complex social phenomena outside people's minds. Market orientation certainly is a phenomenon of this type. Second, Healy and Perry (2000) suggest that a qualitative case study should fulfill the criterion of "contingent validity" - that is, validity about generative mechanisms and the contexts that make them contingent. I ensure meeting this criterion by making sure that information is obtained from appropriate, information-rich sources (entrepreneurs / managers) and by describing the context of the cases, like the size of the firms and the timing of the interviews.

Third, Healy and Perry (2000) suggest that an effort should be made to analyze multiple perceptions about a single "reality". These multiple perceptions would, optimally, involve triangulation of several data sources, and of several peer researchers' interpretations of those triangulations. This validity criterion was met in this study to a certain extent since I analyzed the available public information on the case companies both before and after the actual interviews. If the interviewees' statements had not been in line with the public impression of the company, I would have noticed this. Also, the fact that I was accompanied by another researcher when conducting the interviews increases the validity of the data collection effort. However, the validity could have been increased even further if I had interviewed multiple informants per firm. Given my resource constraints, this was unfortunately not possible.

The next validity criterion concerns methodological trustworthiness - that is, the extent to which the research can be audited. I provide the questionnaire used as a basis for discussion in the preliminary study in Appendix 1. I also use quotations and make an effort to carefully describe the key procedures, such as case selection and data analysis.

The fifth validity criterion of Healy and Perry (2000) is analytic generalization (theory-building). Based on the existing literature, I had developed a pre-understanding of the phenomenon being studied by the time of the interviews. The preliminary empirical study helps me to confirm and disconfirm my beliefs, and, after this, the next step in the research process is the formulation of propositions (hypotheses) in a form suitable for testing.

The final validity criterion of Healy and Perry (2000) is construct validity. It is similar to the construct validity of positivism research and refers to how well information about the constructs in the theory being built are "measured" in the research. To meet this criterion I used prior theory from marketing as well as technology management and entrepreneurship literature to define my constructs.

5.5 Results of the preliminary empirical study: key issues in the market orientation of biotechnology SMEs[19]

Even if the questions in the interview guide formed the basis for each interview, the discussions were very open and informal. Whenever an interviewee mentioned something not covered in my questions, but still relevant from market orientation perspective, I encouraged him / her to tell me more about the topic.

Despite this openness and the freedom given to the interviewees, the aspects emphasized by them very well matched the theoretical aspects reflected throughout the literature review. Essentially, understanding markets

[19] Note: an earlier version of this chapter, i.e. results of the preliminary study, has been published and presented in the USASBE Research Conference in January 2004. Renko Maija and Carsrud Alan (2004) "Market orientation in the context of knowledge intensive high technology SMEs – operationalizing the concept in biotechnology", Proceedings of the USASBE Conf, Track: Technology entrepreneurship.

was considered important but, at the same time, the interviewees were not convinced of the power of the traditional market research tools for the kind of proactive market understanding their organizations need to achieve. For example, in many interviews the CEOs ended up discussing the technology vs. the market aspects of the biotechnology business and how the two views actually complement each other. However, in this thesis many pages have already been devoted to this topic throughout Chapter 4, and repeating these same aspects again - but this time based on the qualitative case studies - would not serve the purpose of increasing comprehension on the subject. Hence in the following I concentrate on communicating those results from the preliminary study interviews that provide *novel* aspects of market orientation. I also refrain from repeating the insights already described as a part of the literature review unless the interviews added new or contrasting perspectives on what has been said so far.

5.5.1 Understanding the life cycle of a biotechnology firm

Based on the company background and historical information collected in the preliminary empirical study, it is clear that all the six firms have developed from a mere technology focus towards a wider focus on multiple stakeholders. The interviewees were asked to elaborate on this development issue more widely based on their industry experience and not only focus on their own firms. This development is illustrated in Figure 14.

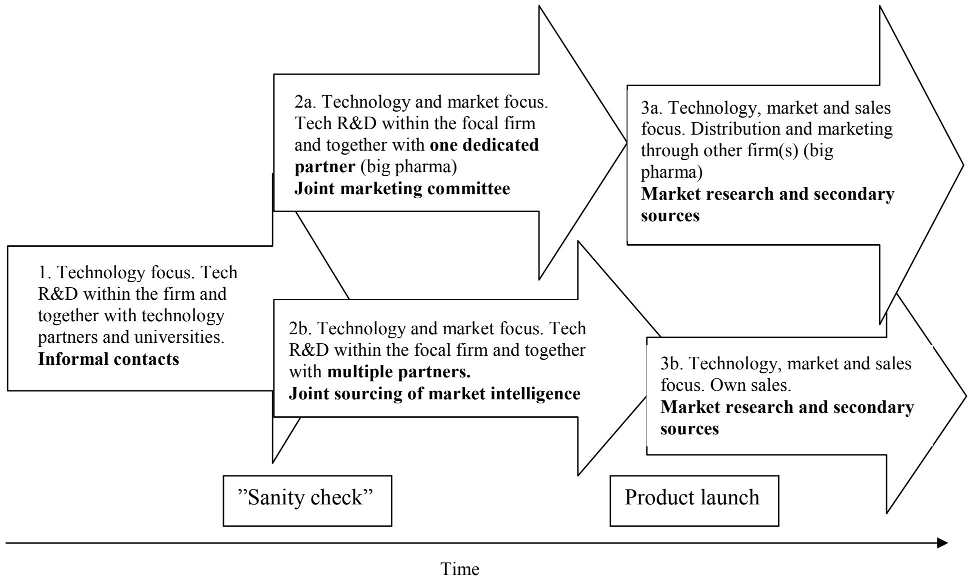

Figure 14: Development of a biotechnology firm

Typically, a biotechnology firm starts as a spin-off or start-up company with a heavy focus on technology (arrow 1 in Figure 14):

> *"In the beginning of a firm like this everything is about technology. Little by little you learn to understand your technology better, its strengths and weaknesses. Only at that point you choose a direction where to go in terms of markets."*

As described by Figure 14, at the early, exploratory stage the predominant sources of market-related data for these firms are the informal contacts, i.e. the social network of the entrepreneur(s). This finding that emerged from the interviews is in line with Birley (1985) who suggests that social networks predominate during the early stages of a venture's life. More strategic partnerships and networks transpire later in a firm's life cycle and consist of, e.g., relationships with customers and suppliers (Larson and Starr, 1993).

When the specific technology that the company is developing is proven to work, there is a stage in the company development that was called "sanity check" by one of the interviewees. Basically, this stage refers to the time when there is a need to answer the "so what" question; what are the potential markets and application areas of the developed technology. From the point of view of market orientation research, this stage in the company development is a very interesting one; a firm that typically has very limited information on potential markets makes critical decisions on its future direction. For example, for one of the companies included in the preliminary study, the decision at this point was to focus on developing their technology further to provide cures in the field of cardiovascular disease, even though the same technology seemed to have similar potential for certain spinal diseases. The decision for this firm to focus on cardiovascular disease was based on the interest of a potential licensor firm; this "big pharma" company was interested in collaborating in the field of cardiovascular disease, which became the company's clinical focus.

When a small firm finds a large, dedicated downstream partner at the "sanity check" stage, it can become very dependent on the links to this one large firm and there may be a decrease in the number of links to other partners. This is because large firms often want to have more or less exclusive deals with the smaller partners. If a small biotechnology firm follows this path of development (arrow 2a in Figure 14), it is very likely that its market intelligence generation, dissemination and responsiveness are very much linked to the processes in the larger, typically downstream partner firm:

> *"We have meetings all the time. We have a joint marketing committee with Glaxo for strategies to commercialize our lead product. These kinds of joint committees are very typical in the industry!"*

> *"We don't do any market research. We are still 6 years away from the market, and then Johnson & Johnson will do the marketing of the first product. And right now market data from J&J is minimal because it is irrelevant, we are still just doing animal studies."*

On the other hand, if a firm at this "sanity check" point continues to operate without exclusive links to major licensing partners and large corporations, it typically has a growing number of links to other firms in the same field of technology (arrow 2b in Figure 14). The complementarity of offerings and R&D with these horizontal partners provides the basis for "joint" market orientation development as well; companies can source market-related data together and this intelligence gets distributed not only within the boundaries of one firm but also within a network of firms.

For the commercialization, distribution and marketing of the final product, most small firms rely on larger, international partner firms with established distribution channels, sales force, etc., in place (arrow 3a in Figure 14). However, entering into these deals with large partners means that a substantial share of profits from the market is channeled to the larger firms that take care of distribution and marketing. Consequently, there are smaller biotechnology firms that go through the commercialization and marketing stage more or less by themselves – at least within a limited geographical area (arrow 3b in Figure

14). For these firms, the traditional aspects of market orientation become more relevant after the launch of the initial product. They are likely to start collecting data on the end markets, they have a network of physicians (in the case of prescription drugs) that give feedback for product development purposes, they have a sales force that also collects feedback from the field, and they also survey the end users (patients). For those firms that enter the end markets through deals with larger companies (3a) however, these direct sources of market intelligence may remain less important if the downstream partner takes care of these activities.

This general trend that emerged form the qualitative study, i.e. development from an exploration phase in which scientific progresses are screened to identify potential innovations into a maturing phase in which innovations are developed and marketed, has also been described in previous research (Afuah and Utterback 1997). However, the development is usually described from the point of view of competence development or evolution of industrial sectors (Porter 1980). The discussion above makes a specific contribution in that it addresses the evolution with a focus on companies' sourcing of market knowledge.

5.5.2 Components of market orientation

Market intelligence generation. At an early stage in the interview the CEOs were invited to describe the firm's markets: who and where are the firm's customers and competitors? Given the context of medical markets, this is very important since there are many stakeholders involved in the commercialization process and the traditional view of markets consisting of end customers does not necessarily apply. Based on the interviews, the network nature and multiple stakeholders involved in the R&D and commercialization processes do, indeed, present biotechnology firms with a challenging task in defining the concepts of "customers" and "markets". As described in Figure 15, a number of "markets" for small firms operating in the "technologies, ideas, and technology platforms" category were identified in the interviews.

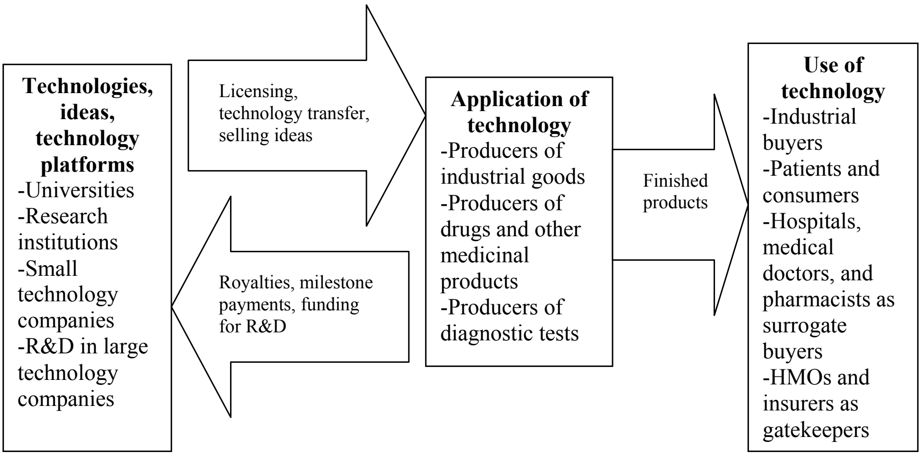

Figure 15: Markets for biotechnology[20]

Based on Figure 15, we can see that small technology companies operating in the "technology platforms" category can view (1) licensors, (2) HMOs and insurers, (3) physicians, (4) end users, and / or (5) other businesses as their customers. A firm's perception of its customers is critical for its market orientation in the sense that market intelligence is generated on the stakeholders that are identified as customers or competitors.

As far as sources of market intelligence are concerned, there is a lot of variation even within this small group of six firms, for example:

> *"Sales representatives are feeding back important information on competition. "*
>
> *"We have several hundreds of doctors in our physician prescriber network, and it is an important source of data from markets."*
>
> *"Scientists in big pharmas and drug discovery firms are our end users, and we communicate with them through (academic) publications and in scientific conferences. If they want to have this tool in their labs they will normally get it."*

In addition to the sources mentioned in the quotes, the following stakeholders as well as firms' own market research efforts were mentioned as sources of market intelligence:

- *Informal contacts*. All of the CEOs interviewed for the preliminary study emphasized the importance of informal contacts as a source of

[20] HMO = Health Management Organization.

market-related intelligence for their firms. The role of informal contacts was considered to be most important at the very early stages of firm's start-up and development.

- *Industry associations*. International, national and regional organizations that represent biotechnology industries promote networking within the industry and also act as a source of market intelligence for participating firms.
- *Universities*. Senior researchers at universities that collaborate with start-up firms are typically key figures in their respective areas of research. Because of their valuable contacts, they can bring market-related data - on technologies and competitors, as well as customers - to a small biotechnology firm.
- *Suppliers*. Suppliers have relationships with competing firms and possibly also with customer companies.
- *Horizontal alliances*. Most alliances are formed for the purposes of collaboration in technology development, but these partnerships also have a role as a source of market-related information. Often the key individuals of horizontally networked firms sit on the boards of each others' companies, which further motivates sharing of information between the firms.
- *Vertical alliances*. For a small or medium-sized biotechnology firm, vertical alliances are typically formed through licensing or joint commercialization and distribution deals with larger firms operating closer to the end markets. These larger firms are typically the ones that excel in marketing and, consequently, the ones with more to offer in terms of market intelligence. Sometimes, a joint marketing committee is formed between the partners.

Market intelligence dissemination. A typical feature of the companies included in the preliminary empirical study has been *fast growth* in terms of the number of employees. Apparently, this is a typical feature of most of the start-up biotechnology firms, provided they are able to attract funding for their R&D. Growth presents problems in terms of communication within a firm. In the beginning, most communication between the people – typically a couple of scientists – working for a firm takes place in the form of everyday communication and no official meetings need to be organized to exchange ideas, opinions, etc. However, as the firm grows and more people – also "species" other than scientists – are employed, information dissemination within the firm has to be reorganized in order to avoid bottlenecks. This, however, seems to be something in which at least the firms interviewed for this research do not excel. For one company, this was clearly related to the lack of resources:

> *"We cannot have everyone participate in the inter-departmental meetings because our salespeople are spread around the country and it is very expensive to bring them together."*

Market intelligence not only gets disseminated within the boundaries of an individual firm but also within a network of firms:

> *"I* [company CEO] *was just selected to sit on the board of a publicly traded company in the field of drug delivery. And this new board got together for an informal dinner a couple of nights ago. I definitely got insights from other board members on what is going on in the field. "*

When firms are collaborating and, for example, developing or offering complementary products to the same markets, they share market intelligence over company borders. The dissemination of this intelligence takes place even more through informal than formal channels. In addition to informal social contacts, industry associations and attending industry seminars and fairs provide the "infrastructure" for intelligence dissemination over company borders. However, this dissemination is not without constraints:

> *"This* [meeting with other firms for the purpose of sharing market intelligence] *is limited by legal issues in the US. R&D people get together more often with people from other organizations."*

Responsiveness. Because of the long time scales typical of biotechnology R&D, a reactive approach to competitors' actions is rather impossible. If a drug discovery company has proceeded to preclinical or clinical trials with an interesting new therapy, there is actually no possibility for other firms to respond to this with a similar action. At this stage there are already numerous patents and probably years of scientific work behind the new therapy, and rapid, reactive responses are impossible.

Also, the responsiveness in terms of product changes is impeded by regulations from institutions like the Food and Drug Administration (FDA) in the US. Even minimal changes in medical products sold to patients have to be approved by the FDA in order to ensure product safety. Hence, because of the nature of the technology and institutions governing the field, companies' possibilities to be responsive to market intelligence are very limited.

Together with the literature review presented in previous chapters, the preliminary empirical study depicts biotechnology - a representative market for technology – as a challenging field, where companies originally founded for technology development mature towards a proactive market orientation over time. Exchange in general, and especially business-to-business exchange, has become increasingly relational (Day 1995; Grönroos 1990a, 1990b; Gummesson 1994; Webster 1992). This, together with the networked nature of biotechnology firms, would suggest that markets for technologies are just another setting for relational marketing. However, as the points listed below in Table 4 indicate, markets for technologies are not necessarily synonymous with relationship marketing. Firms in markets for technology often end up in simultaneous collaborative, competitive and market exchange relationships with each other. However, the driving force behind this development is not necessarily establishment of a long-term customer relationship but visioning and developing usage for novel technological solutions.

Table 4: Marketing in markets for technology in comparison with traditional and relational marketing paradigms

	Traditional marketing	**Marketing in markets for technologies**	**Relationship marketing**
Customer orientation	Customer satisfaction studies, incremental improvements based on customer feedback	Mutual matching of science-driven technology / ideas and customer's technological needs and absorptive capacity	Integrating customers with product / service development
Marketing communication	Communicating value of product / service to potential customer segments	Proactive search for problems (i.e. customers) for a solution (i.e. idea / technology)	Communicating value of a long-term business relationship for customer's operations
Competitor orientation	Responding to competitors' actions, anticipating competition	Working with competitors to establish a market and increase customers' awareness	Networks of companies competing against other networks
Inter-functional coordination	Marketing / sales department collects customer inputs that are disseminated on all levels of a firm	Idea generation, development and business development take place in multiple organizations; inter-firm coordination	Customers are integrated into seller's processes; marketing, R&D as well as manufacturing interact with customers

Relevant themes for marketing in markets for technologies can be derived from Table 4. Customer orientation in markets for technology is about visioning and finding mutual matching between a marketer's technology and a customer. This emphasizes the role of proactiveness in customer search and market communication in markets for technology; customers will not line up at the supplier's door if they cannot even relate their problems to solutions offered by the supplier (Sandberg 2005). Proactiveness in visioning customers' needs can be achieved through listening to potential customers themselves, but also by listening to the other players and stakeholders in the markets. The fact that markets for technologies often have to be created emphasizes the importance of collaborating with other companies aiming at the same markets.

The next chapter summarizes the key findings of the preliminary empirical study together with conclusions from the literature review. This integration will serve as a basis for the formulation of hypotheses that will be tested in a larger sample of firms in markets for technology. Even though the preliminary empirical study reported in this chapter resulted in some interesting insights, these findings are not generalizable to any larger population of companies. Also, the preliminary interviews did not address the performance implications of market orientation at all. These are some of the deficiencies of the research thus far that will be improved upon in the chapters that follow. In line with the mixed methods model adapted in the research, subsequent analyses will also employ quantitative methods, even if this chapter only presented qualitative data and analysis.

6 SUMMARY OF THE THEORETICAL BACKGROUND AND PRELIMINARY STUDY: RESEARCH HYPOTHESES

The purpose of this chapter is to summarize and bring together the findings of the literature review presented in Chapters 2 through 4 and the insights from the preliminary empirical study (Chapter 5). These summaries provide the basis for the research hypotheses developed in this chapter.

Through a triangulation of different theoretical approaches, the literature review presented in previous chapters has shown that market orientation is a complex phenomenon that has important implications for various aspects of a firm's performance. As described in Chapter 3, the starting point of my analysis of market orientation in markets for technologies is the behavioral market orientation of a firm in a form presented in the extant literature. Hence the three components of market orientation are market intelligence generation, dissemination and responsiveness. By now, however, it is clear that given the empirical setting of markets for technology, market intelligence generation stands out in importance compared with intelligence dissemination or responsiveness to it.

As the previous chapters show, it is the intelligence generation that is the bottleneck for development of market orientation in small firms in markets for technology. Both the existing literature as well as the preliminary empirical study suggests that in addition to in-house market research, young technology ventures access market knowledge through managers' social networks as well as through partnering firms. Also, the role of proactive actions in markets for technology and, hence, the role of market knowledge that anticipates the future state of markets is emphasized. Even though rapid growth can cause challenges for intelligence dissemination, small, entrepreneurial firms in general are doing a far better job in intelligence dissemination than the larger firms (Pelham 2000; Verhees & Meulenberg 2004), where departmental boundaries and established structures prevent intelligence dissemination (Felton 1959). Small firms are more flexible than larger companies, and they can also quickly adapt to the changing needs of customers (Pelham 2000, Verhees and Meulenberg 2004).

In the responsiveness dimension, SMEs sometimes even overperform; efficiency and long-term independence are sacrificed at times when a small firm adapts its processes and output to the needs of a limited number of larger, demanding customers. In the highly regulated medical biotechnology markets, changes in end products are not such a common phenomenon because the new product formats have to pass the relevant regulations before they can be marketed.

Because of the relative importance of market intelligence generation compared with dissemination and responsiveness, the following hypotheses and the empirical study focus somewhat more on the generation of market intelligence, i.e. market knowledge, than on the two other aspects (dissemination and responsiveness) of market orientation.

As illustrated in the literature review in the previous chapters, market orientation has at times been contrasted with technological orientation and radical innovativeness. However, when taken together, the literature from the technology management, entrepreneurship and marketing domains seems to suggest that technological capabilities, market orientation, and innovative and proactive culture can all complement each other in a firm en route to financial success. There is no reason to believe that "100 per cent" of any one firm needs to be divided between market orientation, technological capabilities, proactive culture, and so forth. Rather, a firm can simultaneously have a high level of market orientation and extraordinary technological capabilities as well as a highly innovative and proactive managerial approach. Each of these aspects - let us call them resources - can contribute to the superior performance of the firm.

In the following I present two sets of hypotheses for empirical testing. At this deductive stage of the research, these hypotheses are based on the literature review as well as the results of the qualitative preliminary study. The first set of hypotheses is related to the components of market orientation and the second set of hypotheses is concerned with the performance implications of market orientation. In line with the preceding literature review, market orientation is not treated as the only potential contributor to a firm's superior performance. In addition to market orientation, hypotheses are formulated concerning the technological capabilities' as well as the entrepreneurial orientation's positive effects on firm performance. However, this does not mean that the focus of the research is shifting away from market orientation to other strategic orientations of a firm. *Technological capabilities and entrepreneurial orientation are included in order to show their contribution to firm performance in comparison with market orientation*. A rich understanding of the market orientation's role behind firm performance requires that we also understand the relative contributions of other sources of competitive advantage.

6.1 Components of behavioral market orientation in markets for technology

Both the extant literature and evidence from the preliminary study suggest that technology firms evolve from the beginnings of technological focus towards increasing market orientation as they approach the commercialization of technology. Researchers have long been interested in how and why organizations change over their life cycles of birth, growth, maturation and death. According to Kazanjian (1988), during the very early stages of development virtually all ventures go through a period during which the primary focus of the entrepreneur and others is on the invention and development of a product or a technology (technology and product focus). Over the organizational life cycle (Kimberly 1980), technology-based firms have been found to evolve toward market orientation with less emphasis on engineering (Roberts 1990; see also Kazanjian 1988). Influenced by Schumpeter (1934), Gartner (1989) makes a distinction between an entrepreneur and a normal (small) firm manager: entrepreneurship is a behavior tied to the creation of new organizations. Thus, entrepreneurship is a behavioral concept and "these behaviors cease once organization creation is over" (Gartner 1989, 62).

As described in Chapter 4.2.4, a firm has to find a balance between wide focus, specialization, experimentation and efficiency. Berry (1996) and Berry & Taggart (1998) suggest that a technology firm develops from initial beginnings that are based on technological specialization towards a wider focus and exploration of market knowledge. However, as illustrated by the findings of the preliminary empirical study, in markets for technology firms often evolve from a wide focus to specialization and exploitation.

Empirical study of these development patterns that shift between market and technology orientation as well as exploration and exploitation would require longitudinal data; following technology firms over time and investigating their changing strategic orientations. Unfortunately, the main empirical study conducted for this research will only be based on cross-sectional data. Hence hypotheses concerning these development paths cannot be tested, but this theoretical observation, supported by insights from the preliminary empirical study, definitely warrants future research.

Another consistent finding from the literature review as well as from the preliminary empirical study is that a firm's formal partners as well as the social network of the key employees have an impact on the market orientation of a firm – an impact that has remained rather undocumented in the extant research. Although market knowledge and learning play a significant role in inter-firm relationships, Johnson et al. (2004, 21) state that scholarly work in this area is limited to some conceptual articles, like those by Lukas et al. (1996) and Mohr & Sengupta (2002).

Especially in dynamic fields like biotechnology, the traditional boundary activities that bridge the company to its environment are supplemented with a host of collaborative ventures (Owen-Smith & Powell 2004). The informational benefits of a firm's participation in a network (Powell 1990) are easily linked with the "market intelligence generation" part of the behavioral market orientation concept, whereas the partnerships' and networks' contribution to intelligence dissemination and responsiveness are not as straightforward. Chapter 4.4.1 extended the logic of absorptive capacity (Cohen and Levinthal 1990), a concept originally developed for technological knowledge and learning, to understanding a firm's market orientation. Essentially, if market-oriented thinking is present at all levels and in all functions of an organization through effective dissemination of market intelligence, all the employees of a firm can absorb market knowledge from the environment – from partnering firms, industry friends, even suppliers. On the level of an industry, analogies were drawn from Levinthal and March (1993); an environment that is "knowledge intensive" in terms of market knowledge may encourage a firm to invest more in market knowledge development. An opposite to this kind of a stimulus is, for example, an environment that lacks market knowledge and only emphasizes scientific achievements.

In line with the logic of absorptive capacity, the first hypothesis links a firm's internal market orientation with its use of stakeholders outside the firm as a source of market intelligence:

H1: Market orientation is positively related to market intelligence from external stakeholders.

The market orientation concept has emerged in the marketing literature, whereas researchers from different disciplines have also been interested in explaining a firm's performance with other kinds of strategic orientations. Within the entrepreneurship literature, entrepreneurial orientation (described in Chapter

4.3) has been the main construct of interest. Covin and Slevin (1989) have developed a scale for the measurement of the three components of entrepreneurial orientation, namely innovativeness, proactiveness and risk taking. At one extreme, this entrepreneurial orientation has been represented as a complete opposite to market orientation; traditional market orientation has been described as an adaptive capability by which firms react or respond to conditions in the market environment, whereas entrepreneurial orientation, by contrast, is an environmental management capability by which firms embark on proactive initiatives to change the competitive landscape (Atuahene-Gima and Ko 2001, 57). Atuahene-Gima and Ko (2001, 56) explicitly state that entrepreneurial orientation is “akin to technological orientation because it increases the firm’s ability and will to acquire new technical knowledge to build new technical solutions to meet new and latent needs of users”. This technological orientation “refers to a firm’s value system that promotes technology in new products at the expense of customer news or market orientation” (Atuahene-Gima and Evangelista 2000, 1275). Hypothesis one predicted that market-oriented firms also source market intelligence from their stakeholders. The second hypothesis predicts that an alternative strategic orientation, namely entrepreneurial orientation, is positively related to a firm’s technological capabilities:

H2: Entrepreneurial orientation is positively related to technological capability.

Overall, tests of hypotheses one and two help in establishing the construct validity of market orientation as well as entrepreneurial orientation. Also, if entrepreneurial orientation really is a construct completely separate from market orientation, there should be no correlation between the two orientations (or the correlation should be negative).

Since tests of stakeholders’ contributions to a firm’s market knowledge are scarce in the existing literature, the final hypothesis concerning the components of a firm’s market orientation relates to the importance of various stakeholders as a source of market knowledge. One benefit associated with collaborating in the domain of new product development is access to markets (Perks 2000). Improved access to markets often means collaboration with partners that are downstream, i.e. closer to the markets, in an industry where R&D, production and distribution take place in vertically aligned firms. Even though access to markets, as well as access to knowledge and information, are often mentioned as benefits of inter-firm collaboration (Von Hippel 1988; Dyer & Singh 1998; Yli-Renko, Autio & Sapienza 2001), only a limited number of studies have assessed the implications of inter-firm linkages on the market knowledge base of the collaborating firms. In addition, even though the use of networks to access external resources has been identified as a distinguishing factor between fast- and slow-growth entrepreneurial firms (Jarillo 1989), the mechanisms through which positive growth implications are achieved are not known (Wilson & Appiah-Kubi, 2002).

The interviews in the preliminary empirical study clearly showed that the interviewees considered various kinds of stakeholders (industry friends, licensors, marketing partners, technology partners, even suppliers) an important source of market knowledge. However, to some extent, dissemination of market knowledge within a network of firms is limited by legal constraints. Wilson & Appiah-Kubi (2002, 46) have suggested that, especially in a rapidly changing business environment, competing firms may be the best source of up-to-date information on markets, but in light of the preliminary interviews I conducted, this view may be too optimistic.

Chapter 4.4.2 showed how, in light of the existing literature, in a channel partnership where the downstream firm is the leader there are reasons to believe that this company has superior market knowledge that can be transferred to its upstream partner (Hernández-Espallardo & Arcas-Lario 2003). This view can also be extended to the context of this research. A large pharmaceutical company with established distribution channels and marketing procedures is a downstream partner compared with its smaller technology partner firms. The larger firm is likely to have routines for data collection from markets and consumers, as well as other stakeholders such as regulatory authorities. Just like the "leader" company described by Hernández-Espallardo & Arcas-Lario (2003), an established pharmaceutical firm is specialized in the marketing of the products; it has a better knowledge of the market demands and detects changes in market conditions faster and more accurately than its upstream partner, i.e. a small technology-based firm.

In addition to superior access to customer data, a large downstream firm also has a broader perspective on all the commercialization processes and the activities carried out by competitive networks. Also, a downstream partner in a channel relationship often has a broader portfolio of products and relationships, which allows this firm to accumulate knowledge and experiences that can be translated to different situations and relationships. Based on the existing literature as well as the preliminary empirical study, hypothesis three expects that firms further down in the industry value chain are more important sources of market knowledge for a small technology firm than firms positioned far away from the end users:

H3: A stakeholder's position further down in the industry value chain is positively related to market intelligence from that stakeholder.

Clearly, market intelligence generation is only one part of a firm's market orientation. However, as mentioned above, in the context of young, small firms in markets for technology it is maybe the most critical part of market orientation. It is also the part where the outside stakeholders' contribution is observable.

6.2 Performance implications of market orientation

The impact of market orientation on a firm's performance has been discussed throughout Chapter 3, especially in 3.3. The popular notion has been that a proper execution of market orientation brings about superior performance. A comprehensive review of research that has looked at the market orientation-performance relationship is provided in the meta-analysis of Rodriguez Cano et al. (2004). Their findings reveal that the degree of market orientation of a firm explains about 12% of the variance in business performance (Rodriguez Cano et al. 2004).

However, Deshpandé et al. (1993) suggest that the most important manifestation of market orientation may be the success of innovations en route to the success of an organization. Because of the multifaceted nature of the market orientation-performance relationship, it is important to assess the impact of market orientation on multiple performance indicators. In this study the chosen indicators are innovativeness, capital invested in the firm, subjective performance assessment of the manager and sales.

Innovativeness. Innovation is becoming increasingly important as a means of survival, not just growth, in the face of intensifying competition and environmental uncertainty (Gronhaug & Kaufmann 1988). For firms in markets for technology, innovativeness is the only path to survival and growth. Deshpandé et al. (1993) speculate on a causal relationship of market orientation and innovation, and Han, Kim, and Srivastava (1998) provide empirical evidence for the cultural market orientation-innovation link: They find that customer orientation is highly significant for organizational innovativeness, even though competitor orientation and interfunctional coordination do not approach a level of significance. Using the Narver & Slater measurement of market orientation, Lukas and Ferrell (2000) show that a greater emphasis on customer orientation increases the introduction of new-to-the-world products and reduces the number of me-too products launched by a firm. The Narver & Slater measurement was also employed by Mavondo, Chimhanzi, and Stewart (2005), who discovered that market orientation is positively related to process innovation and product innovation, as well as administrative innovation. Their examination of effect sizes showed that market orientation is the more proximate and stronger predictor of innovation than learning orientation.

Strictly speaking, innovativeness is not a traditional performance (outcome) measure; rather, innovativeness further contributes to superior financial performance. Nevertheless, this relationship takes time to develop, and because of the cross-sectional nature of the empirical study I choose not to hypothesize on the contribution of innovativeness to financial performance. This link from innovativeness to superior performance has been well established in the existing literature, as proven by the meta-analysis by Bausch and Rosenbusch (2005). They conduct a meta-analysis of 60 published (peer-reviewed) studies over the past 15 years that have looked into the relationship between innovativeness and firm performance in over 18,000 firms. Researchers have employed accounting-based, growth-oriented, capital-market-based, and subjective measures to assess performance, and Bausch and Rosenbusch (2005) show that the overall effect size is small (r=0.14) but significant (at 95 % confidence interval). However, the effect size for studies using biotechnology firms as an empirical field is higher, namely 0.36. Consequently, innovativeness can be expected to make a difference for a firm's performance in biotechnology.

Capital. Small, young firms in markets for technology, and, more specifically, in biotechnology, are dependent on external investors' money until they break even. Because of the long development timescales, high R&D costs and regulatory issues typical in biotechnology, this break-even point typically comes many years after the start-up of the firm. External investors, like venture capitalists and business angels, encounter information asymmetry problems when evaluating biotechnology start-ups as investment opportunities. Venture capitalists and business angels invest for capital gain and they share in the success of the businesses that they invest in. Accordingly, these investors are expected to place emphasis on the capability of the management team, the product/service and the market when making their funding decisions (Mason & Stark 2004; Shepherd & Zacharakis 1999).

As a characteristic of a firm and its management, a firm's market orientation should have a positive effect on external investors' willingness to invest in the firm. A consistent finding from previous research is that venture capitalists and business angels place importance on the abilities and characteristic of firm management when making investment decisions (Shepherd & Zacharakis 1999; Muzyka, Birley and Leleux, 1996). Additional criteria in investment decision making include product characteristics (proprietary features, competitive advantage, potential to achieve strong market position), market characteristics (size, growth, limited competition) and returns (potential for high returns, clear exit opportunity) (Mason & Stark 2004; Fried & Hisrich 1994 ; Sweeting 1991). A market-oriented firm should be knowledgeable of its market characteristics, and good communication of positive market characteristics should have a positive effect on investors' willingness to invest in the firm.

Subjective performance assessment. Previous studies offer results that suggest a positive relation between market orientation and managers' perceptions of overall firm performance (Jaworski & Kohli 1993), managers' perceptions of financial performance (Pelham & Wilson 1996), managers' perceptions of sales growth (Slater & Narver 1994) and managers' perceptions of new product performance (Atuahene-Gima 1996 ; Pelham & Wilson 1996; Slater & Narver 1994).

Sales. Finally, for those firms who are already selling their products, market orientation is expected to lead to superior sales. Sales turnover is a revenue-based measurement of organizational performance that does not account for the costs of implementing a strategy.

H4a: Market orientation is positively associated with innovativeness.
H4b: Market orientation is positively associated with capital invested in the firm.
H4c: Market orientation is positively associated with a manager's perceived performance of the firm.
H4d: Market orientation is positively associated with sales.

Veldhuizen, Hultink, and Griffin (2004) find that the acquisition of customer information in a high-technology context is directly - that is, without disseminating or using information in new product development processes - associated with product advantage. Veldhuizen et al. (2004) hypothesize that this could be due to intuitive (rather than formal) use of market information in the development of innovative products. Since market intelligence generation from external stakeholders is closely related to the construct of a firm's internal market orientation, I expect that the same positive performance implications that exist for market orientation are also true for the market intelligence generation from external stakeholders.

H5a: Market intelligence from external stakeholders is positively associated with innovativeness.
H5b: Market intelligence from external stakeholders is positively associated with capital invested in the firm.
H5c: Market intelligence from external stakeholders is positively associated with a manager's perceived performance of the firm.
H5d: Market intelligence from external stakeholders is positively associated with sales.

Before the introduction of the current market orientation concept, authors were already arguing that the adoption of the marketing concept could also inhibit firms from developing truly breakthrough innovations (Kohli and Jaworski 1990). Atuahene- Gima (1996) even found that market orientation had a negative effect on product newness. Even though market orientation in traditional markets has mostly been linked to innovativeness, innovations in markets for technology are often disruptive and science-driven with minimal customer input to the development process. A firm's technological capability is a major component of its knowledge base. The resource-based view of a firm, the dynamic capabilities approach, and the knowledge-based view all either explicitly state or imply that a firm's technological capability can be a source of competitive advantage and above-normal performance (Coombs & Bierly, 2001).

Hult and Ketchen (2001) suggest that the linkage between market orientation and financial performance is not linear but rather embedded within a more complex web of relationships. Market orientation, entrepreneurship, innovativeness and organizational learning all contribute to positional advantage, which has a positive effect on financial performance indicators (Hult & Ketchen 2001).

In addition to market-related criteria, additional criteria in investors' decision making include product characteristics like proprietary features, competitive advantage and potential to achieve strong market position (Mason & Stark 2004; Fried & Hisrich 1994; Sweeting 1991). In the context of this study, product characteristics are assessed more broadly because many firms included in the empirical study do not sell physical products. Thus the "technological capability" variable replaces "product characteristics". Indicators of a superior technological capability, like patents and a firm's extensive investments in research and development, should increase investors' willingness to invest in the firm.

In order to assess the magnitude of market orientation's effects on innovativeness, capital invested, subjective performance assessment and sales, we should also know the relative magnitude of the effects of other strategic orientations. All small, young R&D-intensive firms in markets for technology can be expected to possess technological capabilities and have entrepreneurial features (innovativeness, proactiveness, risk taking). However, the level of these skills and traits is likely to vary from one firm to another, and the more entrepreneurially and technologically oriented the firm, the better its performance can be expected to be (e.g., Wiklund, 1999; Zahra, 1991; Zahra and Covin, 1995; Wiklund and Shepherd 2005).

The approach in this research is that market and entrepreneurship orientation are synergistic; they both positively affect innovation activities as well as performance. Such an approach is also supported by the conclusions of Atuahene-Gima and Ko (2001). By definition, firms in a market for technology possess a technological orientation; they are strongly R&D oriented and proactive in acquiring new technologies, and they use sophisticated technologies in the development of new products (Cooper 1985). The kind of "either-or" approach explicitly or implicitly adopted in some studies would seem to suggest that because these firms are technologically oriented, they cannot be highly market oriented at the same time. However, this is definitely not the prediction made in this study. Instead, I suggest that high levels of technological (i.e. entrepreneurial) orientation, market orientation and technological capabilities can co-exist in an organization and all, simultaneously, contribute to superior innovations and performance. However, the right way to assess this simultaneous existence of market orientation and entrepreneurial or technological orientation is to measure each construct independently rather than adapting the Berthon et al. (2004) approach and forcing managers to reflect both the level of entrepreneurial and market orientation of a firm in a single answer.

H6a: Technological capability is positively associated with innovativeness.
H6b: Technological capability is positively associated with capital invested in the firm.
H6c: Technological capability is positively associated with a manager's perceived performance of the firm.
H6d: Technological capability is positively associated with sales.
H7a: Entrepreneurial orientation is positively associated with innovativeness.
H7b: Entrepreneurial orientation is positively associated with capital invested in the firm.

H7c: Entrepreneurial orientation is positively associated with a manager's perceived performance of the firm.
H7d: Entrepreneurial orientation is positively associated with sales.

Table 5 summarizes the hypotheses formulated as well as their background in the literature and in the results of the preliminary empirical study. The hypothesized connections between various concepts are then illustrated in Figure 16.

The preliminary study focused on market orientation in the firms; consequently, hypothesis number two is only based on the existing literature.

Table 5: Research questions and related theories, preliminary study findings and hypotheses.

Research Qs	Theories (Chapters)	Preliminary study findings	Hypothesis
What are the components of behavioral market orientation in markets for technology?	Absorptive capacity and market orientation (4.4.1.)	Firms source market intelligence through their own efforts and from their network.	H1: Market orientation is positively related to market intelligence from external stakeholders.
	Proactiveness and technological orientation (4.3.)		H2: Entrepreneurial orientation is positively related to technological capability.
	Firm's networks and market orientation (4.4. especially 4.4.2)	Joint marketing committees with incumbents as a source of market intelligence for small biotechs.	H3: A stakeholder's position further down in the industry value chain is positively related to market intelligence from that stakeholder.
What are the performance implications of market orientation in markets for technology?	Market orientation and firm performance (3.3.)	Both technological superiority and understanding of markets are important for a firm's success.	H4: Market orientation is positively associated with (a) innovativeness, (b) capital invested in the firm, (c) manager's perceived performance of a firm, and (d) sales.
	The positive effects of market intelligence established in the NPD literature (4.2.2.)		H5: Market intelligence from external stakeholders is positively associated with (a) innovativeness, (b) capital invested in the firm, (c) manager's perceived performance of a firm, and (d) sales.
	Proactive technology development as a basis for success in markets for technology (4.2.4. & 4.3.)		H6: Technological capability is positively associated with (a) innovativeness, (b) capital invested in the firm, (c) manager's perceived performance of a firm, and (d) sales.
	Positive performance effects of entrepreneurial orientation (4.3.)		H7: Entrepreneurial orientation is positively associated with (a) innovativeness, (b) capital invested in the firm, (c) manager's perceived performance of a firm, and (d) sales.

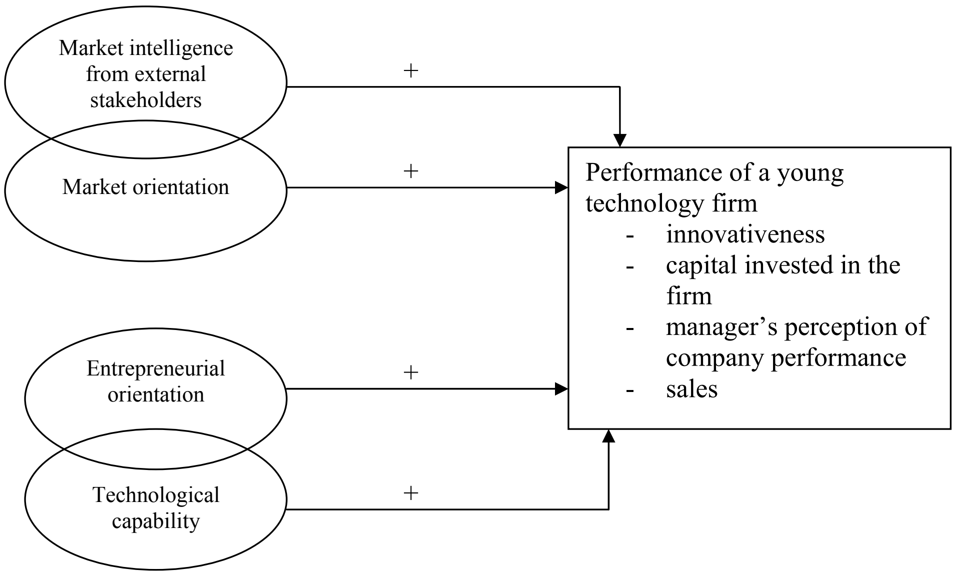

Figure 16: A priori conceptual framework of the main empirical study

In addition to providing the background for the research hypotheses formulated above, the literature review and the preliminary empirical study give ideas for the measurement of behavioral market orientation in markets for technology. These measurement issues are discussed next.

6.3 Measuring behavioral market orientation in markets for technology

Market orientation in this study is approached as a behavioral phenomenon, comprising market intelligence generation, dissemination and responsiveness. The MARKOR scale, derived from Kohli and Jaworski's (1990) definition of a market orientation, focuses on these three specific behaviors as a basis of measurement. Hence MARKOR is a logical basis for the measurement of market orientation in this study. Kohli and Jaworski's construct appears to be capable of tapping into the firm's specific behavioral approach to critical aspects of the market - competition, customers, laws and regulations, and societal and macro-economic forces. However, the original MARKOR scale only represents a limited number of stakeholder domains; it only captures customers and competitors as focal domains for understanding the market environment and does not explicitly address how other market factors suggested in the literature (e.g., legal and regulatory environment, macroeconomic environment) may influence competition and customers (Matsuno, Mentzer & Rentz 2000; Kohli et al. 1993).

Given the emphasis that the interviewees in the preliminary study placed on these kinds of “alternative” markets as well as alternative sources of market knowledge, the MARKOR scale will have to be adapted for the main empirical study in order to capture market orientation in biotechnology. This adaptation will be described in detail in the following chapter as part of the measurement descriptions. However, since the insights concerning the measurement of market orientation have emerged from the preliminary empirical study and the literature review, I will list these insights in the following. This list partially complements and partially substitutes for the components identified as critical for behavioral market orientation in the past (Jaworski & Kohli 1993; Kohli et al. 1993; Matsuno et al. 2000).

These issues emerged from the preliminary study as well as the literature review presented earlier in this chapter:

- Need to make sense of *multiple stakeholders as potential customers* of a firm. For example, as described in Chapter 5, in addition to end-users (patients), purchase decisions in the medical markets are determined by medical doctors and third-party payers.
- Collecting industry information and market data by *informal* means is an issue that was emphasized by the interviewees in the preliminary study. Also, the social capital literature suggests that social, informal contacts of firms’ key employees serve many roles, one of which is access to information.
- Meetings with *other companies and insightful individuals* to discuss market trends. This is an insight suggested in the literature and partly supported in the preliminary interviews, even though meetings and discussions with competing firms are limited by legal issues.
- *No departmental boundaries* in small firms. Many of the items in the original MARKOR scale that measure intelligence dissemination focus on how the knowledge crosses a firm’s departmental boundaries. In a small firm context, these issues are not relevant, and the scale will have to be adapted accordingly.
- Interaction with *regulators* and legislators to influence industry standards. Based on the literature and interviews, it is clear that medical biotechnology is a highly regulated field. As suggested by Matsuno et al. (2000), institutions that regulate industry conduct are a key component of the macro-market of a firm. In a medical context these institutions should be taken into account when measuring market orientation.

- Safety issues and regulations effectively *limit companies' possibilities to modify* existing products or products in development. This is a key issue that emerged from the preliminary interviews concerning the responsiveness dimension of market orientation. Many items that measure responsiveness in the original MARKOR scale assume that modifying products or services based on customers' wishes is a way to respond to market intelligence. However, because of the regulatory environment, such modifications are often impossible in medical markets. Also, long timescales and patent protection in product development *limit the possibilities for reactive actions* based on competitors' moves.
- Need to *educate* customers in the use of products. Because of the complex nature of many products in the medical biotechnology markets, companies have to invest in educating customers in their use. This is an aspect completely ignored in the original MARKOR scale, but extremely important for the market orientation of technology firms.

The above list will help in adapting the widely used MARKOR scale in the empirical study that is reported in the following chapters. Chapter 7 will describe the conducting of the main empirical study to test the hypotheses presented above. Chapter 7 also includes a detailed description of the measurement development.

7 MAIN EMPIRICAL STUDY

"We uncover all kinds of relationships in our data, but it is only through the use of [...] soft data that we are able to explain them."

-Mintzberg 1979, 587.

In a pragmatic approach to empirical research, like that adopted in this research, empirical reality is seen as an ongoing interpretation of meaning produced by individuals engaged in a common project of observation. According to the pragmatic view, an important part of scientific "truth" is the emerging consensus within a community of observers as they make sense of what they have observed (Suddaby 2006[21]). Within the field of marketing there is definitely an "emerging consensus" on the nature and effects of a firm's market orientation (See discussion in Chapter 3). Given this consensus, as well as the related empirical developments in other streams of literature described in Chapter 4, the new theory development achieved in this research should be based on this existing scientific body of knowledge.

The research approach adapted in the preliminary study (Chapter 5) is inductive; since the context of markets for technology is a novel area for the study of market orientation, few existing models of market orientation can be used to describe, understand and explain the phenomenon of market orientation in a market for technology. In line with the inductive approach, Chapter 5 and the preliminary study reported there describe an organic process of theory emergence based on how well the empirical data fit the conceptual categories identified in the existing literature and how relevant the categories are to market orientation (see Glaser and Strauss 1967). The approach in the preliminary study has been a qualitative one, not one geared towards testing existing hypotheses (either overtly or unconsciously). Even if novel insights to market orientation were gained in the preliminary study, basing the whole research on induction is not a feasible approach given the research questions. This is why the existing literature as well as the preliminary study results have been summarized in Chapter 6 to develop empirically testable hypotheses. Qualitative data cannot be used to test hypotheses about reality, even if it is appropriate for making statements about how actors interpret reality (Suddaby 2006). Hence a quantitative hypothesis testing approach is applied in the main empirical study. The purpose of this chapter is to describe the research

[21] Suddaby (2006) interprets the views of the early pragmatist Charles Saunders Peirce (1839-1914).

instrument and procedures applied for empirical testing of the hypotheses. Towards the end of the chapter I will also discuss the quality of the empirical study focusing on validity and reliability.

Looking back to the two research questions that were presented in Chapter 2, the data collected in the main empirical study is analyzed to answer both research questions. Qualitative data from the interviews is analyzed to understand the components of behavioral market orientation in markets for technology. Quantitative measurements are applied to examine the performance implications of market orientation in markets for technology. *Mixing both qualitative and quantitative methods* in the same empirical study allows both an *inductive* research approach needed to *understand* and *categorize* phenomenon, and a *deductive* approach (hypothesis testing) needed to *explain* the relationship between market orientation and a firm's performance. Even though such mixing of methods may be confusing to a reader that denies either a realist or an "interpretivist" ontology, this mixing of methods has the advantage of providing data rich enough for understanding and categorization, and structured enough for hypothesis testing. As discussed in Chapter 2, in line with a pragmatist approach, the researcher has a key role in judging how to answer research questions. The tools - methods - available are not limited to quantitative or qualitative, as is often the case for researchers with strictly subjectivist – relativistic or objectivist – rationalistic worldviews.

7.1 Instrument design

The challenge in instrument design for concepts such as market orientation and entrepreneurial orientation is in finding the items that are clearly related to the domain construct but at the same time discriminate between the construct we want to measure and other related but unequal constructs. Various instruments have been successfully employed in the existing literature to capture the market orientation of an organization. Since markets for technology are a novel environment for the study of market orientation, ideally we would first develop, refine and test a market orientation instrument in markets for technology in a sample of firms. However, I have not had the resources to collect data from a separate sample for scale development. Hence, for the measurement of market orientation, I adapt a widely used scale based on the insights gained from the preliminary study and literature review of markets for technology. Table 6 summarizes all the measurements used in hypothesis testing in this study.

Table 6: Constructs and measurements in the main empirical study

Research Qs	**Hypothesis**	**Constructs / Measurements**
What are the components of behavioral market orientation in markets for technology?	H1: Market orientation is positively related to market intelligence from external stakeholders.	- Market orientation /Adapted MARKOR, 5-point Likert scale - Market intelligence from external stakeholders / Contribution of 12 stakeholder groups to market intelligence, items adapted from Hernández-Espallardo and Arcas-Lario (2003), 5-point Likert scale.
	H2: Entrepreneurial orientation is positively related to technological capability.	- Entrepreneurial orientation / Entrepreneurial orientation measurement based on Knight (1997) and Covin and Slevin's (1989), 5-point Likert scale. - Technological capability / Number of patents, R&D intensity (%).
	H3: A stakeholder's position further down in the industry value chain is positively related to market intelligence from that stakeholder.	- Position in the value chain / Stakeholders' value chain positions based on biotechnology industry literature review. - Market intelligence from external stakeholders / Contribution of 12 stakeholder groups to market intelligence, items adapted from Hernández-Espallardo and Arcas-Lario (2003), 5-point Likert scale.

Research Qs	**Hypothesis**	**Constructs / Measurements**
What are the performance implications of market orientation in markets for technology?	H4: Market orientation is positively associated with (a) innovativeness, (b) capital invested in the firm, (c) manager's perceived performance of a firm, and (d) sales.	- Market orientation, stakeholders' contribution, entrepreneurial orientation, and technological capability, see above. - Innovativeness / Three-item scale that measures product innovativeness. All items continuous. - Capital invested in the firm / Total amount of capital invested in the firm by the time of the interview (self-reported by the interviewee) divided by the age of the firm. - Manager's perceived performance of a firm / 7-item scale of interviewees' grading of their firm's performance in comparison with competitors, 5-point Likert scale. - Sales. Total firm's sales (continuous item) self-reported by the interviewee for 2002.
	H5: Market intelligence from external stakeholders is positively associated with (a) innovativeness, (b) capital invested in the firm, (c) manager's perceived performance of a firm, and (d) sales.	
	H6: Technological capability is positively associated with (a) innovativeness, (b) capital invested in the firm, (c) manager's perceived performance of a firm, and (d) sales.	
	H7: Entrepreneurial orientation is positively associated with (a) innovativeness, (b) capital invested in the firm, (c) manager's perceived performance of a firm, and (d) sales.	

7.1.1 Operationalization of independent variables

Instead of single-item measurements, methodologists advocate the use of multiple-item measurements. Single-item measurements are popular because they are quick and easy to administer to large samples, but single-item measurements cannot provide reliable measurements of relatively complex constructs. They do not allow for the estimation of the psychometrically important internal-consistency reliability of the measurement. Thus multiple-item measurements have been the norm for over 50 years (Shadish, Cook & Campbell 2002; Loo 2002). In this study, (1) market orientation, (2) stakeholders' contribution to market knowledge, (3) entrepreneurial orientation, (4) innovativeness, and (5) respondent's subjective assessment of a firm's performance are measured by multi-item scales as described in the following. Technological capability is captured through the use of two single-item measurements. Sales as well as capital invested in the firm are measured with single items. All of these measurements are described in detail in the following.

7.1.1.1 Market orientation.

Measurement development. Since there is no separate scale development sample available, the measurement of market orientation in this study has to rely on the scales used in the existing literature. Two of the most extensively used measurements of market orientation are the "MARKOR" scale developed by Kohli, Jaworski and Kumar (1993), and the "MKTOR" scale developed by Narver and Slater (1990) (Ngai & Ellis 1998). Both scales are theoretically consistent, but MKTOR tends to outperform MARKOR in explaining variance in business performance (Oczkowski & Farrell 1998). One reason for this, according to Rodriguez Cano et al. (2004), is the lower reliability of MARKOR compared with MKTOR. This lower reliability may underestimate the true relationship between market orientation and business performance (Oczkowski & Farrell 1998). In the studies included in the meta-analysis of Rodriguez Cano et al. (2004), the weighted average Cronbach's alpha for MARKOR was 0.83, compared with 0.91 for the MKTOR scale. However, Matsuno, Mentzer & Rentz (2005) conducted an empirical study to compare MKTOR and MARKOR scales, and concluded that the reliability of neither scale is high. Matsuno et al. (2005) also argue that from the theoretical domain perspective, the MARKOR scale is superior to MKTOR scale for its consistency with the theory and scale operationalization.

Deshpandé and Farley (1998a) analyze the three most widely used measurements of market orientation (Deshpandé et al., 1993; Jaworski & Kohli 1993; Narver & Slater 1990). They find that all three scales are reliable and valid, generalize well internationally, and are similar in terms of validity measurements and correlations with performance. Deshpandé and Farley (1998a) factor analyzed the 44 items from these three previous scales and synthesized a 10-item market orientation scale (MORTN). The 10 items encompass general behaviors related to understanding customer needs, assessing customer satisfaction and providing superior quality or service. Even though such a scale has intuitive appeal and has been employed in subsequent studies (Narver et al. 2004), its conceptual foundations consist of mixed components from behavioral market orientation on the one hand, and cultural orientation on the other. Even though these two sides of market orientation (cultural / cognition and behavioral) are intertwined, the measurement of them with one scale raises concerns. Undoubtedly, the one-scale approach (Deshpandé & Farley 1998a) assumes one latent construct behind the scale, i.e. market orientation. However, Narver et al. (2004) found that the 10-item MORTN scale was *not* unidimensional (confirmatory factor analysis). Because of concerns about unidimensionality as well as because of my focus on behavioral aspects of market orientation, the MORTN scale will not be used in the empirical part of this study. Instead, I will base the quantitative empirical data collection on the original MARKOR measurement of behavioral market orientation (Kohli et al. 1993).

The MARKOR scale includes items that reflect the behavioral market orientation of a firm, whereas the MKTOR (Narver and Slater 1990) scale is more culturally oriented. In this study I am interested in capturing the behavioral market orientation of a firm. Consequently, I use an extended version of the MARKOR scale to assess the market orientation of the sample firms. The original 32-item MARKOR scale reported in Jaworski and Kohli (1993) has subsequently been developed into the 20-item MARKOR by Kohli et al. (1993). However, the results of Caruana (1999) do not confirm the 20-item MARKOR scale, suggesting particular scale items being more relevant to specific situations (e.g. industries and countries). Also, in the study by Deshpandé and Farley (1998a) the Cronbach's alpha reliability score for the 20-item MARKOR scale is below acceptable (Nunnally 1978), i.e. at 0.51. Because of these severe problems with the 20-item MARKOR, the original 32-item MARKOR scale of Jaworski and Kohli (1993) was the basis of my measurement for market orientation.

Measurement refinement. This 32-item measurement by Kohli and Jaworski (1993) was further developed to reflect the current empirical context, i.e. small biotechnology firms. These 32 items only represent a limited number of stakeholder domains, mostly customers and competitors. They do not explicitly address how other market factors suggested in the literature and preliminary studies (e.g. legal and regulatory environment) may influence competition and customers (Kohli et al. 1993; Matsuno et al. 2000). Consequently, I added items that reflect the regulatory environment to the scale. Based on the preliminary case studies and literature review, the wording of some items in the original scale was changed; instead of departments, in small firms individuals are the relevant unit of analysis in information dissemination. Also, in addition to current markets, the respondents were asked to assess the items from the perspective of potential future markets. After the changes, the final MARKOR scale in my questionnaire included 38 items (Cronbach's alpha .83). The development process is outlined in Appendix 3. (R) in the table denotes a reverse coded item.

To increase the validity of the measurements and, more specifically, to reduce mono-operation bias (Shadish et al. 2002, 75), an alternative operationalization of market orientation was used as a check for validity. In the Kohli et al. (1993) study the questionnaire included a validation scale, where respondents were asked to distribute 100 points between two business units that resembled their organization. Thus, if an organization was primarily like Organization A (market-oriented) and only remotely like Organization B (non-market-oriented), the respondent should allocate more points to Organization A and fewer points to Organization B.

In my questionnaire, business philosophy items (Page 5 of the questionnaire, see Appendix 2)-, used by Harris (2001, 2002) and adapted from Deng and Dart (1994) and Peterson (1989), were used to check the construct validity of the MARKOR scale. These items are supposed to measure the sales, production, customer, stakeholder and technology focus[22] of the organization (for actual items, see questionnaire in Appendix 2). The main characteristics of each orientation from a managerial and customer point of view are listed in Table 7.

[22] Items for production, sales, customer and stakeholder focus were formulated similarly to previous studies, and the item for technology focus was formulated specifically for this study.

Table 7: Orientation towards markets and customers (Hedaa & Ritter 2005, 715)

Orientation	***Customer behavior***	***Managerial focus***
Production	Customers prefer products that are widely available and inexpensive	Production efficiency, low costs, mass distribution
Product	Customers prefer products that have the best feature combination	Superior product features
Sales	Customers buy too little if not motivated	Sales efforts
Marketing	Customers buy solutions to their needs	Understanding customers

Logically, a firm that ranks high on the MARKOR scale is also expected to rank high on customer focus (marketing) on the business philosophy scale (Table 7). The correlations between the MARKOR scale and the validation items are reported below under construct validity.

7.1.1.2 Stakeholders' contribution to market intelligence generation.

Measurement development and refinement. Based on the preliminary case studies and literature review, twelve important stakeholder groups that can contribute to market intelligence generation by young biotechnology firms were identified. These groups are: suppliers of equipment, contract research and manufacturing companies, R&D / technology partners (business entities), universities and other non-profit organizations, licensors, licensees, marketing and distribution partners, business consultants, venture capitalists, governmental (national / state) organizations, industry associations and informal contacts like friends.

Traditional market orientation studies do not typically measure various stakeholders' contribution to a firm's market orientation. For example, the MARKOR scale's intelligence generation items focus almost solely on intelligence that comes straight from the company's customers. The only item in the MARKOR scale that explicitly asks about different stakeholders' contribution to a focal firm's market orientation is "We collect industry information by informal means (e.g. lunch with industry friends)".

Hernández-Espallardo and Arcas-Lario (2003) completed a study on how market orientation is created and nurtured in business relationships. An integrated part of their study is measuring a firm's market orientation improvements attributed to a partnership with another firm. Previously, a similar type of measurement has been used by Kale, Sing and Perlmutter

(2000) to measure learning obtained from a partner in a strategic alliance. In line with Kohli et al.'s (1993) conceptualization of behavioral market orientation, Hernández-Espallardo and Arcas-Lario (2003) have measurements for the three components of intelligence generation, dissemination and responsiveness. A second-order factor analysis demonstrates that the three behavioral dimensions can be modeled with the data as being reflected by a higher-order construct (market orientation).

Because of the good face validity of the intelligence generation items of Hernández-Espallardo and Arcas-Lario (2003), because of the items' alignment with the Kohli et al. (1993) conceptualization of behavioral market orientation, and because of the good statistical validity and reliability established for the measurement (good fit in structural equation modeling) in the original study, I used two intelligence generation items from the Hernández-Espallardo and Arcas-Lario (2003) study to measure stakeholders' contribution to market intelligence generation in my sample firms. On a one to five scale, interviewees were asked to assess each stakeholder groups' contribution along two dimensions, slightly adapted from Hernández-Espallardo and Arcas-Lario (2003): "When you think about the formal relationships your company has to [for example, suppliers of equipment], these relationships have benefited your firm in…(1) knowing more exactly the products that your customers want now and will demand in the future … (2) Rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)". Cronbach's alpha for this scale of 12 times 2, i.e. 24 items, is 0.85. This can be considered good (Nunnally 1978).

Based on these 24 items (12 times two items), stakeholders' *mean contribution* to market intelligence generation was calculated for each firm (mean of the 24 items). To estimate the *total contribution of stakeholders*, this mean was multiplied by the number of stakeholder groups (from one to twelve) that were contributing to a firm's market intelligence generation.

7.1.1.3 Entrepreneurial orientation

Measurement development. The entrepreneurial orientation (EO) measurement used in this survey is based on Knight's (1997) 8-item scale for entrepreneurial orientation. It measures the three components of entrepreneurial orientation, namely innovativeness, proactiveness and risk taking. Knight's (1997) scale, again, is a slightly modified version of Covin and Slevin's (1989) 9-item scale. To be consistent with the MARKOR measurement part of the survey, the EO scale was formulated as a 5-point Likert scale (Knight's scale is a 7-point scale), where the two ends of each question “continuum” present opposites to each other, and higher values stand for more entrepreneurial orientation.

Knight (1997) employs numerous techniques to assess the validity and reliability of the scale for the measurement of entrepreneurial orientation. All in all, Knight (1997) finds that the scale performs well with regard to consistency and pattern of factor structure, internal consistency and convergent, as well as discriminant validity.

Measurement refinement. In this study, one item was added to the Knight (1997) scale: “How many new lines of products or services does your firm have under research and development right now?”, the answers ranging from “1” that represents “no new lines of products or services” and “5” that stands for “very many new lines of products or services”. This addition was necessary since most firms included in the current empirical study did not have any products on the markets at the time of the interview. The reliability measurements are reported item by item in Table 8. As the Table shows, the items in this study behave in a similar way to Knight’s (1997) items: items 6,7,and 8 have high item-to-total correlations, whereas items 1,2,3, and 5 have lower item-to-total correlations.

Table 8: Entrepreneurial orientation scale reliability, item statistics

Item[23]	This study, item-to-total correlation	This study, Alpha if item deleted	Knight (1997)[24], item-to-total correlation	Knight (1997), Alpha if item deleted
1. Product lines	0.065	0.683	0.490	0.826
2. Product changes	0.270	0.615	0.560	0.816
(Product lines under R&D)[25]	0.336	0.597		
3. R&D leadership	0.298	0.607	0.512	0.822
4. New techniques	0.432	0.579	0.585	0.812
5. Competitive posture	0.294	0.607	0.455	0.829
6. Risk-taking proclivity	0.456	0.571	0.629	0.809
7. Environmental boldness	0.363	0.592	0.636	0.805
8. Decision-making style	0.453	0.568	0.666	0.802
Cronbach's alpha	0.631		0.834	
N of cases	85		204	

As shown in Table 8, the 9-item scale for entrepreneurial orientation employed in this study has a Cronbach's alpha of .631. After an analysis of the item-total statistics of the scale, items one and two were dropped from the scale. Item one in particular has a poor item-to-total correlation, which is probably due to the fact that most study firms have either not launched any products on the markets or have only launched a few. After removing the two first items, the resulting 7-item scale has a Cronbach's alpha of .719, and the mean value on this scale is used as a proxy for entrepreneurial orientation in the regression analysis.

Overall, the item-to-total correlations in this study are worse than those reported by Knight (1997). However, as mentioned above, the item-to-total correlation patterns are similar to Knight's (1997) study. The most likely explanation for the lower correlations in this study is the fact that the respondents typically ranked their companies very high on the entrepreneurial orientation items; by definition, most biotechnology startups are taking huge risks and have to be proactive and innovative if they wish to recover their R&D costs one day. The mean value for entrepreneurial orientation in this study is 3.86, which is also the median value for the scale (5-point Likert

[23] For exact items, see questionnaire in Appendix 2

[24] English questionnaire

[25] This item was not in the Knight (1997) scale but was added to the measurement in this study because of the young age of the study firms.

scale). The standard deviation of the scale is 0.608. Knight's (1997) companies come from medium-sized firms in the textiles, clothing, electronic goods and electrical parts industries in Canada. Within this population of firms you are likely to see more variation and also possible co-variation for entrepreneurial orientation items. Unfortunately, Knight (1997) does not report scale means or standard deviations for his items.

The Wiklund and Shepherd (2005) study is used here to compare the level of entrepreneurial orientation of the biotechnology firms included in this sample with the results from other industries. Wiklund and Shepherd (2005) measure entrepreneurial orientation using Miller's (1983) eight items, which also reflect innovativeness, proactiveness and risk taking, like the items in this study. Each item is measured on a 7-point Likert scale, and Wiklund and Shepherd (2005) obtain a mean of 28.93 for the summated scale (standard deviation 6.19). The sample firms of Wiklund and Shepherd (2005) represent Swedish firms in the following sectors: knowledge-intensive manufacturing, labor-intensive manufacturing, professional services and retail. The mean value of the Wiklund and Shepherd (2005) summated EO scale would translate into a mean of 2.58[26] on a five-point scale like the one employed in this study. This value is 1.28 points lower (on a five-point scale) than the sample mean of this study. This indicates that at least compared with the sample firms of Wiklund and Shepherd (2005), the firms in this study exhibit higher levels of entrepreneurial orientation.

7.1.1.4 Technological capability.

Measurement development. Technological capability is mostly an unobservable construct and researchers need to analyze different indicators, which each offer clues about the construct without directly measuring it. Here, technological capability is measured with two items, namely (1) "share of R&D expenses out of total expenses of the firm[27]", and (2) number of patents. Measurements of R&D activity, such as the total amount of R&D spending and R&D spending divided by total sales, have been used as indicators of technological capability in previous research (Coombs & Bierly 2001). Nelson and Winter (1982) suggest that the probability of a firm coming up with an innovation is proportional to the firm's R&D spending. At the same time, R&D is regarded as a highly uncertain activity, and institutional structures supporting innovation are complex and diverse (Nelson & Winter 1977). R&D spending reflects investment in knowledge, rather than knowledge itself, and

[26] [28.93/(7*8)]*5=2.58
[27] The more conventional way is to estimate R&D spending as a share of total sales, but since most sample firms did not have sales at the time of the interview this estimate was not deemed feasible.

is a questionable proxy because knowledge generation is cumulative. Hence patents are used as an additional proxy for technological capability.

Patents are output measurements of technological capability (Coombs & Bierly 2001). Firms, laboratories and individuals can apply for a patent to protect a new technology, to signal technological competence, or "to mark technological territory" (Ramani & De Looze 2002, 321). In biotechnology, most new technology is protected by patents. The protection of technology - prevention of copying by competitors - is the typical reason for patenting innovations, but the positive "signaling" impact of patent applications is also considered to be particularly strong in the biotechnology sectors (Lemarié, DeLooze & Mangematin 2000). Whatever the strategic motivations, a patent can only be granted if it has an industrial use. However, using a firm's number of patents as a proxy for its technological capability is problematic for many reasons (Pavitt 1985). Patents differ greatly in their technical and economic significance, not all types of technological capability can be patented, and patenting strategies - i.e. what to patent, where to patent and how frequently to patent - vary widely between industries and even between firms in the same industry. To overcome these problems, researchers have, for example, measured the quality of the patent by how often others cite it (Coombs & Bierly 2001). Even though R&D spending and patent count are both problematic measurements of technological capability, I believe that using them both should capture the variation in the sample firms' technological capability.

The interviewees were asked to estimate the share of R&D expenses (%) out of the total expenses of their respective firms. They were also asked to provide information on the patent count of the firm. Two interviewees refused to give out this information. Most interviewees were confident in answering the patent questions, but six interviewees were unsure of the actual counts. These interviewees were asked to check the numbers after the interview, and all of them replied later with the patent numbers.

Measurement refinement. The United States Patent and Trademark Office's (USPTO) publicly available database was searched to verify the patent data given by the interviewees. However, many of the sample firms have obtained rights to patents that have not actually been developed by the firms themselves; for example, university spin-offs often have rights to patents developed by university research groups. Thus the USPTO patent search by company names is not likely to catch all the patents the interviewees were referring to when providing patent numbers during the interviews. Still, it is important to check interview data against a more objective source, and even though those patents that are not assimilated with the firm's name are missed in the search, the resulting numbers should still correlate positively with the numbers provided by the interviewees. Comparison of patent data from the interviews with the USPTO patent data (Table 9) reveals that the numbers given by the interviewees are higher. They commonly reported that the same patents have been approved or applied for both in the home country as well as internationally, hence no large differences between "domestic" and "international" patent figures. Table 9 below summarizes the means and medians for patent data.

Table 9: Comparison of patent data from USPTO and interviewees.

	USA-based firms				**Finland and Sweden-based firms**			
	Mean	Median	S.D.	Skewness	Mean	Median	S.D.	Skewness
Data from interviewees:								
Number of domestic patent approvals	7	2	10	1.939	4.7	2	6.5	2.667
Number of international patent approvals	7.7	1	23	5.881	4.7	2	7	2.436
USPTO:								
Patents (approved) under company name, May 31st 2005.	4	0	7.3	2.463	1.46	0	2.5	1.952

As indicated by Table 9, the numbers reported by the interviewees are higher than the numbers obtained from the USPTO. Nevertheless, for the reasons mentioned above, this does not mean that the interviewees were not truthful when answering the questions about patents. Because there are no large differences between numbers reported for domestic and international patents, the correlations between the subjective data and the USPTO data were calculated for the whole sample, not making a difference between US- based and Nordic companies. There is a significant positive correlation between the USPTO patent numbers and the numbers provided by the interviewees. The correlations are listed in Table 10.

Table 10: Comparison of patent data from USPTO and interviewees.

Variables	1	2	3
1. Number of domestic patent approvals	1		
2. Number of international patent approvals	.832***	1	
3. USPTO: patents (approved) under company name, May 31st 2005.	.433***	.299***	1

*** Correlation is significant at the 0.01 level (2-tailed)

Despite the positive correlations between the numbers of patents obtained from the interviewees and from the USPTO, the Wilcoxon Signed-Rank test has a significant p-value ($p < 0.01$) for tests of both domestic and international patents as reported by the interviewees against the USPTO data. This indicates that the distribution of the patent data obtained from the USPTO is different to the patent data provided by the interviewees. This is problematic for the analyses; the USPTO numbers are objective, but, as mentioned earlier, the numbers given by the managers also include patents for which the very company is not listed as "assignee" in the patent database. In the case of many young firms, and especially spin-off firms, ignoring this data would be problematic. Thus, for the analyses, *an average of the number of patents reported by the interviewees and the number of approved patents listed in the USPTO database was computed*. This mean is used as a proxy for patents in the analyses.

7.1.2 Operationalization of dependent variables.

How to assess company performance in biotechnology? Conventional internal performance evaluation is based on comparable and well-accepted measurements, which are also backward looking (Cumby & Conrod 2001, 261). In the pharmaceutical industry, sales, profits, customer base, or the richness of the R&D pipeline are commonly used as performance indicators. However, for most biotechnology companies that have no products on the markets yet, these measurements are irrelevant. Löffler (2002) talks about the substitution potential of biotechnology companies. This can be determined by valuing the inventive potential (how revolutionary the technology / product is), the embodiment merit (how the technology / product is visualized), the functionality of the product, and the commercial potential. An accurate assessment of this kind, however, requires not only profound knowledge of the biotechnology markets and currently available technologies and solutions but also evaluation of current and future competition and available substitutes. Thus this could end up being a very biased estimate for a firm's performance.

Essentially, business performance can be investigated by both subjective (e.g., self-reported) and objective (e.g., market share, sales, profit) measurements. However, even some "objective" financial data is subject to managerial decisions such as evaluation of investments and assets, reporting of liabilities and costing (Rodriguez Cano et al. 2004). Objective and subjective scales do not produce identical findings (Bommer, Johnson, Rich, Podsakoff & MacKenzie 1995; Harris 2001). The difficulty in obtaining objective data contributes to the wide use of subjective measurements (Dawes 1999; Harris 2001). Especially for the kinds of small and young (mostly private) firms included in the sample for this study, objective information is not readily available. Rather, managers, especially in the US-based companies, tend to disclose as little financial information as possible. Thus performance in this study is measured through subjectively reported items.

Subjective performance assessment. Some empirical studies have found a positive relationship between market orientation and managers' perceptions of overall firm performance (Jaworski & Kohli 1993), managers' perceptions and financial performance (Pelham & Wilson 1996) and managers' perceptions and new product performance (Atuahene-Gima 1996, 1995; Pelham & Wilson 1996). The interviewees in the empirical study were asked to grade their firm's performance on a one to five scale in comparison with competitors (7 items, of which 2 are only for firms that already have sales). In addition, they were asked to provide information on the firm's innovations, the capital invested in the firm, and sales (if the company has sales). Even though these measurements are subjectively reported, they should reflect various sides of a technology firm's performance. Most of the studies that report objective measurements of performance rely on only one element, like new product success, sales growth or return on investment (Oczkowski & Farrell 1998). The subjective measurements employed in this study are more holistic evaluations and capture more than a single element of performance. Young firms like those focused on in this research lack history. A CEO's perception of the performance of the firm may actually be the only holistic measurement of the firm's performance, since the innovative output of a firm only turns into financial outcomes over a period of time.

Sales. Growth in sales (sales growth rate) is a traditional accounting measurement of a firm's performance widely used in the entrepreneurship literature (e.g. Lumpkin & Dess, 1996). In this study the respondents were asked whether or not their firm currently sells products. If the answer was yes, they were further asked to provide information on the way the product(s) is / are marketed: licensing agreement / own distribution and sales / selling through a partner company (non-licensing agreement). Furthermore, these respondents were asked to provide objective (numeric) information about sales turnover for 2001 and 2002 financial years, return on sales and % of sales generated by new products the previous year. Many of the firms only recently started to have sales income, so there were more missing datapoints for sales turnover in 2001 than in 2002. Hence, instead of sales growth, 2002 sales is used in the analyses. If the respondent answered “No” to the question “Do you currently sell products?”, he/she was not asked about sales figures; instead, there was a question whether the firm is planning to reach end markets through a licensing agreement / own distribution and sales / selling through a partner company (non-licensing agreement) in the future.

Innovativeness. One aspect related to the complexity of the biotechnology innovation process is that there is not normally a one-to-one relationship between a specific scientific discovery and a certain industrial application. Any given biotech research finding or instrumentation may be used in a variety of applications and industries (McKelvey, Rickne & Laage-Hellman 2004, 48). The measurement of innovativeness in this study includes the following continuous items: (1) New product introductions to markets; (2) New product development projects started; and (3) End products that are / have been developed based on the company’s invention(s). A composite measurement (sum) of these three items is used in the analyses. The three-item scale has a Cronbach’s alpha value of 0.758.

Capital invested in the firm. Limited internal funds and lack of sales income typical of young firms in markets for technology combined with the imperfections of capital markets suggest that external equity financing is crucially important for these firms (Carpenter & Petersen 2002). In the venture capitalists’ view, the expectation of high financial returns is mainly correlated with the size and growth of markets targeted by the young innovative firm, and the radical nature of innovation (Tyebjee and Bruno 1984). In the US in particular, the role of venture capitalists in backing up promising technology ventures is a phenomenon that has received a wealth of attention in research studies of these firms (See e.g. Amit, Brander and Zott 1998; Hellman and Puri 2002; Gompers and Lerner, 2001). A recent study of German biotechnology firms by Champenois, Engel and Heneric (2006) emphasizes the importance of venture capital finance as a source of funding for biotechnology firms developing new products and technologies in the therapeutic and diagnostic fields. Forty-two per cent of the “high risk” sample firms of Champenois et al. (2006) received early stage venture capital. Remembering that only a proportion of startup firms that search for venture capital investments actually receive funds, it is clear that venture capital is a crucially important phenomenon for biotechnology startups. This was also underlined in my preliminary study: biotechnology CEOs spend a lot of time trying to attract the attention of potential investors for the purpose of attaining investments.

In the interviews conducted for the main empirical study the respondents were asked to provide information on the capital invested in their firm up to the time of the interview. Seventy interviewees actually provided this information. Since these young companies are not required to provide information about their sources of capital to the public, secondary data to confirm these numbers are not readily available. For currency conversions, USD 1 = EUR 0.9 = SEK 8.

Control variables. *Firm location as a control variable.* The dummy variable for location (1 = USA, 0= Finland or Sweden) is used as a control variable in all statistical analyses.

Firm age and size as control variables. Firm size is measured as the number of employees at the time of the interview (self-reported by the interviewee). The age of the firm is measured as the number of years between the year of the firm's formation (self-reported) and the year of data collection.

7.2 Design of the survey process

Market orientation in a global setting. Empirical market orientation studies incorporating samples from multiple countries are sparse (For examples of multi-country studies, see e.g., Deshpande , Farley & Webster 1997; Hooley, Cox, Fahy, Shipley, Beracs, Fonfara & Snoj 2000; and the meta-analysis by Rodriguez Cano et al. 2004). Marketing scholars have recognized this limitation and called for the extension of research to an international context (Deshpandé et al. 1997; Homburg & Pflesser 2000). This research, for its part, serves to bridge this gap by investigating market orientation in Finland, Sweden, Pennsylvania, Florida and California. Unlike previous studies that have *compared* market orientation across nations (e.g. Mavondo 1999), the approach here is to build one sample of companies from these countries. Even though I will be observant of differences rising across the different geographic regions when conducting the analysis, comparisons and finding similarities / differences between areas is not the purpose of this research.

The global nature of the biotechnology business and, especially, the international scope of biotechnology markets – be it global markets for medicines or the licensing markets for inventions – make it feasible to assume that despite location, market orientation manifests in the same ways in R&D-

intensive biotechnology SMEs. In Mavondo's (1999) study of market orientation in the Australian automotive industry, Australian "personal and other services" industry, and Zimbabwean food manufacturing industry, the results imply that there are several differences between the Australian and Zimbabwean samples. Given the features of a developed economy like Australia and the developing market of Zimbabwe, and bearing in mind that the samples represented different industrial sectors as well, the variety of results is no surprise. However, in this study we are talking about one single industrial field, very global in nature, and geographic areas in modern, westernized countries. In this context there are no reasons to hypothesize for diversity in the ingredients of market orientation across sample firms from different locales.

Having said that, there are national differences on the supply side of biotechnology. The role of the public sector in supplying the soft infrastructure of innovation support for enterprises is not uniform from country to country, continent to continent. Critics say that the public sector is the source of Europe's innovation gap with the United States because reliance on public intervention in Europe signifies a major market failure (Cooke 2001).

Market orientation in a science driven field. Sheen (2003, 268) has not been the only one to state that "success in the pharmaceutical industry depends, perhaps more than in any other industry sector, on scientific research". However, even though the development process of a new drug or other kind of medical product is extremely long, knowledge intensive and costly, in the end the process aims at selling the output to end users. The deliberate decision to focus on medical biotechnology companies in this research – hence, mostly on pharmaceutical firms - is based on the understanding of the specific, science-driven nature of the industry. Biotechnology is a representative field of the functioning of markets for technology (Arora et al. 2001). The research results revealed by the study on the market orientation of small biotechnology firms illustrate this phenomenon in a field that is considered extremely science and technology driven.

Primary data collection. The basic difficulty with quantitative research approaches to the biotechnology field lies in the fact that biotechnology is not an industrial sector but a technological area. Modern biotechnology has many product dimensions, different underlying knowledge bases and wide fields of application. According to Brink et al. (2004, 31-32), the main data sources for existing economic research in the field of biotechnology include:

- trade data classified by product group;
- specialized surveys of firms engaged in some form of biotechnology production
- surveys of 'technology use' at the firm level;

- scientific publications' data;
- patent data, either United States Patent and Trademark Office or European Patent Office;
- R&D data covering expenditure and personnel;
- databases on specific topics, such as alliances, venture capital, firms and so on.

Behavioral market orientation, the focus of this study, is an organizational phenomenon. To study this phenomenon based on secondary data would certainly not capture the essence of it. Even though secondary data on, e.g., market intelligence generation through firms' subscription to various databases could be available, the only way to collect firm level data on market intelligence generation, dissemination and responsiveness altogether is either through empirical observation of firms, or through interviewing key individuals. In this empirical study, the latter approach is put into action.

Biotechnology in Finland and Sweden. In both Finland and Sweden the private capital market has undergone a change during the last decade. More venture capital has become available for innovative firms in their early development phase, especially for firms within biotechnology or information technology (Nilsson 2001). This has been an important driver for new firm formation; numerous new biotechnology firms have been formed in both Finland and Sweden since the beginning of the 1990s (Renko et al. 2005). However, public funding also plays an important role in the early stages of a firm, especially because it is "soft" money and the inventor still owns his/her idea. There are several public actors in both Finland and Sweden that provide funding to early-stage high-technology firms. Both the Swedish and the Finnish system are characterized by close cooperation between academia, clinical practice and basic, pre-clinical and clinical fields.

New biotechnology firms seem to be very small "research boutiques" with "little demonstrated capacity for growth" (Rosenberg & Hagén 2003, 21). This slow growth phenomenon in Sweden – as well as in Finland for that matter, even though comparative empirical figures that would prove this are scarce – seems to be more true for university than commercial spin-offs (Rosenberg & Hagén 2003, 22). Nilsson (2001) discusses the question of why the researchers in Swedish academia do not create their own firms as eagerly as, for example, researchers in the USA. An important factor is likely to be the lack of role models that could show the (economic) benefits of creating a firm. In line with the Finnish legislation, Swedish university researchers own their inventions and may not choose to pursue commercial goals with the inventions (Nilsson 2001).

Biotechnology in the US. The USA provides a good environment for biotechnology firms to flourish, which is clearly illustrated by the funds invested in biotechnology R&D; 70 per cent of biotechnology R&D takes place in the US. In 1992 there were 1,231 companies in the biotechnology business in the US with a total of 79,000 employees. By 2001 these figures had risen to 1,457 companies with 191,000 employees (Ernst & Young 2002; Kermani & Bonacossa 2003). US-based biotechnology companies like Genentech, Amgen, Biogen, Chiron and Genzyme have brought biotechnology-based drugs to markets over the past twenty years.

A recent report on the US biotech centers presents four general groupings of the 51 US metropolitan areas defined by the relative amount of biotechnology activity in each. Nine metropolitan areas (Boston, Los Angeles, New York, Philadelphia, Raleigh-Durham, San Diego, San Francisco, Seattle and Washington/Baltimore) stand out as biotechnology centers because they have above-average levels of biotechnology research activity and biotechnology commercialization. Four metro areas can be characterized as biotech research centers with limited commercial activity. Twenty-eight metro areas have median levels of biotech research and commercialization, and within this group there are two metropolitan areas from the state of Florida, namely Miami—Fort Lauderdale, FL, and Tampa—St. Petersburg—Clearwater, FL. Ten metro areas have no significant biotech activities taking place (Cortright & Mayer 2002).

The US data collected for this research comes from companies in South Florida, Pennsylvania (Philadelphia area), and the Bay Area in California. The state of biotechnology in the Philadelphia area was already described in Chapter 5 as a setting for the preliminary study. The key aspects of biotechnology in South Florida and Bay Area are highlighted in the following.

Florida. In terms of population, Florida is the fourth largest US state and it is third in consumption of pharmaceutical products. Florida's government officials and state agencies are supportive of expanding the biotechnology industry in Florida, and the state has made investment in and developed the medical infrastructure that is critical for the growth of the industry. Florida is well positioned for the growth in the biomedical industry because of its growing pool of scientific, technical and management labor. A boost to biotechnology in Florida is expected as a result of the decision of the Scripps Research Institute, a California-based non-profit research institute, to open its second facility in West Palm Beach, FL (Abrams 2004). Scripps' arrival is fueling expectations of growth in the number of new biotechnology companies that will emerge in South Florida. The life science field in Florida is dominated by medical devices. Florida ranks second in the United States for its number of FDA-registered medical device establishments and these companies typically specialize in minimally invasive surgery, disposable devices and supplies, orthopedic and cardiac implants, diagnostic imaging and sterilization equipment (Enterprise Florida 2004).

Bay Area. The San Francisco Bay Area is an intellectual center with three world-class universities - the University of California, Berkley; the University of California, San Francisco; and Stanford University, Palo Alto - fueling biotech innovation. Many of the first biotech companies in the United States emerged in the Bay Area in the early 1980s, including Genentech, Chiron and Cetus. The area also benefits from a permissive regulatory infrastructure. For example, Stanford University announced the formation of an institute to study stem cells and human cloning in 2002 despite national pressure against the exploration or use of the technologies. In per capita concentration of life scientists, San Francisco ranks second in the world (after Boston) with about 3,100 life scientists. In terms of biotech patents, the San Francisco area is clearly a hotbed of activity, with almost 1,300 patent registrations in 2000 compared with less than 850 in Boston (Bergeron & Chan 2004).

7.3 Sample

The sample of this main study includes a total of 85 biotechnology firms in the USA, Finland and Sweden.

Population. The target population of the survey is the small and medium-sized independent medical biotechnology companies in Finland, Sweden, San Francisco Bay Area, Philadelphia area and South Florida. These areas were chosen so that firms from different institutional environments (Nordic and American) would be included. Furthermore, some areas have long roots in biotechnology (like Bay Area and Pennsylvania), others have experienced a dominance of large pharmaceutical companies in the past (Sweden), and some areas have only witnessed rapid growth in the biotechnology field over the past decade (Finland and South Florida).

Sampling method. Random sampling ensures that the answers from a sample approximate to what we would have got had we asked everyone in the population (Shadish et al. 2002, 248). Random sampling was used in this study to make the sample similar to the population.

Sampling criteria. The sample was stratified using the following criteria: (a) corporate governance (independent firms), (b) employment size class maximum of 250 people following the European Union's cutoff for small and medium-sized enterprises, (c) industrial sector: active in R&D in human therapeutics (drug discovery & development), diagnostics, medical devices, and / or technology research that helps in developing the aforementioned classes of products, and (d) product-orientedness (i.e. even if firms provide services as a part of their business model, their main lines of business are about researching and developing physical products).

Sampling frame. The random sample of companies included in this research was derived from the industry databases of BioFlorida (www.bioflorida.org), Pennsylvania Biotechnology Association (www.pabiotech.org), Biotechnology Industry Organization (www.bio.org) member directory of Californian companies, Directory of Finnish biotechnology companies (www.finbio.net), and "The Swedish Biotech Industry Guide" (http://biotech.idg.se/industryguide/).

BioFlorida is an organization that promotes the biotechnology industry in the state. Its goals include providing an infrastructure for companies, research community - both private and governmental - and others to exchange information and ideas (networking), providing and promoting education and other programs to assist biotechnology companies and attracting financial resources for BioFlorida members. BioFlorida lists 160 companies active in biotechnology in Florida. The companies were assessed for the sampling criteria, and the CEOs of the firms (28) that fulfilled the criteria of this research were sent an e-mail and asked about their interest to be included in this research (personal interview). Twenty-two Managers answered and with 19 of them it was possible to set a time for a face-to-face interview.

In a similar way, the Pennsylvania Biotechnology Association lists 170 firms. Again, these companies were assessed for their characteristics and those that fulfilled the criteria of this research were approached by e-mail (43 companies). Naturally, the companies included in the earlier reported preliminary study were not considered. In Pennsylvania it was possible to set times for 14 interviews with managers of firms in the Delaware Valley area. One of these interviews turned out to be unusable because the interviewee – even though very willing to discuss trends in biotechnology in general – was not able to answer the questions presented. He kept on talking about issues related to the questions presented, but within the one-and-a-half hours I spent with him only about 5 per cent of the whole questionnaire got filled in. Thus, the sample from Pennsylvania comprises 13 firms.

Of the 256 firms listed by the Biotechnology Industry Organization in California, 78 were evaluated as suitable for the study based on sampling criteria, and they were contacted. Of these firms, interviews were conducted in 26 Bay Area firms.

In Finland the Finnish Biotechnology Industry Association listed a total of 128 firms in the country at the time of the research. Of these, 28 firms were evaluated as suitable for this study. They were approached either by phone or by mail, and 20 managers agreed to a face-to-face interview.

Finally, in Sweden data collection was completed within a five-day period in the Gothenburg – Linköping area. Based on the directory used, 34 biotechnology companies were active in the area at the time of the interviews, and of them, 16 were deemed suitable for this study. Of these 16 firms approached, interviews were conducted in seven firms.

It should be pointed out that the data collection in Sweden as well as in Pennsylvania was carried out within a very short period of time (five days in Sweden in February 2004, seven days in Philadelphia area in Pennsylvania in October 2003). Consequently, because of the busy schedules of the managers, some of those willing to be interviewed could not be included in the sample. In Finland the data collection was completed over the months of January and February 2004, in South Florida in November-December 2003, and in the San Francisco Bay Area in April-June 2004.

Data collection method. In order to collect valid and comprehensive data from the sample firms I wanted to make sure I had personal, face-to-face contact with each respondent when they answered my questions. This was important for a number of reasons. First, in addition to a structured questionnaire, the survey instrument included questions that were open ended and the analysis of which would be qualitative. The length and depth of the respondents' answers to these questions was certainly enhanced by the fact that they were able to speak out their thoughts instead of writing them down on, e.g., a mail survey. Second, face-to-face contact gave the respondents a possibility to ask for clarification if they did not understand some questions. Third, a personal visit and data collection minimized the amount of missing data.

The interviewees were told about the general purpose of the research before the interviews, but they were not shown the questionnaires. In the actual interview the session started with questions about company demographics, after which open-ended questions were presented. It was important to ask the open-ended questions before the interviewees filled in the standardized scales so that the answers to the open-ended questions would not be biased by the scale items. Overall, the questionnaire worked well and the personal interview approach resulted in a minimal amount of missing data. The interview questionnaire is available in Appendix 2.

Data collection with the survey instrument took place between October 2003 and June 2004. In 2003 and 2004 the biotechnology industry worldwide rebounded from the depressed stock market conditions of 2001 and 2002. Increasingly, pharmaceutical and medical device companies are converging with health care providers. This network of companies and non-profit organizations is aimed at saving lives while responding to pressures from health care payers to contain costs. The number of publicly traded biotech companies declined slightly in 2003 to 611 from 619 in 2002, but these companies earned 17% more in revenues and hired more workers, boosting employment by 9% while reducing R&D spending by 16% and improving their net loss by 65% (Ernst & Young 2004).

7.4 Description of the survey response

Non-response bias is a potential problem in any sample survey; non-response error represents a failure to obtain information from some parts of the population. Specifically, non-response is a problem if those included in the sample differ systematically from those who did not respond (Armstrong & Overton 1977). Figure 17 presents the response analysis of the study.

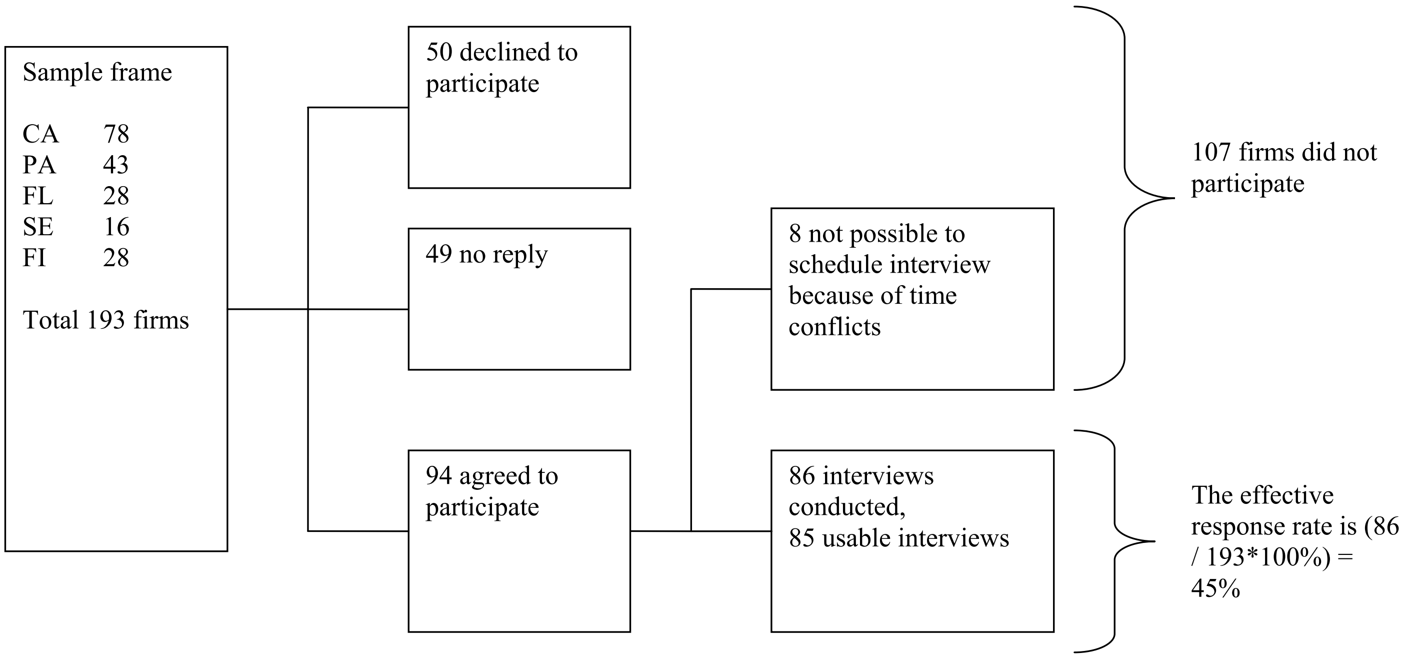

Figure 17: Response patterns in the empirical study

The response rate of 45% is rather good, especially considering that I was asking for a commitment of an hour from the CEO of the company. The only incentive given for participation was access to research results; I promised to share the executive summary of the research report, once completed, with every interviewee. In some firms (n=16) the CEO directed me further to the business development manager of the firm, saying that this manager was better equipped to answer my questions. The actual length of the interviews varied between 40 minutes and a bit over two hours. Most interviews, however, lasted for about one hour.

In some of the 49 firms that did not respond the interview request possibly never reached the CEO of the firm. Often, the e-mail addresses of CEOs were not available and e-mails to the general company addresses (info@company.com) seldom resulted in replies. Telephone calls reached the managers' secretaries, and even if they assured me I would get a call back, that seldom happened.

One method for estimating non-response bias is to compare results from a survey with known values of the population (Armstrong & Overton 1977). To assess non-response bias, Table 11 describes the company age of the sample firms (n=85) and non-respondents (n= 107) area by area. The purpose of the table is to show that respondents do not significantly differ from non-respondents. The data is based on the companies' websites; for firms in the sample, information provided on the website was confirmed in the interview, whereas for non-respondents, the data is based on website information only. All of these firms in each area were contacted, and those who did not respond to the inquiry about their willingness to be interviewed for the research or responded negatively are classified as non-respondents.

Table 11 reveals that in South Florida and Finland the sample firms are, on average, older than the non-respondents. In the three other locations the sample firms are younger than the non-respondents. Age typically correlates with size (Hansén 1981), so we can assume that these sample firms are also smaller in terms of number of employees than the non-respondents. However, only in the Bay Area of California does the difference in age between the two groups turn out to be significant (t-test p-value < 0.05). There are two possible explanations for this. First, it may be that in some cases – despite numerous trials – my attempts to contact the CEOs of larger firms did not go through. For example, in larger firms the managers' secretaries may scan the managers' e-mails, in which case my interview invitation could have been deleted and the actual manager would have never seen it. Furthermore, when contacting companies by phone, in larger firms

I often ended up talking with the managers' secretaries instead of the managers themselves. Even though the secretaries often promised to forward my request to the manager in question, this may not always have been the reality. In smaller firms I usually spoke with the manager herself. Another possible explanation is that larger firm managers are busier and do not have time for research interviews. In fact, many of those who turned down my interview invitation said that they were too busy to devote time to my study. One more speculation is that larger firms often have "professional" managers, whereas smaller firms are typically run by scientists who have been PhD students themselves. It may be that these ex-PhD students sympathized with me and were more willing to agree to be interviewed.

Table 11: Age of sample firms and non-respondents[28]

Firm Age

	Sample firms		Non-respondents[29]	
	Mean	S.D.	Mean	S.D
South Florida, USA	7.47 (n=19)	5.40	7.00 (n=9)	7.38
Pennsylvania, USA	5.61 (n=13)	4.39	7.41 (n=29)	6.68
Bay Area, Northern California, USA	3.50** (n=26)	2.94	5.38** (n=52)	4.02
Sweden, Gothenburg Area	5.14 (n=7)	1.86	7.00 (n=9)	8.46
Finland	6.45 (n=20)	3.78	4.75 (n=8)	3.70

**= Significant at $p < .05$

Chi-square tests were conducted to analyze if there were significant differences between respondents and non-respondents in terms of industry sectors. The only significant difference between the sample firms and the non-respondents can be observed for diagnostics firms in Pennsylvania. There, the count for diagnostic

[28] Because of the small n in many categories the results should be interpreted with caution.
[29] Non-respondent here means that the company was determined to fulfill the criteria to be included in the sample and the company was contacted to ask for interview appointment, but either the company never responded or the response was negative.

firms in the sample is zero, whereas there are four non-respondents that are diagnostics firms. Even though the difference is significant ($p<0.05$), the overall count of diagnostics firms is very small and selection bias is hard to prove.

Even though the rather small sample size (n=85) may present constraints on statistical conclusion validity, it is worthwhile mentioning that a number of important contributions to market orientation research have been based on similarly small samples. The sample of Appiah-Adu (1998) included 74 firms, Caruana, Ramaseshan and Ewing (1998) 84 organizations, Dawes (2000) 93 organizations, Deshpandé and Farley (1998a) 82 organizations, Gray, Matear and Matheson (2000) 21 firms, Langerak (2001) 72 firms, Ngai and Ellis (1998) 73 firms, Pelham and Wilson (1996) 68 organizations, and that of Slater and Narver (2000) 53 firms.

7.5 Quality of the study - testing, checking and validation procedures

The first ten interviews also served as a pilot test for the questionnaire. Because the final questionnaire was developed based on the preliminary study described earlier as well as the extant literature, it was expected that not many changes would be necessary after the pilot testing. In the pilot testing stage, i.e. during the first ten interviews, the respondents were asked to pay extra careful attention to the formulation of the questions and give feedback on any possible problems or challenges. The feedback and the actions taken are summarized in Appendix 4.

Even though minor changes were made to the questionnaire based on the pilot testing (see Appendix 4), the changes were not of such dramatic nature that they would have justified dropping all or some of the first ten interviews (pilot testing) from the sample. Consequently, the interviews that served as pilot tests for the questionnaire remained in the final sample.

7.5.1 Single-respondent bias

There is considerable debate concerning the effect of leaders on organizational outcomes. At one extreme, Perrow (1970) argued that “leadership” approaches to organizational analysis represent a form of psychological reductionism and understate the effect of systemic influences on organizational outcomes. At the other end, however, there is evidence that suggests that the characteristics of key organizational actors cannot be ignored when studying organizations. For example, those who allocate organizational resources also influence innovation adoption (Hage & Dewar 1973). Especially in small firms, the characteristics and skills of the entrepreneur-manager influence all aspects of business.

A common problem in researching small firms is that secondary, objective data on these firms is not readily available. Most firms in my sample are very small and they do not publish their financial information. Thus, the only way to assess company financials, for example, is to ask the managers. Controlling the accuracy of the information they provide is difficult. In this study, in addition to asking the managers about their firms' performance, I searched through multiple company databases in order to find objective numbers I could compare with those given by the managers. Demographic data is readily available from multiple sources for the public companies in the sample (n=12), and it matches very well the numbers given by the interviewees. However, only scarce data is provided by secondary sources for the private biotechnology companies; sales information is the piece of information most commonly available. Thus sales data was collected from secondary databases for as many sample firms as possible. Altogether, I was able to obtain sales data for 36 firms in this way. The following databases were consulted in this search:

Database	***Information obtained***	***Number of cases for which data was collected***
Hoover's, Inc, available through ABI Inform Global. Hoover's offers proprietary business information and features a database of information on more than 12 million corporations and organizations.	Sales (2004), employees (2004)	14 (US-based firms)
FIB Index of Biotechnology Companies, Organizations and Research Institutes in Finland. 9.12.2003	Sales and employees	15 (Finnish firms)
The Swedish Biotech Industry Guide http://biotech.idg.se/industryguide	Sales and employees	4 (Swedish firms)
Thomson-Gale, Business & Company Resource Center. Database to find detailed company and industry news and information.	Sales	3 (US-based firms)

At the time of the interviews 43 interviewees indicated that their firms had sales, and 41 of them provided sales figures. The mean for these self-reported sales numbers (asked for 2002) is USD 7.88 Million and the distribution is positively skewed; the median sales turnover (self-reported) for 2002 is USD 1.04 Million. The sales figures obtained from the secondary sources listed above are higher than those reported by the interviewees themselves. The main explanation for this is sales growth; secondary data was mostly available for 2004. The mean sales turnover based on secondary sources is USD 21.3 Million and, again, the distribution is positively skewed; median value is USD 2.1 Million. The most important piece of information is that there is a strong positive correlation between the self-reported sales turnover and the sales data obtained from secondary sources (Pearson correlation coefficient 0.741, p-value = 0.001). Consequently, based on the sales data provided by about half of the interviewees, there seems to be no reason to suspect that the respondents have been giving biased information. The Wilcoxon Signed-Rank test was also employed to detect differences in the distributions of sales as reported by the interviewees (sales for 2002) and the sales data obtained from secondary sources (mostly for 2004). The 2-tailed p-value for this test was non-significant (p = 0.121); the distribution of sales obtained from secondary sources is not different from the sales data provided by the interviewees.

In research where measurements of different variables are collected from the same respondents and an attempt is made to interpret any correlations between those variables, common method variance can be a severe problem that biases the research results (Campbell & Fiske 1959). Because the measurements come from the same source, any "defect" in that source contaminates both measurements, presumably in the same fashion and in the same direction. For example, in this data collection it is possible that a self-report measurement for a firm's performance (a manager's perception of his / her firm's performance relative to competitors) and a self-report measurement for a firm's market orientation may each overlap with the variance in the respective domains. But this does not guarantee that the overlap in the variance of the measurements themselves, when taken from the same sources, includes any overlapping variance they share with their referent domains. However, finding this kind of a correlation between the self-report measurements could erroneously lead us to infer a relationship between the constructs (Podsakoff & Organ 1986, 533-534).

Because the variables of this study were obtained from a single key informant per firm, I tested for common method bias using the Harman one-factor test (Podsakoff & Organ 1986). Because of the relatively small number of cases in the dataset (n=85), the factor analysis had to be limited to selected sets of variables at a time. Hence I selected eight variables at a time for factor analysis. The variables were selected from different constructs that the questionnaire was desired to tap in order to detect possible common method bias. Altogether, three sets of eight variables were chosen for factor analysis. For each set of variables analyzed, the results of the principal components analysis revealed three factors with eigenvalues greater than 1.0. These results (even with limited sets of variables at a time) seem to indicate that there is no one general factor in the unrotated factor structure. Hence common method bias should not be a great concern.

7.5.2 Validity and reliability of the measurements

Valid measurement is a prerequisite for the successful study of concepts. Constructs such as intelligence, attitudes and behavior - and market orientation, for that matter - cannot be directly and perfectly measured with one item. Validity refers to the degree to which an instrument is truly measuring the construct it is supposed to measure (Peter 1981).

Cook and Campbell (1979) divided validity into four related components: statistical conclusion validity, internal validity, construct validity and external validity. Each one of these is discussed in the following.

7.5.2.1 Statistical conclusion validity

Statistical conclusion validity refers to the appropriate use of statistics to infer whether the presumed independent and dependent variables co-vary and – if they do – how strongly do they co-vary. We can incorrectly conclude that cause and effect co-vary when they do not (type I error) or incorrectly conclude that they do not co-vary when they actually do (type II error) (Shadish et al. 2002). In this study, the most severe threat to statistical conclusion validity arises from the use of a rather small sample (n=85) of firms. This is a problem especially for the development of new scales for, e.g., measurement of partners' contribution to market orientation; scale development requires larger sample sizes. However, large data sets often compromise the quality of data collected. As I will later describe, the face-to-face data collection used in this research increased the internal as well as the construct validity of the research. Given the limited resources of one researcher, using such a personal data collection method to access more than 85 firms would have required more time and money than was available. Thus I needed to compromise the sample size in order to be able to collect data that would satisfy the internal validity and construct validity requirements.

Shadish et al. (2002) suggest a number of strategies to increase the statistical validity of a research. In this study I chose as reliable measurements for the variables of interest as possible. Whenever possible, I chose measurements that had shown high reliability in previous studies, because a conclusion about co-variation may be inaccurate if either variable is measured unreliably (Nunnally & Bernstein 1994). I also tried to avoid restricting variables to a narrow range; in the statistical analyses I avoided dichotomizing continuous variables. Also, the fact that the units of analysis, and, more importantly, respondents, represent a relatively homogenous group of companies in terms of firm demographics should increase the statistical conclusion validity. The more the units in a study are heterogeneous within conditions on a variable, the greater will be the standard deviations on that variable (and on any others correlated with it). It would make little sense to collect a sample combining small R&D firms (low sales figures) and large, worldwide distributors of, e.g., drugs for the purposes of tracking the effect of market orientation on sales and profits. Heterogeneity in terms of sales and profits would obscure systematic co-variation between market orientation and these outcome variables. Finally, to increase statistical conclusion validity I aim at as accurate effect size estimation as possible. Before conducting the statistical analyses I scanned the data for potential outliers that would cause the distribution to depart from normality (Wilcox 1995).

7.5.2.2 Internal validity

Internal validity refers to inferences about whether observed co-variation between A and B reflects a causal relationship between A and B in the form in which the variables were measured (Shadish et al. 2002, 53). In this study, and especially when making predictions on factors affecting a firm's market orientation and further market orientation's contribution to outcome variables, we should be concerned about ambiguous temporal precedence. Because of the cross-sectional research design, I cannot empirically prove that market orientation actually precedes the expected outcomes of market orientation. Actually, it is likely that instead of unidirectional causation relationships, many of the variables measured in this empirical study share a bidirectional (reciprocal) causation. For example, investors may be willing to invest more money in market-oriented R&D firms than in a totally science-driven start-up. These resources may make it possible for the market-oriented firm to further invest in market intelligence generation and dissemination. If this is the case, a unidirectional "causal" relationship observed at a point of time does not reveal the true nature of the relationship between the two variables. Because of these concerns, conclusions from the observed correlations between variables should be drawn with caution.

Systematic differences in respondent characteristics from those of the population of interest can also cause the observed effect. The key feature of such a selection bias is a confounding of observed effects with population differences (Shadish et al. 2002). For example, if the market orientation of a young biotechnology firm is largely determined by the firm's age, and if the firms included in the current sample systematically represent firms that were established more than five years ago, I should be concerned about the internal validity of the results. In this case it would be possible that I could find significant relationships between, for example, a firm's level of market orientation and the money invested in the firm. However, both a high level of market orientation and large investments could be a result of a confound effect of the firm's age. Furthermore, it could also be possible that if my sample in this case also included younger (less than five years of age) firms, I would not find a correlation between the level of market orientation and money invested in the firm.

Comparing sample characteristics to population characteristics was carried out when discussing the non-response bias above. Overall, the sample seems to be representative of the population, i.e. medical biotechnology SMEs in Finland, Sweden, South Florida, Pennsylvania and San Francisco Bay Area. However, one more important concern related to internal validity is the operationalization of variables of interest; do the measurements employed in the empirical study really reflect the underlying constructs, like market orientation? This question also relates to construct validity and is discussed in the following.

7.5.2.3 Construct validity

Construct validity is the most salient indicator of measurement validity. It is commonly regarded as consisting of two aspects: convergent and discriminant validity. Convergent validity is the degree to which multiple independent attempts to measure the same construct are in agreement. Discriminant validity is the extent to which measurements of two or more different constructs are distinct (Bagozzi, Yi & Phillips 1991; Gerbing & Anderson 1988; Peter 1981). Exploratory factor analysis and principal component analysis (PCA) are typical ways to analyze the initial construct validity and underlying dimensions of scales. However, these analyses are extremely sensitive to small sample sizes like the one I have here. Hence construct validity is assessed via means other than PCA and factor analysis.

In my questionnaire the business philosophy items (Page 5 of the questionnaire, see also Table 7) measuring the sales, production, customer, stakeholder and technology focus[30] of the organization (for actual items, see questionnaire in Appendix 2) were used as validation items for the MARKOR scale. Logically, a firm that ranks high on the MARKOR scale is also expected to rank high on customer focus on the business philosophy scale. Table 12 lists the correlations (Pearson) between the various items of the business philosophy scale and the composite MARKOR measurement (mean) calculated for each firm. As expected, there is a strong positive correlation between the MARKOR measurement and customer focus (0.290). Correlations between MARKOR and business philosophy items other than customer focus turned out to be insignificant, but it is worthwhile noting that the relationship between MARKOR and the technology focus is negative. If this negative relationship was significant, we could speculate that behavioral market orientation (measured with MARKOR) and technology focus would not co-exist in the same organization.

[30] Items for production, sales, customer and stakeholder focus were formulated similarly to previous studies, and the item for technology focus was formulated specifically for this study.

Table 12: Correlations between the MARKOR scale composite measurement (mean) and business philosophy measurements as validation items.

Variables	Mean	SD	1	2	3	4	5	6
1. Business philosophy, production focus	2.95	1.298	1					
2. Business philosophy, sales focus	3.87	1.138	.355***	1				
3. Business philosophy, customer focus	4.01	.963	.039	.309***	1			
4. Business philosophy, stakeholder focus	3.62	1.063	.231**	.257**	.146	1		
5. Business philosophy, technology focus	4.37	.889	.193*	.275**	.051	.327***	1	
6. MARKOR	3.79	.440	-.109	.004	.290***	.082	-.139	1

*** Correlation is significant at the 0.01 level (2-tailed); ** Correlation is significant at the 0.05 level (2-tailed); * Correlation is significant at the 0.1 level (2-tailed)

This positive correlation (Table 12) between MARKOR and customer focus provides support for the claim that the MARKOR scale actually measures an orientation that is distinct from sales, production, technology and stakeholder orientations and focuses on customers instead.

Partners' contribution to market intelligence generation was assessed with a 24-item scale that measures the contribution of 12 distinct stakeholder groups to (1) customer intelligence generation and (2) environmental scanning. The construct validity of this scale was checked against three items placed earlier in the questionnaire that reflected the firm's relationships on a more general level. These three items were measured on a one to five scale:

The relationships that your firm has with other firms and organizations help your firm in that…
…Your firm gets information about potential customers.
…Your firm gets information on potential business partners.
…Your firm gets information on what is happening in competing firms.

This three-item scale was assessed for reliability and showed Cronbach's alpha of 0.721. This indicates that the reliability of the three-item scale is good (Nunnally 1978) and all three items reflect one underlying construct, i.e. partners' contribution to market intelligence generation. Logically, a firm that ranks high on these three items is also expected to rank high on the 24-item scale that measures stakeholders' contribution to market intelligence generation in a more detailed manner. Table 13 lists the correlations (Pearson) between the composite measurement (mean) for the three items mentioned above and the composite measurements for stakeholders' contribution to market intelligence generation (mean and total).

Table 13: Correlations between scales for stakeholders' contribution to market intelligence generation and the 3-item validation scale.

Variables	Mean	SD	1	2	3
1. Stakeholders' contribution to market intelligence, mean for the 12 groups	3.134	.587	1		
2. Stakeholders' contribution to market intelligence, total contribution of the 12 groups	20.26	11.247	.767***	1	
3. 3-item validation scale	4.03	.836	.197*	.205*	1

*** Correlation is significant at the 0.01 level (2-tailed); ** Correlation is significant at the 0.05 level (2-tailed); * Correlation is significant at the 0.1 level (2-tailed)

Even though there is a weak positive correlation between the validation scale and both the mean and total scale based on the twelve stakeholder groups (Table 13), these correlations are not as strong as one would have expected (p-values are .072 and .061 respectively). One possible explanation for this is the wording and scheduling of these items. For the three-item validation scale, the interviewees were supposed to think of the bulk of all relationships their respective firms have with other organizations, both formal and informal. It is likely that when answering on the one to five scale they thought of relationships in a positive light (social desirability), which also resulted in a high mean value for the three-item scale (4.03). Later in the interview they were introduced to the 12 stakeholder groups, each individually, and asked to assess each group's contribution to market intelligence generation. This resulted in a lower mean score (3.13), most likely because even though some of the twelve groups helped in accessing market intelligence, others did not and received lower scores.

As a conclusion, the construct validity of the two key measurements of the empirical study, i.e. the adapted MARKOR scale and the scale that measures stakeholders' contribution to market intelligence, appears to be solid. Both constructs and their measurements are based on existing research (Jaworski & Kohli 1993; Hernández-Espallardo & Arcas-Lario 2003) and the adaptations to the MARKOR scale, as well as the choice of twelve stakeholder groups, are based on the six preliminary case studies as well as the literature. The validation items show positive correlations with the scale items, even though these correlations with the stakeholder scale are not as strong as one would have expected. However, these weaker correlations are understandable when considering the wording and varying degrees of specificity for the items.

7.5.2.4 External validity

External validity concerns inferences about the extent a causal relationship holds over varying conditions, like variations in people, settings and outcomes (Shadish et al. 2002, 83). Thus the question of external validity is essentially a question of generalizability. Shadish et al. (2002, 87-90) distinguish between five different threats to external validity. Of those five, the relevant threats in this study concern the interaction of the causal relationships with units (i.e. firms being studied), with outcomes (i.e. the kinds of performance measurements employed in this study) and with settings (e.g. medical biotechnology industry).

The threat of interaction of the observed causal relationship(s) with the units of the study can be avoided through random sampling. The sampling procedures of this study were described in detail earlier, and they aimed at guaranteeing a random sample of the population, i.e. of the small and medium-sized independent medical biotechnology companies in Finland, Sweden, San Francisco Bay Area, Philadelphia area and South Florida. Random sampling – within the limits of sampling error – guarantees that the average relationships observed in the sample are the same as (1) the average relationships that would have been observed in any other random sample of companies from the same population, and (2) the average relationships that would have been observed across all other firms in that population which were not in the original random sample. Thus random sampling should eliminate possible interactions between the causal relationship(s) observed and the class of firms who are studied versus the class of firms who are not studied.

As described earlier, markets for biotechnology are global in nature. However, because of the different institutional settings in, e.g., the USA versus Europe, companies' approach to stakeholders such as venture capitalists or governmental organizations may vary. It is possible that in differing country settings market orientation also manifests differently in young biotechnology firms and, furthermore, its consequences on firm performance could differ. This potential importance of physical location led to the deliberate decision to sample firms in five locations on two continents. This has benefits for external validity. It allows tests of the interaction between the relationships observed between the variables of interest and firm location in the study data. If an interaction is detected (i.e. if firm location moderates the firms' market orientation levels and orientations' contribution to performance), this is prima facie evidence of limited external validity across geographical locations (Shadish et al. 2002, 83-95).

Even after considering the physical location, there are naturally numerous potential moderators that I have not thought to test. In these cases random sampling (described earlier in the text) procedures within the chosen geographical clusters should make the sample heterogeneous on every possible moderator variable. This sampling has the benefit of demonstrating that the observed relationships exist despite the heterogeneity of the sample. After these considerations, the interaction of the observed relationships with the units, i.e. firms, does not seem to be a great concern here. Generalizations to other firms should – as always – be made cautiously, but there is no reason to suspect that the findings of the study are systematically biased and / or non-representative of the target population.

The careful selection of performance measurements that was described earlier should reduce the threat that possible the detected causal relationships actually interact with the outcomes (i.e. the kinds of performance measurements employed in this study). Also, I use a number of different performance measurements, which should further reduce this threat.

7.5.3 Face validity

An instrument is said to have face validity if it "looks like" it is going to measure what it is supposed to measure. At the end of each interview the interviewee was asked to comment on the interview; what did he / she think about the relevance of the questions asked? Was there something that was not asked even though he / she thought it was an important aspect of market orientation? How would he / she improve the questions?

Overall, the interviewees were satisfied with the interview experience and many of them commented that the issues covered in the questions were very important in their everyday work. However, some of the interviewees mentioned that rather than business issues they were more preoccupied with advancing technological development. Some interviewees said that although partners do share information on markets, the phenomenon is still marginal; alliances are formed for technological collaboration and / or marketing and distributing products to markets. Sharing market intelligence may - or may not - happen as a "by-product" of this collaboration. Some of the most insightful comments by the interviewees about the relevance and quality of the questions asked are listed below.

"Marketing being commonsense, a lot of questions here are about reacting quickly."

"Answers to your questions are different for different products. When I was answering I had this one specific product in mind, but if I had thought of another product my answers would have been different."

"Why do you need to have a scale from 1 to 5 for questions that are clearly yes / no questions?"

"What does this word "periodically" mean really? I don't think it matches the thinking of a dynamic company."

"Cultural desires. They are missing from the questions. In some countries doctors want something that is not acceptable in other markets. Country-based changes in products."

"Very few early stage companies are interacting directly with patients, it is a stepwise process. But the data is already important in the early stages. We picked small indications because they require smaller clinical trials."

" This business is about technology, we don't partner with firms to source market data together. This business is about intellectual property rights and you don't want to share this information."

Most interviewees felt that the interview questions as well as most questionnaire items were relevant for their firms' strategies and operations. Of the MARKOR scale items, the ones that address responsiveness to market intelligence raised most questions and comments. Clearly, many respondents felt that in their current operations their possibilities to actually respond to feedback from markets were very limited. This is partly due to the highly regulated nature of the biotechnology field and products and, in part, the reason is the distance of many sample firms' from the markets; they do not receive actual feedback form customers as of today.

7.5.4 Reliability

Reliability is a matter of internal consistency; the degree to which the instruments are free from error and thereby yield consistently accurate measurements of the construct of interest (Churchill 1979; Peter 1979). Perhaps the most popular method for assessing measurement reliability is Cronbach's alpha (Cronbach 1951). Cronbach's alpha summarizes the extent to which a set of items - e.g., the MARKOR scale statements measuring market orientation in this study - are interrelated with each other (Churchill 1979; Peter 1979). Cronbach's alpha is formulated as:

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum_{i}^{k}\delta_i^2}{\delta_t^2}\right)$$

where
k = number of items in the scale,
δ_t^2 = total variance of the scale, and
δ_i^2 = variance of item i.

Table 14 shows the values of Cronbach's alpha for the scales used in the empirical study. Naturally, no reliability coefficients can be computed for variables measured on a unidimensional scale consisting of a single question. Skewed distribution toward socially desirable responses is a common problem with self-response measurements. Since the distribution is skewed for practically all items on the scales, it was not possible to eliminate a subset of them. Because these variables are important for the analyses, they were retained and used in further statistical analyses.

Table 14: Scale reliabilities

Variable, name of scale	*Number of items*	*Mean*	*Standard deviation*	*Reliability, Cronbach's alpha*
Performance (subjective)	7	24.42	5.052	0.788
Stakeholders' market intelligence	24	78.94	15.592	0.850
MARKOR scale, adapted	38	143.50	15.117	0.830
MARKOR subscale, generation	12	46.83	5.941	0.609
MARKOR subscale, dissemination	17	61.53	7.750	0.705
MARKOR subscale, responsiveness	9	36.03	4.770	0.666
Innovativeness[31]	3	12.23	14.238	0.758
Entrepreneurial orientation	7	3.86	0.608	0.719

Nunnally (1978) and Churchill (1979) suggest that for a reliable scale, Cronbach's alpha should be over 0.7. Here, the alpha coefficients range from 0.609 to 0.850. Because of the low reliability of subsets of the MARKOR scale (market intelligence generation, dissemination, and responsiveness), they are not employed independently in the analyses. The alpha value for the total MARKOR scale, i.e. 0.830, is high and compares well with the improved MARKOR scale developed by Matsuno et al. (2000) (Cronbach's alpha for their 22-item scale is 0.85). It should also be noted that Matsuno et al. (2000) as well as Jaworski & Kohli (1993) had lower reliabilities for the subconstructs of market orientation; in Matsuno et al. (2000) the reliabilities were for intelligence generation = .65, intelligence dissemination = .75, and responsiveness = .81. In Jaworski and Kohli

[31] Includes the following continuous items: New product introduction to markets; New product development projects started; and End products that are / have been developed based on the company's invention(s).

(1993) the realibilities for the 32-item scale were 0.61 for intelligence generation, 0.69 for dissemination, and 0.81 for responsiveness.

Overall, with the limitation presented by the small sample size, the reliability and validity of the key measurement instruments, especially the MARKOR scale, seem to be comforting. Table 15 summarizes the validity and reliability considerations of the MARKOR scale used in this study, most of which have already been discussed above.

Table 15: Summary of validity and reliability measurements for MARKOR scale in this study

	Market orientation scale / subscale			
	Market intelligence generation	Market intelligence dissemination	Responsiveness	Whole MARKOR scale
A. MARKOR Reliability, measured by Cronbach's alpha				
Deshpandé & Farley (1998a)	NA	NA	NA	0.51 (20 items)
Caruana (1999)	0.82 - 0.88	0.80 - 0.87	0.87 - 0.94	NA
Matsuno, Mentzer & Rentz (2000)	0.65	0.75	0.81	0.85 (22 items)
Matsuno, Mentzer & Rentz (2005)	0.61	0.69	0.81	0.86 (32 items)
Kara et al. (2005)	0.69	0.74	0.83	NA
This study	**0.61**	**0.65**	**0.69**	**0.83 (38 items)**
B. **Validity** (this study): Correlation with business philosophy item of customer focus. High correlations expected.	0.087	0.303**	0.298**	0.290**
C. **Predictive validity** (this study): Correlation with subjective performance scale mean value.	0.139	0.199	0.314**	0.238*
D. **Discriminant validity** (this study): Business philosophy items and entrepreneurial orientation. Insignificant or significant negative correlations expected.				
Sales orientation	-0.215*	0.148	0.046	0.004
Production orientation	-0.309*	0.002	0.000	-0.109
Stakeholder orientation	-0.053	0.254*	0.048	0.082
Technology orientation	-0.190	0.132	-0.165	-0.139
Entrepreneurial orientation	0.222*	0.324**	0.272*	0.305**

** Correlation is significant at the 0.01 level, * Correlation is significant at the 0.05 level

As illustrated by Table 15, the reliability values of the MARKOR scale in this study compare well with the values of a number of previous studies. Even though the Cronbach's alpha values of the MARKOR subscales are below what would be considered good (0.7) (Nunnally 1978), similar, somewhat problematic values have been identified in previous studies as well. The alpha value of the whole scale in this study is good (.83), even though its appeal is limited by the fact that the scale is lengthy (38 items).

Also, for most of the validation items presented in Table 15, all the correlation values demonstrate the expected direction. There is a slightly positive correlation between stakeholder orientation and market intelligence dissemination, but other than that, the business philosophy items provide evidence for the validity of the MARKOR measurement; the correlations between MARKOR and customer focus are positive and mostly significant, whereas the correlations between MARKOR and the business philosophies of sales, production, stakeholder, and technology focus are mostly non-significant and / or negative. However, the positive and significant correlations between the MARKOR measurements and entrepreneurial orientation are problematic. Conceptually, the two constructs should be discrete, but the positive correlations indicate that the construct domains overlap. A principal component analysis of the items in the entrepreneurial orientation and market orientation scales could clarify the areas of overlap, but unfortunately the current sample size of 85 cases does not lend itself to a reliable principal component analysis of the items[32]. The multicollinearity between the entrepreneurial and market orientation measurements has to be taken into account in the data analysis.

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[32] Despite the concerns caused by the small sample size, I did run a PCA to detect a six-factor solution for the items of entrepreneurial orientation and market orientation. The six factors should reflect (1) market intelligence generation, (2) dissemination, (3) responsiveness, (4) innovativeness, (5) proactiveness, and (6) risk-taking. It turned out that five factors reflected different aspects of market orientation, and one factor had high factor loadings for five of the seven EO items. In addition, this EO-dominated factor had a high positive loading for "We collect industry information by informal means" and a high negative loading for "Our company subscribes to industry / market databases". This would seem to suggest that the overlap between the MO and the EO constructs is in the domain of informal market intelligence generation; entrepreneurially-oriented firms access market knowledge through informal means and, unlike industry incumbents, do not subscribe to secondary industry data. This conclusion makes intuitive sense, but because of the limitations of PCA in a dataset with only 85 cases, the PCA results should be considered only anecdotal evidence.

7.6 Data analysis

7.6.1 Multiple linear regression

Multiple linear regression analysis is a tool for assessing the relationship between one dependent variable and a number of independent variables. The technique is used to test models that help to predict the dependent variable based on the (known) values of the independent variables (Hair, Anderson, Tatham & Black 1995). The resulting model indicates the relative contribution (weight) of each independent variable on the dependent variable. Stepwise multiple linear regression was used to test Hypotheses 1-19. The basic multiple regression model has the following form:

$$\hat{Y} = b_0 x_0 + b_1 x_1 + \ldots + b_n x_n$$

In the equation above, Y is the dependent variable (for example, a performance variable), b_0 a constant, x_n an independent variable and b_n the relative weight of that variable. The main assumptions for using multiple linear regression are normality of the variables, homoscedasticity (i.e. equality of variance) and independence of the independent variables.

7.6.2 Normality and homoscedasticity in regression analysis

In this research the normality of the variables was tested by assessing the normality of distribution graphically with the help of normal probability plots. This procedure is widely used and recommended by experts (Hair et al. 1995). The findings of each assessment were additionally verified by means of the Kolmogorov-Smirnov test for normality.

The homoscedasticity of the variables is tested using Levene's test. This test is robust against departures from normality and thus particularly recommended (Hair et al. 1995). Variance-stabilizing transformations were applied in order to achieve equal variances in cases where heteroscedasticity was present. The use of these transformations is reported for each variable where applied.

7.6.3 Independence of predictor variables

In true experiments, typical for the natural sciences, it is often possible to control the introduction of independent variables. In such a case the overall importance of each factor (for example, the proportion of the Y variance it accounts for) can be unambiguously determined since its orthogonality with the other factors assures that its effects on Y cannot overlap with the effects of the others (Cohen & Cohen 1983). This is seldom the case in behavioral research and the social sciences. The presence of multicollinearity between independent variables has a substantial effect on the results of a regression analysis; it complicates determining the contribution of each single variable. A common strategy for detecting multicollinearity is the calculation of the tolerance value or its inverse, the variance inflation factor (VIF). The smaller the tolerance value, the higher the multicollinearity. When running the regression analyses, I use the VIF value to assess multicollinearity.

In addition to the assumptions mentioned above, the existence of *outliers* – cases that have large residual values – influences the result of the regression analysis (Belsey, Kuh and Welsch 1980). When residuals are standardized by dividing them by their standard deviation, a residual that is as much as three (or, certainly, four) of these units in absolute size is reasonably considered an outlier (Cohen & Cohen 1983). As a regression equation minimizes the squared residuals, an outlier not only makes a relatively large contribution to the variance (thus reducing R^2 of the model) but also exerts a disproportionately strong pull on the regression. Outliers are, therefore, particularly bothersome when they are all or predominantly of the same sign.

Outliers can incur the suspicion that they arose from some causal process different from that operating on the bulk of the data, usually an error in recording or data input. In the case of outliers in this dataset, I went back to the original interview documents and made sure that the outliers did not result from mistakes in data input. Typically, this was not the case. There were a few outlier values for some of the dependent variables (especially capital invested in the firm) but, as suggested by Cohen & Cohen (1983), these outliers were left alone because they were few (less than 3 % of n) and no error could be assumed.

8 RESULTS

The results of the main empirical study are presented in the following. These results are based on the quantitative survey data as well as the qualitative information gathered during the research interviews. No tape recorders were used in the interviews. Hence the quotes are reported as I wrote them down during the interviews. Even though this approach may result in some words not being reported exactly as mentioned by the interviewees, the content of the quotes remains unchanged.

8.1 Description of sample firms

Biotechnology is a representative field of markets for technology. Even though small and medium-sized enterprises in biotechnology pursue a variety of strategies to commercialize their innovations, a large share of them rely on licensing out their product ideas at a point during the R&D process instead of taking the innovations all the way to the end markets themselves. However, saying that this would be true for all biotechnology SMEs would naturally be an over-generalization. Consequently, the analysis of the sample firms started by categorizing them according to the groups presented by Giuri and Luzzi (2004). This was done in order to ensure that the sample actually represented companies in markets for technology.

All the firms included in the study are active in product development; technology service companies (group d in Table 16) were not included. To make a distinction between the four other groups (a) (b1) (b2) and (c) (Table 16), the companies were first classified based on their sales. Companies with no sales (n=42) for the time being could be classified as companies in markets for technology because technology services (group d) were not their business focus. Of the firms with sales, the distinction between groups (a), (b1) and (b2) was made based on what the interviewees said about their customers and what their main field of business was. Those firms with sales that classified themselves in the "technology platform" category (n=23) were naturally added to that category (b1). For other firms with sales, the correct group (a) (n=8) or (b2) (n=12) was determined based on what they said about their customers when answering the open-ended questions.

Table 16 summarizes the distribution of sample firms between various market strategies. Altogether, 65 of the 85 firms surveyed are clearly operating in markets for technology, i.e. groups (c) and (b1) in Table 16. Furthermore, those 20 firms whose primary strategies are more product-oriented are still operating in markets in which licensing agreements and technology deals are common ways to trade knowledge. Thus the sample firms represent small, young companies in markets for technology.

Table 16: Empirical study firms (n=85), taxonomy of market strategies (Adapted from Giuri & Luzzi 2004)

		Company's first hand customers are…	
		Downstream companies that add their contribution to the product / idea and sell it further	Companies or consumers that use products / technologies for their own purposes without developing them further
Company sells physical products…	Yes	(a) Market for embedded technology and traditional physical supply chains (n=8)	(b1) Market for technology platforms (n=23) (b2) Market for products (n=12)
	No	(c) Market for technology (n=42)	(d) Technological services, not included in the empirical study

Of the total of 85 interviews, 58 were conducted in the US. The remaining 27 were divided between Finnish (n=20) and Swedish (n=7) companies. In Finland, the sample companies are located in the three major cities, namely Helsinki, Turku and Tampere. In Sweden, all seven companies are located in the Gothenburg area.

Additional Tables that illustrate the descriptive statistics of the sample firms are provided in Appendix 5. Some key features of these Tables are discussed in the following.

With regard to the positions of the interviewees in their respective organizations, 69 of the 85 interviewees are CEOs or founders, or both CEOs and founders of their respective firms. The remaining 16 interviewees hold managerial positions in business development. These interviewees typically represent larger firms in the sample.

In terms of business focus, most of the sample firms (n=33) provide technological tools and platforms in biotechnology. Some of these firms have a secondary line of business where they develop their own proprietary drugs or devices; 29 firms indicated drug discovery and development as their main activity and 16 firms represent the field of medical devices. One firm was categorized as a "fully integrated pharmaceutical company", but in the following analyses that include "field of business" as a variable this one firm is included in the "drug discovery and development" category. Finally, six of the sample firms indicated "diagnostics" as their main field of business.

About half of the sample firms, i.e. 42 companies, did not have sales income at the time of the interview. Nineteen of these firms had their most advanced product at the preclinical development stage, for six firms this lead product was in early stage clinical development, and 16 firms had no sales yet but had a product in late stage clinical development[33]. Of the 43 firms that were selling their product(s) at the time of the interview, 24 marketed the product(s) themselves and 16 firms had their products on markets through some kind of a licensing or third-party distribution agreement. Four firms could not provide information on the development phase of their most advanced product. Cross-tabulations for distribution and sales method against whether or not the firm has sales for the time being are presented in Appendix 5. Firms that already sell products mostly do it through their own sales and distribution, whereas those firms that are not selling anything yet hope to reach markets mostly though licensing or other kinds of partner agreements. The low Chi-square significance values ($p< 0.01$)[34] indicate that there is a relationship between the two variables. This may be an indication that even though young biotechnology firms hope to establish partnering agreements to get their products to the markets, in practice they still often end up commercializing products themselves. However, the differences in distribution and sales methods may also indicate differences in prevailing business models in various fields within biotechnology; only six (out of 30)

[33] Not all sample firms follow the standard clinical development path in the product development. However, the interviewees of firms that do not follow this standard path to FDA approval and marketing had no difficulties in assessing and placing their firms' lead product at a relevant stage along this standard pharmaceutical product development timeline.

[34] Low significance values for both tau and the uncertainty coefficient indicate that there is a relationship between the two variables.

pharmaceutical / drug discovery and development firms had sales at the time of the interviews, whereas the corresponding figure was three out of six for diagnostics firms, 11 out of 16 for medical device firms, and 23 out of 33 for tool / platform companies. Licensing agreements are commonplace, especially in the pharmaceutical sector, so it may well be that the Chi-square test results tell a story of sectoral differences rather than a mismatch between plans and reality.

In terms of firm size, all the sample firms employ 250 people or less, the average size being 38 employees. The average sample firm is six years old. The sample includes one firm that was 23 years old at the time of the interview, but most firms are very young; 88 per cent of the sample firms are 10 years old or younger. On average, 60 per cent of all company expenses are categorized under the umbrella of "R&D expenses". However, for 40 per cent of the sample firms this figure (i.e. the share of R&D expenses out of total expenses of the firm) is 80 per cent or more. Even though the average for capital raised by sample firms is 27 million USD per firm, this figure varies remarkably from one firm to another; 26 per cent of the firms had – by the time of the interview – raised one million USD or less, and 70 per cent were below the USD 18 million level.

The majority (n=59) of the sample firms have been started by teams rather than individuals. Forty-one firms have started as independent ventures, 25 interviewees categorized their firms as university spin-offs, and 17 as industrial spin-offs from another company. Both university and industrial spin-offs are relatively more commonplace in the Nordic countries than in the US sample (13 university spin-offs and 6 industrial spin-offs in the Nordic countries, where the total n=27, Chi-square significance values $p < 0.05$). Altogether, 12 sample firms were publicly traded at the time of the interviews. Of these firms, 3 are in the Nordic countries and 9 in the US. Of the total of 85 firms, 35 have a separate sales and / or marketing department in their firm. Finally, 30 firms - 26 in the US and four in Finland or Sweden - have been started by a serial entrepreneur. This data (a dummy variable of yes / no for previous start-up by the same entrepreneur) is not self-reported by the interviewees but was gathered after the actual interviews based on publicly available information, mostly online. This information was available for 79 firms. Most firms report their managers' biographies on their website, and if an entrepreneur has previously started another technology firm, this information would be mentioned in the biography.

A test of means for the key firm demographic variables and the variables used in the regression analyses in the USA-based and Finland- or Sweden-based sample firms was conducted and the results are depicted in Table 17. My null (H0) and alternate (Ha) hypotheses are as follows:

H0: $M_{USA} = M_{NOR}$
Ha: $M_{USA} \neq M_{NOR}$

M_{USA}: Mean score for a given factor in the USA-based firms.
M_{NOR}: Mean score for a given factor in the Nordic (Finland & Sweden) firms.

Table 17: T-test for differences in variables, USA vs. Nordic firms[35].

	USA firms (N=58)		Nordic firms (N=27)		t-Values for Differences in Means
	Mean	S.D.	Mean	S.D.	
Age of firm, years	5.72	4.33	7.11	3.40	
Size of firm, employees	44.57	58.99	22.70	17.23	**
Patents, domestic approved	8.32	12.39	8.70	21.80	
R&D expenses out of total expenses	63.34	28.42	54.81	32.97	
MARKOR	3.80	0.46	3.77	0.41	
Stakeholders' contribution, total	21.66	12.12	17.29	8.59	*
Stakeholders' contribution, mean	3.23	.610	2.94	.487	**
Entrepreneurial orientation	3.97	.612	3.63	.538	**
Sales in 2002 (log)	7.91	2.08	6.80	1.41	*
Subjective performance assessment	3.78	0.71	3.33	0.70	***
Capital invested / year	6200	8437	1757	2647	***
Innovativeness	2.05	.948	2.12	.831	

As indicated by Table 17, the null hypothesis is rejected for firm size, stakeholders' contribution to market intelligence generation, entrepreneurial orientation, subjective performance assessment and capital invested in firm per year. Also, the null hypothesis can be marginally rejected for the "stakeholders' total contribution to market intelligence generation" and sales in 2002. The US-based sample firms are larger (number of employees), have more sales income, exhibit higher levels of entrepreneurial orientation, and have gathered more capital on a per-year-basis than their Nordic counterparts. Also, the US-based

35 *** Significant at the 0.01 level; ** Significant at the 0.05 level; * Significant at the 0.1 level

interviewees tend to be more optimistic about the performance (subjective assessment) of their respective firms than the interviewees in Finland and Sweden. Finally, the US-based managers tend to grade the importance of various stakeholders as a source of market intelligence more favorably than the Nordic managers.

8.2 Content of market orientation

Let us now move on to the analysis of the market orientation construct as the interviewees described it themselves (inductive approach). Parts of the following analysis of the content and sources of market knowledge are also reported in Renko (2006).

8.2.1 What is a market? What is market intelligence?

The more complicated the market structure of a firm, the more stakeholders there are, and hence the more constituencies the firm should include in its market knowledge. In order to study the markets of sample firms, the managers were first invited to describe their customers and competition. This was necessary given the conceptualization of market knowledge employed in the study; market knowledge comprises customer and competitor knowledge. Table 18 describes the numbers of times that various kinds of customers and competition were mentioned by the interviewed managers. The questions were open ended, and each interviewee could mention as many groups of customers and competitors as he / she wanted to.

Table 18: Customers and competitors of study firms (n=85).

Customers of the firm are…	*Number of managers mentioning this customer group (n=85)*
Other biotechnology companies	59
Medical doctors	33
Patients	29
Hospitals	16
Investors	9
Regulators	4
Insurance companies / third-party payers	4

Competitors of the firm are…	*Number of managers mentioning this source of competition (n=85)*
Both large and small firms	45
Other biotechnology companies	17
Large companies (pharmaceutical / biotech)	10
No competition	7
Attitudes and current practices	6

The field of biotechnology encompasses companies operating in a number of traditional industries – like pharmaceuticals and agriculture – and an even larger number of emerging, new technology fields, like nanotechnology, biomaterials and pharmacogenomics. The companies in this study were only selected from medical biotechnology so that comparisons of firms in terms of market knowledge would be feasible. However, even within the small number of firms included in this study there are significant differences between the kinds of customers the companies are targeting.

A closer look at the types of customers by types of firms reveals that drug discovery and development companies see (1) patients and (2) investors as their customers more often than other types of companies (Chi-square $p<0.01$). “Other biotechnology companies” were mentioned as customers by 29 out of the total 33 technology platform companies and by 20 out of the 30 drug discovery and development companies. This group was less often mentioned as a customer by medical device or diagnostic firms (Chi-square $p<0.05$). The interviews revealed that whereas technology platform firms typically aim at selling their technologies to other companies, drug discovery and development firms mostly aim at licensing their innovations to other firms. Medical doctors are an especially important customer group for medical device firms and often also mentioned by drug discovery and development companies, but they are not an important customer group for technology platform firms (Chi-square $p<0.01$). In the case of medical care, the physician has the ultimate responsibility for choosing which therapy to use or which drug to prescribe, whereas the patient is the end user and in some cases also the payer of the chosen product. Even though a physician is not the customer in the sense of actually buying the product, nor is he the end user of the prescribed drug, he still dominates the end user's decision-making process to a varying degree. These kinds of stakeholders have been named "surrogate consumers" or "surrogate shoppers" in previous research (Solomon 1986; Turnbull & Parsons 1993; Hollander & Rassuli 1999).

These differences in the customer groups of various types of biotechnology firms point to the challenges researchers face when trying to generalize concepts such as market knowledge across firms. As mentioned earlier, market knowledge comprises knowledge of customers and competition. The content as well as the sources of market knowledge are very different for those whose customers are patients versus those who have other businesses as customers. Also, even though most managers mentioned that the competitor base comprises both small and large firms in the same technological area, seven managers indicated that their firm faces "no competition". This is most likely a reflection of the managers' narrow view of the competitor base based on technology; only firms developing similar technologies would qualify as competitors and if they do not exist or are not known, hence the "no competition" notion. As an example of a much wider understanding of the sources of competition, six managers mentioned "current practices and attitudes" – especially among physicians – as their competition.

8.2.2 Sources of market intelligence

Now that we have an understanding of the types of markets the firms are dealing with and the competition they face, we can move on to the question about sources of market knowledge. After asking the interviewees about the their firms' customers and competitors, I asked them to think of their markets consisting of customers, potential customers and competitors, and asked them the open-ended question "*What are the most important sources of market knowledge for your firm?*". Table 19 summarizes the answers I got. Again, every manager could mention as many sources as he / she liked with no any limitations.

Table 19: Sources of market knowledge for study firms (n=85).

Source of market knowledge:	**Number of interviewees mentioning this source (n=85):**	**% of interviewees mentioning this source (n=85)**
Industry databases	39	46
Communication with customers / potential customers	28	33
Own in-house market research	25	29
Academic publications	24	28
Informal contacts, friends	23	27
Commercially available market reports	22	26
Commercial fairs and conferences	19	22
Academic conferences	18**	21**
Partner companies	13	15
Talking to opinion leaders	11	13
Venture capitalists and investors	4	5
Focus groups	2	2

** Chi-square test, US firms vs. Nordic firms, p-value (2-sided) <0.05

T-tests were conducted in order to test for differences in the sources of market knowledge between different types of firms. There are no significant differences between very young (5 years and younger) and older (6 years and older) firms in terms of their sources of market knowledge. Also, apart from the importance of academic conferences as a source of market knowledge, there are no significant differences between US and Nordic firms. Academic conferences were mentioned as an important source of market knowledge by 16 interviewees in the US, whereas only two interviewees in Finland and Sweden mentioned them.

Spearman correlation coefficients between the items mentioned by interviewees reveal certain patterns in their answers. The interviewees that mentioned industry databases also often mentioned market reports ($p<0.01$) and academic publications ($p<0.05$) as sources of market knowledge. However, these interviewees were highly unlikely to mention communication with customers or potential customers (negative correlation coefficient with databases, $p<0.01$; and with academic publications, $p<0.05$), communication with opinion leaders (negative correlation coefficient with market reports, $p<0.05$), commercial fairs and conferences (negative correlation coefficient with both market reports and databases at $p<0.05$), and academic conferences (negative correlation coefficient with databases, $p<0.05$). The correlation coefficients between these four aforementioned items, namely (1) communication with customers or potential customers, (2) communication with opinion leaders, (3) commercial fairs and conferences, and (4) academic conferences, are significant and positive. Furthermore, the interviewees that mentioned venture capitalists or other investors as a source of market knowledge were also likely to mention partner companies ($p<0.01$), such as technology partners or suppliers, as another source. Finally, the interviewees who mentioned informal contacts and industry friends as an important source of market knowledge were highly unlikely to mention in-house market research (negative correlation coefficient, $p<0.01$) or market reports (negative, $p<0.05$) or customers (negative, $p>0.05$).

Overall, even though these results should be interpreted with caution because they are based on a small sample (n=85) of companies and nominal (dummy) variables, they do suggest a clear pattern in the ways in which firms emphasize different sources of market knowledge. It should be borne in mind that the categories presented here in the analysis actually emerged from the data; the interviewees were presented with an open-ended question on their sources of market knowledge, and they could mention as many or as few sources as they liked with no limitations or pre-determined lists.

Even though larger sample factor and cluster analyses should be employed to confirm the finding, my data roughly suggests that there are four types of biotechnology ventures when it comes to sourcing market knowledge. First, there are firms that rely on industry databases, commercially available market reports and academic publications as sources of market knowledge. However, small firms often aim at small market niches with their initial products, and the available market reports tend to cover major markets that are mostly of interest for larger pharmaceutical companies. Young, small firms often face challenges in interpreting the information available from secondary sources:

> *"We got numbers from UNOS [United Network for Organ Sharing] but we had to find out about clinical practices ourselves by calling transplantation centers and asking how much these tests cost."*

> *"It is a challenge to get good and reliable data on markets. For example, there is no data available on the potential indication we aim at with our new product because there are no competitive products currently available."*

Maybe surprisingly, many interviewees indicated that academic publications are an important source of market knowledge for them. This either reflects the fact that for early stage firms the markets are so intertwined with science that no clear-cut distinction between the two – i.e. markets and science – exists, or it may be a reflection of the scientific background of the interviewees themselves. Managers with backgrounds in science and technology are used to reading academic texts and maybe they are able to derive hints for commercial applications from that literature. University spin-offs are no more likely than other kinds of firms to rely on academic publications as a source of market data (Chi-square test between a university spin-off dummy variable and academic publications as a source of market knowledge, dummy, has a non-significant p-value of 0.598).

Second, there are firms that interact with their current customers or future customer base in order to understand their needs. These same firms often rely on the assessments of opinion leaders when it comes to information on clinical practices. In order to interact with both customers and opinion leaders, these firms actively participate in both academic as well as commercial conferences and fairs. However, typical of high-technology markets, interpreting and responding to customers' opinions is far from simple:

> *"Doctors are integrated in our R&D. Their skills and needs vary; top opinion leaders [within the medical profession] do not represent the mainstream market."*

> *"Surgeons cannot really communicate what they want. We have to find ways to get into their heads and understand what they want".*

> *"We are a small company early in the process. We cannot be responsive to customers, we are responsive to technology. The only customer information we are responsive to is the clinical trial data. We have started to go down a path* [multiple sclerosis] *and we cannot change many things anymore."*

> *"Size of market, etc., does not really guide R&D, focus group data from cardiologists does: how to make the product better?"*

Third, there are firms that consider their partner companies an important source of market knowledge. This often follows naturally from these partners' downstream position in the industry supply chain. The same companies also sometimes rely on investors for gaining understanding of customers and competition. However, further questions on the role of investors revealed that rather than providing market data to firms as such, some investors facilitate communication between their portfolio companies and in that way contribute to dissemination of knowledge between portfolio firms. On some occasions venture capitalists also provide their portfolio firms with access to market databases and reports that these firms would not otherwise purchase.

Finally, for some biotechnology firms included in the sample, the managers' personal industry friends are an important source of market knowledge. Some interviewees mentioned that they have access to expensive market reports they could not afford to buy themselves through their friends in larger firms. Even though discussions with industry friends provide firms with market insights, the reliability and relevance of this information is sometimes questionable.

Despite their small size and early development stage, many of the firms studied mentioned their own, in-house market research as a source of market data. For many firms this means ad-hoc searches online for incidence and prevalence data of diseases, for example. However, some firms had been engaged in more resource intensive and time-consuming market research activities, for example:

> *"We ourselves did an e-mail survey of dentists around the world. We sent out 20,000 questionnaires to dentists through e-mail and got 500 responses."*

By and large, this division of firms into different categories based on how they access market knowledge is in line with the results obtained earlier from the case study firms in the preliminary empirical study.

8.2.3 Dissemination and responsiveness[36]

Previous studies on market orientation have highlighted organizational culture and structures as barriers to generating and disseminating market knowledge (for a review, see Harris 1999). To understand the distribution of market knowledge within the study firms, I asked the managers to elaborate on "*How would you describe the relations between people working in marketing/sales in your firm and other "departments"*? and "*What kinds of challenges are there when you try*

[36] Parts of this analysis on dissemination and responsiveness have been previously reported in Renko (2005).

to integrate the market intelligence into your R&D?". The answers to these questions basically reflect the "departmental" friction that arises between individuals involved in R&D work – typically scientists – and those trying to make a business out of that science. At the very early stages of company development the two functions are actually carried out by the same people, the focus being on science. Later on, when dedicated business development and marketing personnel are added to the team, the communication between them and scientists presents challenges. Even though most interviewees described the relations between the two functions as "close" and "integrated", they also identified challenges in communication and integration, as illustrated by the following interview quotes:

1. *"There is a little bit of friction between the two* [marketing and R&D]. *Marketing wants to move quickly, the science side wants to critically analyse, they are more negative. PhDs are concerned about looking good to their peers, they need to be critical. On the other hand, investors are very cautious about negative information and signals."*

2. *"All this* [market knowledge] *can now be integrated in my head. The biggest challenge is to put everything together, to turn this into priorities is actually easy."*

3. *"At a certain stage NPD* [new product development*] requires commercial info; we [*business development*] come together with R&D at proof of concept stage."*

4. *"Our in-house marketing is three people. The relationships between them and the rest of us are cooperative but embryonic. The challenge is that, depending on the development stage of products, the focus shifts between various departments. First you are concerned about discovery, then development, finally sales."*

5. *"We are a small firm, the relations are good. Still, there are some tensions: scientists want to validate everything and they do not want to over-promise. Scientists are actually the best salespeople."*

6. *"Everyone in the firm is a scientist. That is why market information is not disseminated so well. However, when Ben* [Business development manager]

hears something important about the markets he shares it with the others and they are normally interested. But scientific info is much better disseminated."

The field of biotechnology itself was mentioned by some interviewees as a challenging arena for combining market knowledge into R&D. The long product development timescales of medical products - especially pharmaceuticals - and scientific uncertainty of this development are reflected in the role that market knowledge gets in these firms. Overall, the less developed the product concept of the firm, the more difficult it is to talk about rigorous market research and knowledge. At an extreme, it may well be that the company does not initially know the potential its technologies have when applied to commercial purposes. When the goal of product development is not clear, it is naturally very difficult to gain knowledge of the markets for that product.

7. *"We should actually develop our products backwards. We first think about where the drug is most likely to work, only after that you think about the size of the market. You ask yourself what is the market where you can have most impact and thus charge higher prices."*

8. *"It is really hard to predict what will happen in the markets. Most breakthroughs arise from a backup plan of a small firm turning out to be more valuable than anticipated, not from a primary project being easier than anticipated."*

Table 20 summarizes the points discussed above through a focus on barriers that prevent market intelligence dissemination and responsiveness in the sample firms. The points in the Table emerge from the qualitative data analysis. The numbers in parentheses after each "barrier" refer to the numbered quotes above.

Table 20: Barriers to market intelligence dissemination in sample firms based on qualitative data analysis. (Numbers in parentheses refer to the numbered interview quotes on previous pages)

Locus of barrier	
Industry	*Science*: Technological and scientific advances drive the development of biotechnology; commercial issues have a somewhat secondary role when science dominates. (6,7,8) *Long NPD processes*: Long product development timescales because of regulatory requirements in biotechnology → what is the "right" stage to incorporate market knowledge into NPD? (3,4)
Organization	*Science and funding*: Companies started by scientists, funded for their technology → focus on science and technology. (6,7) *Growth*: Rapid growth brings challenges to internal communication. (3)
Individuals	*Mental models*: Different mentalities and goals of scientists vs. business people. (1,4) *Role of marketing*: "Anyone-can-do" mental model related to marketing and sales among scientists. (2)

Taken together, the points listed in Table 20 can prevent the distribution of market-related information, not only within individual firms but also within collaborative organizations typical for biotechnology. On the other side of the coin, as the following analysis shows, partners are often viewed as an important source of market-related information by biotechnology entrepreneurs.

8.2.4 Stakeholders' contribution to market orientation

As described above, some interviewees mentioned partnering firms and other stakeholders as sources of market intelligence, whereas others did not. A more quantitative view of each stakeholder groups' contribution is provided by Table 21 and Figure 13. Here, the average rating of each stakeholder group as a source of market intelligence is presented in numeric form (Table 21) as well as graphically (Figure 18). Not surprisingly, marketing partners and licensors, i.e. partners that have a downstream position in the industry value chain, on average received higher ratings for their contribution to market intelligence generation. Also, informal contacts (industry friends) have a high ranking. Partners that typically represent technological rather than market knowledge, like universities and R&D / technology partners, were also considered, on average, to be a rather important source of market intelligence. Overall, based on the qualitative data as well as the quantitative descriptive figures, we can conclude that partnering firms and other stakeholders are important sources of market intelligence for many of the sample firms.

Table 21: Descriptive figures for twelve stakeholder groups' contribution to market knowledge (1=lowest, 5 = highest)

		n	*Mean*	*Median*	*Std. dev.*
Suppliers of equipment	…help in knowing customer needs.	81	2.2	2	1.3
	…help in detecting changes in the environment.	82	2.5	2	1.4
Contract research and manufacturing companies	…help in knowing customer needs.	68	2.5	2	1.3
	…help in detecting changes in the environment.	68	2.8	3	1.4
R&D and technology partners	…help in knowing customer needs.	72	3.6	4	1.2
	…help in detecting changes in the environment.	72	3.7	4	1.2
Universities and other non-profit collaborators	…help in knowing customer needs.	78	3.2	3	1.3
	…help in detecting changes in the environment.	79	3.4	4	1.3
Licensors	…help in knowing customer needs.	36	3.8	4	1.3
	…help in detecting changes in the environment.	36	3.4	4	1.5
Licensees	…help in knowing customer needs.	51	2.7	3	1.4
	…help in detecting changes in the environment.	51	2.9	3	1.5
Marketing and distribution partners	…help in knowing customer needs.	50	4.1	4	1
	…help in detecting changes in the environment.	50	4	4	1.1
Business consultants	…help in knowing customer needs.	65	3.8	4	1.2
	…help in detecting changes in the environment.	65	3.7	4	1.3
Venture capitalists	…help in knowing customer needs.	72	2.8	3	1.3
	…help in detecting changes in the environment.	72	3.1	3	1.4
Governmental (national / state) organizations	…help in knowing customer needs.	79	2.2	2	1.1
	…help in detecting changes in the environment.	80	2.7	3	1.2
Industry associations	…help in knowing customer needs.	82	2.5	2	1.1
	…help in detecting changes in the environment.	82	2.9	3	1.2
Informal contacts like friends	…help in knowing customer needs.	83	3.9	4	1.2
	…help in detecting changes in the environment.	83	4.1	4	1.1

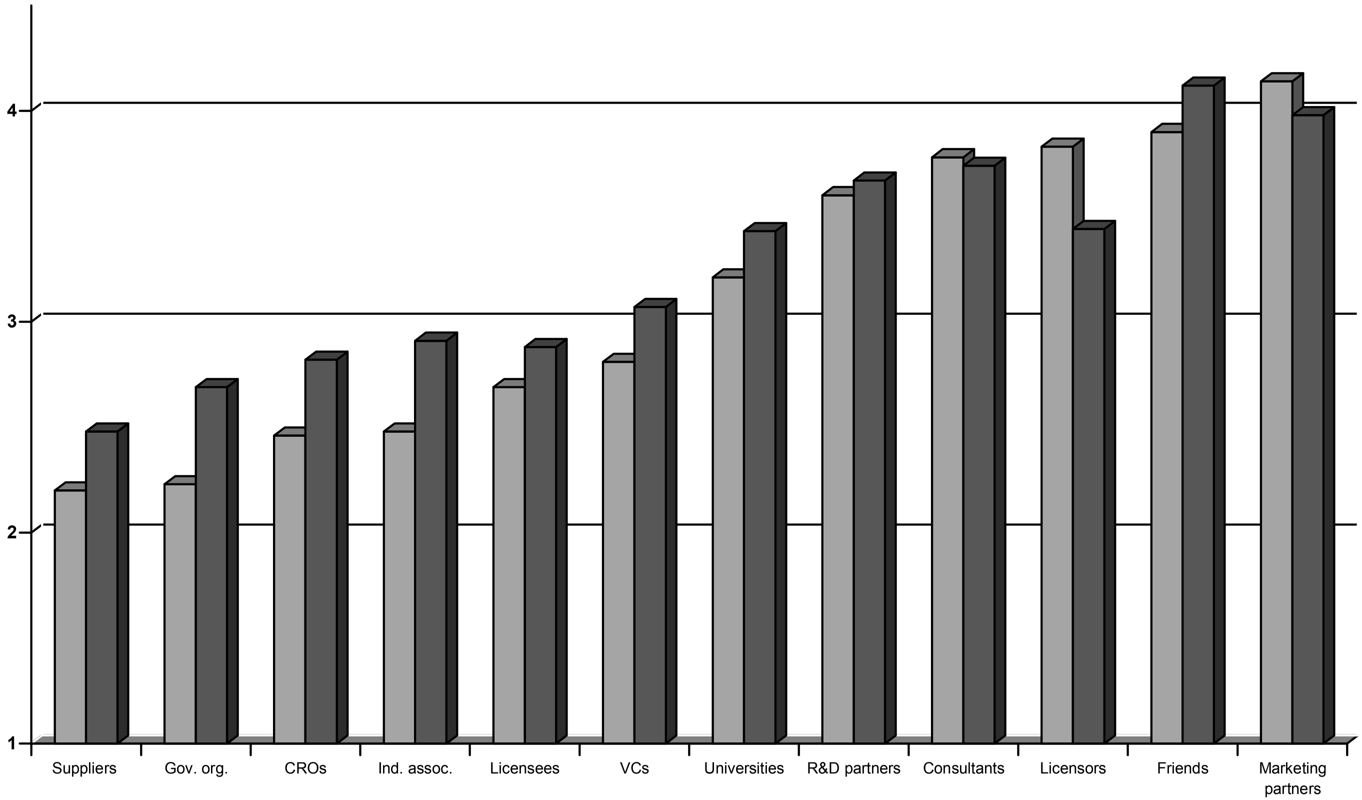

Figure 18: Stakeholders' average contribution to customer knowledge (light grey column) and environmental knowledge (dark grey column) in sample firms. (1=lowest, 5=highest)

Initially, I expected to find that the sample firms would rely extensively on external, network-based sources of market knowledge. To some extent, the results confirm this belief. However, some of my initial assumptions were obviously too naïve; even though market knowledge is sometimes channeled to a young biotechnology firm from partnering companies, this is not always the case. Some firms utilize industry and market databases and other secondary data. Others prefer to interact with customers and opinion leaders to understand their needs. Yet others rely extensively on industry friends' knowledge. The most important obstacles to wider use of external sources of information seem to be the managers' limited time combined with the fact that consulting partner firms for customer or competitor intelligence can constitute anti-competitive, illegal behavior.

Hypothesis three predicts that a stakeholder's position further down in the industry value chain is positively related to market intelligence from that stakeholder. The qualitative analysis summarized in Table 19 and the related Figure 18 provide anecdotal evidence to support this hypothesis; marketing partners and licensors are rated as important sources of market knowledge, whereas suppliers and licensees are less important.

To assess the hypothesis, stakeholder groups were ordered according to their position in the industry value chain from the perspective of R&D-intensive small firms that aim at licensing out their innovations. For most stakeholder groups considered in the study, it is impossible to define a position in the industry value chain since they operate in multiple parts of the industry. For example, contract research organizations can assist young R&D startups at very early stages of research and development, or at the end of clinical trials. Table 22 lists the ordering of those stakeholders that can be placed rather unambiguously based on the biotechnology industry literature and the qualitative insights gained in the preliminary study and qualitative part of the main study.

Table 22: Position of different stakeholders along the biotechnology value chain

Stakeholder group	***Order in industry value chain, 1=furthest away from end markets; 4=closest to end markets***
Suppliers of equipment	1
Contract research and manufacturing companies	n/a
R&D and technology partners	2
Universities and other non-profit collaborators	n/a
Licensors	3
Licensees	2
Marketing and distribution partners	4
Business consultants	n/a
Venture capitalists	n/a
Governmental (national / state) organizations	n/a
Industry associations	n/a
Informal contacts like friends	n/a

The correlations between stakeholders' positions (Table 22) and their importance as a source of market knowledge (Table 21) were analyzed to test Hypothesis one. It turned out that there is a positive correlation of 0.890 (significant at $p < .05$) between the importance of a stakeholder as a source of market knowledge and the position of the stakeholder further down in the industry value chain. Hence there is support for Hypothesis three. This finding is also in line with the results of Hernández-Espallardo and Arcas-Lario (2003), who show that in a channel partnership where the downstream firm is the leader there are reasons to believe that this company has superior market knowledge that can be transferred to its upstream partner.

8.3 Consequences of market orientation[37]

The exploration of data started with tests for the normality and linearity of the variables. Potential outliers were also identified. To test normality, Kolmogorov-Smirnov, as well as Shapiro-Wilk, tests were completed, and skewness values were computed for each variable. For most variables, normal Q-Q plots did not indicate major problems with normality. However, for “capital invested in the firm”, “innovativeness”, “number of employees”, “patents” and “annual sales turnover 2002” the Q-Q plots did not follow the desired pattern. Box plots were analyzed in order to detect outliers. Table 23 summarizes the key characteristics of these initial analyses.

[37] Some results presented here about the consequences of market orientation have also been presented at the 2nd Symposium on the Entrepreneurship – Innovation – Marketing Interface, Universität Karlsruhe, October 6-7, 2005, Karlsruhe, Germany. (No proceedings)

Table 23: Data characteristics (consequences of market orientation)

	n	Mean	Min/ Max values	Standard deviation	Number of moderate / extreme outliers	Skewness	Kolmogorov-Smirnov/ Shapiro-Wilk test for normality (** indicates significant at p<.05)
Subjective performance assessment i)	84	3.64	1.14/5	.731	0/0	-.737	**
Capital raised by the firm, USD thousands	70	27067	0/ 315000	50263	1/4	3.494	**
Innovativeness ii)	77	12.23	1/84	14.24	0/2	2.968	**
USA vs Scandinavia	85	.68	0/1	.468	-	-.798	ns
Time on market iii)	83	9.62	0/25	5.016	0/0	.656	ns
Number of employees, current	85	37.62	1/250	50.57	1/1	2.822	**
Patents, mean of USPTO and reported domestic approved patents	85	6.07	0/57	9.68	1/2	2.672	**
Share of R&D expenses (%) of all the expenses of the firm	80	60.46	0/100	30.10	0/0	-.533	ns
Market orientation (scale mean)	85	3.79	2.67/4.76	.439	0/0	-.237	ns
Entrepreneurial orientation (scale mean)	85	3.86	1.71/5.00	.608	0/2	-.655	ns
Stakeholders' contribution to market knowledge (mean)	84	3.13	1.63/4.54	.587	0/0	.055	ns
Stakeholders' contribution to market knowledge (total contribution)	84	20.26	2.9/49	11.25	0/0	.695	ns
Annual sales turnover 2002, USD thousands	36	7876	0/69300	17502	0/3	2.818	**

i) Mean of subjective performance scale, 7 items
ii) A sum of 3 variables: (1) New product introductions to markets, (2) Discontinued projects, and (3) End products that are / have been developed based on the company's invention(s).
iii) 2003 minus the actual / estimated year of product launch +9 (positive value for all firms)

Based on tests for normality (Table 23) and the skewness values, the following transformations were completed for the variables in the analysis to assure normality. The maximum value of the subjective performance assessment is 5, so the transformed value for this variable is computed as LG10(6-X).

Table 24: Data transformations

	Skewness of the original variable	Transformation	Skewness after transformation
Subjective performance assessment	-.737 (substantial negative)	Reflect & logarithm LG10 (K-X)[38]	-.151
Capital raised by the firm per year, USD thousands	3.494 (severe positive)	Logarithm LG10(X)	-.588
Innovativeness	2.968 (severe positive)	Logarithm LG10(X)	.265
Number of employees, current	2.822 (severe positive)	Logarithm LG10(X)	.019
Patents, mean of USPTO and reported domestic approved patents	2.672 (severe positive)	Logarithm LG10(X)	.155
Annual sales turnover 2002, USD thousands	2.818 (severe positive)	Logarithm LG10(X)	.316

After these transformations the variables were tested for normality and linearity again. High significance values (p>.05) of the tests for normality indicate that the distribution of the data does not differ significantly from a normal distribution after the transformations. The correlations between variables are presented in Table 25.

[38] K = a constant from which each score is subtracted so that the smallest score equals 1.

Table 25: Correlations for dependent and independent variables in the regression analysis (Pearson) (N=85)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Subjective performance assessment (transformed)	1												
2. Capital invested in firm per year (log)	-.32**	1											
3. Innovativeness (log)	-.14	.32*	1										
4. Sales turnover in 2002 (log)	.08	.42	.28	1									
5. Location, USA / Scandinavia	-.30**	.36**	-.04	.30	1								
6. Time on market	.11	-.28*	.15	.05	-.14	1							
7. Current number of employees (log)	-.14	.67**	.35**	.64**	.10	.04	1						
8. Patent count (log)	.02	.36**	.36**	.39*	.17	.00	.38**	1					
9. Share of R&D expenses of all expenses of the firm	-.16	.13	.22	-.17	.14	-.49**	-.07	.17	1				
10. Market orientation (MARKOR) scale mean	-.22*	.22	.16	.40*	.03	-.16	.15	.19	.15	1			
11. Stakeholders' contribution to market knowledge (total)	-.09	.18	.02	.25	.15	-.12	.42**	.06	-.02	.06	1		
12. Stakeholders' contribution to market knowledge, mean	-.09	.10	-.11	.07	.23*	-.04	.19	-.11	-.06	.02	.76**	1	
13. Entrepreneurial orientation, scale mean	-.28**	.08	.08	.10	.26*	-.33**	-.02	-.09	.35**	.30**	.08	.16	1

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Hypothesis one predicts that a firm's market orientation is positively related to market intelligence from external stakeholders. Hypothesis two predicts that entrepreneurial orientation is positively related to technological capability.

The correlations in Table 25 reveal that the market orientation measurement (MARKOR) is not significantly related to market intelligence from external stakeholders (mean or total). The correlations are low (0.06 and 0.02) and insignificant. Hence there is no support for Hypothesis one; a firm's internal market orientation does not seem to operate as an "absorptive capacity" (Levinthal and March 1993) allowing a firm to channel more market knowledge from its stakeholders to the firm. It may also be that the measurement of stakeholders' contribution to market knowledge is not a very successful one. For example, rather than averaging the contribution of all twelve stakeholder groups, one should maybe only focus on some stakeholders that are the most important for each individual firm.

The correlations also reveal that entrepreneurial orientation is, indeed, significantly and positively related to a firm's level of R&D expenditure ($r= 0.35$, $p<0.01$). This provides support for Hypothesis two. The second measurement for technological capability, i.e. patents, however, is not significantly related to entrepreneurial orientation. A possible explanation is that entrepreneurial orientation and R&D investments tell about the long-term commitment to the innovation and innovative culture of the firm. Patents, for their part, are a measurement of innovative output rather than culture. As a conclusion, there is partial support for Hypothesis two.

Interestingly, as mentioned in Chapter 7 when the validity of the MARKOR measurement was analyzed, there is a significant positive correlation between entrepreneurial orientation and market orientation. This is a confusing result. It either indicates that in the case of biotechnology startups the two constructs are, indeed, related, or that there is a common method bias in the answering patterns of the respondents. The latter explanation is unlikely since the business philosophy items used to establish the discriminant validity of the MARKOR measurement (see discussion earlier in Chapter 7) were negatively or non-significantly correlated with the MARKOR items. The first explanation gains some support from Kohli and Jaworski (1990, 15): in order to implement a market orientation in an organization "senior managers also need to develop positive attitudes toward change and a willingness to take calculated risks". It should also be noted that market orientation and entrepreneurial orientation are highly correlated in the Atuahene-Gima and Ko (2001) study, $r = .39$, $p < 0.001$.

The relationships predicted in Hypotheses 4-7 were assessed through a regression analysis. At the first step, control variables for firm location, size and time it has marketed its products (or the estimated time to product launch if not on markets yet) were introduced to the model. At the second step, the two technology capability variables were added. The third step measures the effect of market orientation and network-derived market knowledge on the performance variables. Entrepreneurial orientation was introduced to the model at step four, and finally, the fifth step combines all predictor variables. Even though the correlations between independent variables in Table 25 do not raise much concern (except for the EO-MO correlation), the VIF multicollinearity statistic was calculated for each variable and model. All VIF values were comfortably low, including full models where entrepreneurial orientation and market orientation variables were included simultaneously.

8.3.1 Capital invested in a firm

The analysis started by investigating the relationship between market orientation, technological capability and entrepreneurial orientation, respectively, and capital invested in a firm. In Model A1 (Table 26), only control variables of firm location and time on market were introduced to the analysis. Model A1 shows that 19 per cent (Adjusted R-square) of the variance in capital invested in a firm per year is explained, and the two significant variables in the model are the firm's location (highly significant) and the length of time the firm has had its products on market (significant). US-based firms seem to attract significantly more capital than Scandinavian firms, and the longer the firm has had its products on the market, the lower the values of capital invested in the firm per year. The location effect is in line with the secondary data. Biotechnology investment trends are reflected, for example, in PriceWaterhouseCoopers (2005) report: European biotechnology sector investments totaled € 647 Million in 2003 and € 625 Million in 2004. The corresponding figures for the US are € 3,046 Million for 2003 and € 3,076 Million for 2004. More importantly, the average biotechnology deal size in Europe in 2003 was € 1.04 Million, whereas in the U.S. it was € 9.55 Million (PriceWaterhouseCoopers, 2005). As far as the effect of time on market goes, it is logical that firms that have been longer on the market have accumulated more sales. Hence instead of looking for outside investment capital, they are likely to use sales income to finance operations.

At the next step after the control model, the technological capability variables of patent count and R&D investment intensity were added to the model (Model A2). Patent count turned out to be a highly significant predictor of capital invested in a firm per year, and the model has an adjusted R-square value of 0.28. Investors seem to be aware of the empirical fact that patents have an economically and statistically significant impact on firm-level productivity and market value (Bloom and Van Reenen 2002).

Tyebjee and Bruno (1984) analyzed the investment decisions of venture capitalists and came to the conclusion that the two constructs of "market attractiveness" and "product differentiation" determined the returns expected by the investors. Market attractiveness consists of market size, growth and access to customers, and product differentiation includes uniqueness, patents, technical edge and profit margin. In light of this, it is not surprising that the market orientation variable (Model A3) also turned out to be a marginally significant predictor of capital invested. In the full model with all variables (Model A5), the effect of market orientation is actually significant at $p<.05$. Entrepreneurial orientation did not turn out to be significant in Model A4, but when all independent variables were combined in Model A5, entrepreneurial orientation actually had a marginally significant but negative effect on capital invested in the firm. This suggests that investors are more cautious with their investments in firms that rank high on the components of the entrepreneurial orientation scale: innovativeness, proactiveness and risk taking. Even though empirical evidence from previous research mainly suggests that entrepreneurial orientation is positively related to company performance (Namen and Slevin 1993; Zahra and Covin 1995; Wiklund 1999), Hart (1992) has hypothesized that entrepreneurial strategy may lead to lower rather than higher performance because of role imbalances between top management and other members of an organization.

Overall, the models seem to be robust; the directions of effects (negative / positive) and relative magnitudes of independent variables' effects remain similar in Models A1 through A5 (Table 26). When the number of observations is small ($n=85$) and the number of predictors is large, it is expected that there will be a greater difference between R-square and adjusted R-square compared with a situation when the number of observations is larger compared with the number of predictors. However, the Model A5-adjusted R-square (with eight predictors) is still better (0.34) than that of the other models. Also, the F value of all models is highly significant. To summarize the results from this full model:

- US-based firms have significantly higher values for "capital invested in firm per year" than Nordic firms,

- The longer the firm's products have been on the market, the lower the yearly capital investments in the firm,
- One of the two technological capability variables, namely that of the firm's patent count, is significantly and positively related to the amounts of capital invested in the firm,
- The firm's level of market orientation is significantly and positively associated with capital investments in the firm, and
- The entrepreneurial orientation of a firm is negatively associated with capital invested in the firm, but this relationship is only marginally significant.

The results are presented in a numeric form in Table 26.

Table 26: Regression results. Dependent variable: Capital invested in the firm per year, log.

	Model A1	Model A2	Model A3	Model A4	Model A5
Location, USA vs. Scandinavia	.38***	.34***	.41***	.46***	.43***
Time on market	-.26**	-.39***	-.22*	-.33***	-.40***
Firm size, number of employees (log)	c	c	c	c	c
Patent count (log)		.39***			.31**
Share of R&D expenses (%)		-.15			-.13
Market orientation (MARKOR)			.22*		.29**
Stakeholders' contribution to market intelligence generation,			.22		.19
Stakeholders' contribution to market intelligence generation,			-.24		-.06
Entrepreneurial orientation				-.21	-.24*
R-square	.22	.34	.29	.25	.44
Adjusted R-square	**.19**	**.28**	**.22**	**.21**	**.34**
F-value	**8.3*** **	**6.1*** **	**4.5*** **	**6.5*** **	**4.3*** **
Durbin-Watson	2.295	1.978	2.261	2.114	2.043

*** Significance p< 0.01, ** Significance p< 0.05, * Significance p< 0.1
c) Firm size is not used as a control variable here. Rather than contributing to capital invested in the firm, the size of the firm is likely to be influenced by the availability of capital.

As hypothesized, both market orientation and patents are positively related to the amount of capital invested in the firm per year. Entrepreneurial orientation has a marginally negative effect on capital invested in the full model (Model A5). Even though the existing literature mostly suggests that there should be a positive relationship between a firm’s entrepreneurial orientation and it’s performance (e.g., Lumpkin & Dess 1996; Zahra 1991; Zahra 1993), there are also studies that are more critical of the performance consequences of entrepreneurial orientation. For example, Covin & Slevin (1988, 1990) suggest that entrepreneurial orientation does not always lead to growth and profitability. Recently, Walter, Auer and Ritter (2006) found that entrepreneurial orientation did not have a direct effect on sales growth, sales per employee or profit attainment in a sample of university spin-off firms. Similar to the sample firms in this study, the firms of Walter et al. (2006) are technology-intensive. Walter et al. (2006) conclude that the entrepreneurial orientation–performance relationship depends on the context in which it occurs. Firms that operate in a technology-intensive environment do not necessarily benefit from being more entrepreneurially oriented than their competitors; the mere fact that these firms operate in a technology-intensive environment exhibits a level of innovativeness, proactiveness and risk taking. However, even if not related to financial performance, entrepreneurial orientation may still produce worthwhile non-financial contributions (Zahra 1993). For example, Walter et al. (2006) find that entrepreneurial orientation contributes to the relational capital of the firm.

8.3.2 Innovativeness

An attempt to measure a firm's innovativeness is, indeed, a challenging task. As mentioned earlier, in this study the proxy adopted for a firm's innovativeness includes a sum of (1) New product introductions to markets; (2) New product development projects started; and (3) End products that are / have been developed based on the company's invention(s). All of these items are continuous, i.e. the interviewees reported an absolute number for each category. They were invited to think of the previous three years of the firm's operations and estimate the numbers for that time period. The youngest sample firms had not even existed for three years at the time of the interviews, in which case the numbers were reported for the whole history of the firm.

Model B1 in Table 27 indicates that the firm's size is strongly related to its innovativeness. Again, it should be borne in mind that this innovativeness only reflects product innovations. In addition, a case could be made for suggesting an inverse relationship between firm size and innovativeness; maybe it is not firm size that drives innovativeness, but innovativeness that actually allows a firm to grow. Unfortunately, the cross-sectional data in this study lends itself poorly to causal interpretations. When technological capability variables are introduced to the model (Model B2), the adjusted R-squared value rises from 0.11 (for Model B1) to 0.19 (for Model B2). "Share of R&D expenses" is a marginally significant predictor of innovativeness in this model, and the number of patents the firm holds has a significant, positive relationship to (product) innovativeness. In

Models B3 and B4, the market orientation and entrepreneurial orientation variables were added to the control model, respectively, but neither of these variables turned out to be a significant predictor of a firm's innovativeness. The full model (B5) with all independent variables included has an adjusted R-squared value of 0.18, but the only significant predictor of innovativeness in this model is firm size.

Table 27: Regression results. Dependent variable: Innovativeness, log.

	Model B1	Model B2	Model B3	Model B4	Model B5
Location, USA vs. Scandinavia	-.06	-.06	-.01	-.10	-.02
Time on market	.14	.17	.18	.20*	.19
Firm size, number of employees (log)	.35***	.27**	.34***	.36***	.32**
Patent count (log)		.27**			.26
Share of R&D expenses (%)		.24*			.19
Market orientation (MARKOR)			.15		.10
Stakeholders' contribution to market intelligence generation,			.01		-.01
Stakeholders' contribution to market intelligence generation,			-.19		-.19
Entrepreneurial orientation				.19	.04
R-square	.14	.26	.18	.17	.30
Adjusted R-square	**.11**	**.19**	**.11**	**.12**	**.18**
F-value	**4.0****	**3.8*****	**2.4****	**3.7*****	**2.4****
Durbin-Watson	1.823	2.055	1.857	1.887	2.089

*** Significance p< 0.01, ** Significance p< 0.05, * Significance p< 0.1

Again, the models in Table 27 seem to be robust; the directions of effects (negative / positive) and relative magnitudes of independent variables' effects remain somewhat similar in Models B1 through B5. When the adjusted R-squared value is used as a criterion, Model B2 with the control variables and technological capability variables should be preferred. To summarize the results from Table 27:

- Larger firms (in terms of numbers of employees) have higher levels of (product) innovativeness than smaller firms. However, because of the lack of longitudinal data it is impossible to say whether larger firm size leads to more innovations or whether innovative product introductions allow firms to grow faster. Most likely, the relationship is cyclical.
- Technological capability is positively related to innovativeness. The number of patents a firm has is significantly and positively related to the firm's innovativeness, and the level of the firm's R&D investments is a marginally significant predictor of innovativeness. Because of the small number of cases these relationships are not significant in the full model with nine predictors, but the effects are there when the technological capability variables are combined with the control variables (five predictors).
- Neither the market orientation nor entrepreneurial orientation variables turn out to be significant predictors of a firm's innovativeness.

Innovativeness is one of the components measured as part of a firm's entrepreneurial orientation (innovativeness, proactiveness, risk taking). In this study, entrepreneurial orientation was measured using a 5-point Likert scale (See Appendix 2 for interview questionnaire). Items such as "…having very many lines of products or services under research and development", "top management favoring a strong emphasis on R&D, technological leadership and innovations", and the firm being "very often the first business to introduce or involve in the development of new products/services, administrative techniques, operating technologies" in the entrepreneurial orientation measurement essentially reveal the "innovation orientation" of the firm. Thus one would expect to find a strong correlation between a firm's entrepreneurial orientation and "innovativeness" when measured as a dependent variable. However, as shown earlier in Table 25, the correlation between a firm's innovativeness and entrepreneurial orientation is almost non-existent. This is indeed surprising, but some logical explanations for the lack of relationship can be found. First, it may be that instead of actually measuring innovativeness, the entrepreneurial orientation construct here measured with the seven items actually measures mostly proactiveness and risk-taking - that is, the two other components of entrepreneurial orientation. As pointed out by Lyon, Lumpkin and Dess (2000, 1059), it might be difficult to determine the sources of variability in a firm's entrepreneurial orientation.

Another, and more likely, explanation is that the entrepreneurial orientation construct measures innovativeness as an attitude and "culture" within the firm, whereas the innovativeness measurement used as a dependent variable in this study only focuses on *product* innovation; it does not take innovativeness into account as far as it pertains to managerial practices, process improvements and continuous non-product types of innovations. It is very possible that the kind of innovativeness measured by the entrepreneurial orientation construct materializes in the form of new product innovations as well, but, especially in a field like biotechnology, these developments take time. Unfortunately, the current data only reflect a cross-section of time. The correlations (Table 25) reveal that even though entrepreneurial orientation is not related to the (product) innovativeness measurement, it shares a significant positive correlation with "Share of R&D expenses of a firm's total expenses". Patents, again, are significantly and positively correlated with the (product) innovativeness measurement. A feasible interpretation of these relationships is that innovativeness and patent numbers reveal the current innovativeness of the firm as far as it relates to products developed and in development. R&D expenses and entrepreneurial orientation, for their part, can reflect the future innovation potential of the firm. As theorized by Lumpkin and Dess (1996, 136): "An entrepreneurial orientation refers to the processes, practices, and decision-making activities that *lead to* new entry". This dynamic relationship, however, remains speculation for the time being, and only additional data collection in the future can actually provide evidence of this suggested causal relationship.

8.3.3 Sales

The only robust, significant finding about the sources of superior sales performance concerns firm size; the larger the firm (in terms of the number of employees), the more sales income it had in 2002. However, as was the case with innovativeness and firm size, the cross-sectional data in this study makes it impossible to say whether larger firm size leads to more sales or whether larger sales income allows a firm to grow. As with innovativeness, we can speculate that the relationship is most likely cyclical.

Neither technological capability variables nor entrepreneurial orientation (Models C2 and C4) in Table 28 are significant predictors of sales income. The introduction of market orientation to the model (Model C3) increases the adjusted R-square value of the model from 0.40 (for the control model) to 0.50. Even though the contribution of the market orientation variable is only marginally significant and positive, the effect of “time on market” (a control variable) turns out to be significant when considered together with market orientation. Model C3 shows that 50 per cent (adjusted R-square) of the variance in sales is explained, and the three significant variables in the model are (1) the length of time the firm has had its products on the market, (2) firm size (highly significant), and (3) the level of market orientation (marginally significant). Previous studies have typically looked at sales growth instead of absolute sales as a dependent variable (Rodriguez Cano et al. 2004), which makes exact comparisons between the current results and those of previous studies rather difficult. Measuring sales growth in this study would have given a biased view of the firm’s performance since many companies either have not had sales income before the year 2002 (year of current sales data) or have just launched their first product(s) recently, in which cases the yearly growth figures could have easily reached multiple hundreds of per cents.

Table 28: Regression results. Dependent variable: Sales in 2002, log.

	Model C1	Model C2	Model C3	Model C4	Model C5
Location, USA vs. Scandinavia	.08	.14	.18	.07	.19
Time on market	.21	.15	.32**	.30	.24
Firm size, number of employees (log)	.66***	.54***	.64***	.65***	.40*
Patent count (log)		.23			.14
Share of R&D expenses (%)		-.11			-.10
Market orientation (MARKOR)			.31*		.32
Stakeholders' contribution to market intelligence generation,			.05		.47
Stakeholders' contribution to market intelligence generation,			-.28		-.54
Entrepreneurial orientation				.15	.06
R-square	.46	.51	.59	.47	.67
Adjusted R-square	**.40**	**.40**	**.50**	**.39**	**.49**
F-value	**7.8*** **	**4.5*** **	**6.1*** **	**6.0*** **	**3.8*** **
Durbin-Watson	2.175	2.289	2.485	2.240	2.439

*** Significance p< 0.01, ** Significance p< 0.05, * Significance p< 0.1

Even though the adjusted R-square values of the models predicting sales are very comfortable – and higher than those seen for other dependent variables so far - and the F-values are significant as well, the relevance of these models is somewhat downplayed by the fact that firm size has such a dominant role in all models. Establishing a relationship between firm size and the level of sales really does not add much to our theoretical understanding of what drives firm performance. Outside of the regression models presented in Table 28, it is interesting to note that there is no correlation (Pearson r = -0.05, non-significant) between the sales of a firm on the one hand, and its sales-oriented business philosophy on the other[39].

8.3.4 Subjective performance assessment

An overwhelming majority of the market orientation studies included in the meta-analysis of Rodriguez Cano et al. (2004) employed a subjective performance assessment (e.g. self-reported) from a respondent as a dependent variable instead of – or sometimes, in addition to – a more objective performance measurement (e.g. ROI, market share, sales growth). The results of the meta-analysis show that objective and subjective measurements of business performance are statistically different, and the relationship between market orientation and business performance is stronger when a subjective scale rather than an objective scale is used to measure business performance (Rodriguez Cano et al. 2004). Based on these aggregated results from the existing body of literature, one would expect at least Model D3 (Table 29) to have both a significant F-value as well as a high R-square value. The F-value is, indeed, significant, but the adjusted R-square value of 0.09 is low; in fact, it is lower than the corresponding value for three other dependent variables regressed against the control and market orientation variables (Models A3, B3, and C3) presented above. This finding goes counter to the meta-analytic results of Rodriguez Cano et al. (2004), based on which we would expect the adjusted R-square value of Model D3 to be higher than that of Models A3, B3 or C3.

The respondents from the US-based firms give more positive ratings of their firms' performance than the Nordic respondents. The technological capability variables are not related to the subjective performance assessment (Model D2), but when introduced to the models separately, both market orientation (Model D3) and entrepreneurial orientation (Model D4) are significantly and positively[40] related to the subjective performance assessment. The model with entrepreneurial orientation (D4) has the highest adjusted R-square value (0.12) and also an F-value that is significant at $p< 0.01$. This positive effect of entrepreneurial orientation on the subjective performance assessment also pertains (marginally significant) in the full model (Model D5), but because of the large number of predictors introduced in this model compared with the number of cases, the F-

[39] This sales-oriented philosophy was measured as part of the MARKOR validation scale, see "Business Philosophy" items in the interview questionnaire. Based on Harris (2002, 2001), Deng and Dart (1994) and Peterson (1989).

[40] Note: Because of data transformation, negative coefficients reveal a positive relationship.

value of this full model is only marginally significant. Interestingly, in the full model (D5) the number of patents is negatively and marginally significantly related to the subjective performance assessment.

Table 29: Regression results. Dependent variable: subjective performance assessment. *Note: Because of data transformation, negative coefficients indicate a positive relationship.*

	Model D1	Model D2	Model D3	Model D4	Model D5
Location, USA vs. Scandinavia	-.29***	-.26*	-.30***	-.24**	-.19
Time on market	.07	.02	.03	-.00	-.07
Firm size, number of employees (log)	-.09	-.17	-.08	-.11	-.18
Patent count (log)		.19			.24*
Share of R&D expenses (%)		-.15			-.14
Market orientation (MARKOR)			-.22**		-.19
Stakeholders' contribution to market intelligence generation,			.04		-.12
Stakeholders' contribution to market intelligence generation,			-.02		.19
Entrepreneurial orientation				-.24**	-.25*
R-square	.11	.14	.16	.16	.24
Adjusted R-square	**.08**	**.07**	**.09**	**.12**	**.12**
F-value	**3.3****	**1.9**	**2.4****	**3.7*****	**2.0***
Durbin-Watson	1.727	1.864	1.690	1.698	1.909

*** Significance p< 0.01, ** Significance p< 0.05, * Significance p< 0.1

The initial reaction to using perceptual measurements of performance is obvious: Are the informants honest (Huber and Power, 1985)? Is their response a reflection of what is or what should be? The fact that the US-based managers seem to systematically regard their respective firms' performance better than the Nordic managers points to the possibility that instead of actually referring to firm performance, the subjective assessment may reveal a cultural bias in the way the managers communicate their firms' performance. However, as mentioned above, in terms of capital invested in firms, the US-based firms are, indeed, doing much better than their Nordic counterparts. In that sense, the American managers' favorable performance assessments are justified.

Even though only marginally significant, it is interesting that there seems to be a negative relationship (in the full model) between the subjective performance assessment and the firm's number of patents. This makes little sense, especially when patents are significantly and positively related to innovativeness and capital invested in the firm per year (Models A2 and B2). Again, this could be a sign of single method / respondent bias; some respondents may have a tendency to systematically rank their firms higher on perceptual scales, like those of market orientation, entrepreneurial orientation and subjective performance assessment. Furthermore, these respondents may represent firms that have fewer patents in their possession than an average sample firm. However, once again, this remains speculation for the time being because of the small sample size.

8.4 Summary of results

Table 30 summarizes the results of the empirical study as far as the hypotheses are concerned. These results will be reflected in light of the existing literature as well as the qualitative interview data collected in the final chapter of this thesis.

Table 30: Results by hypothesis

Hypotheses	**Support**
H1: Market orientation is positively related to market intelligence from external stakeholders.	Not supported
H2: Entrepreneurial orientation is positively related to technological capability.	***Partial support***[41]
H3: A stakeholder's position further down in the industry value chain is positively related to market intelligence from that stakeholder.	***Supported***
H4a: Market orientation is positively associated with innovativeness.	Not supported
H4b: Market orientation is positively associated with capital invested in the firm.	***Supported***
H4c: Market orientation is positively associated with the manager's perceived performance of the firm.	***Supported***
H4d: Market orientation is positively associated with sales.	***Marginal support***
H5a: Market intelligence from external stakeholders is positively associated with innovativeness.	Not supported
H5b: Market intelligence from external stakeholders is positively associated with capital invested in the firm.	Not supported
H5c: Market intelligence from external stakeholders is positively associated with the manager's perceived performance of the firm.	Not supported
H5d: Market intelligence from external stakeholders is positively associated with sales.	Not supported
H6a: Technological capability is positively associated with innovativeness.	***Supported***
H6b: Technological capability is positively associated with capital invested in the firm.	***Partial support***[42]
H6c: Technological capability is positively associated with the manager's perceived performance of the firm.	Not supported

[41] R&D intensity is related to entrepreneurial orientation, but patent count is not.
[42] Strong support for the patent-capital invested relationship, but no support for R&D intensity as a predictor of capital invested.

Hypotheses	**Support**
H6d: Technological capability is positively associated with sales.	Not supported
H7a: Entrepreneurial orientation is positively associated with innovativeness.	Not supported
H7b: Entrepreneurial orientation is positively associated with capital invested in the firm.	Not supported
H7c: Entrepreneurial orientation is positively associated with the manager's perceived performance of the firm.	***Supported***
H7d: Entrepreneurial orientation is positively associated with sales.	Not supported

As Table 30 indicates, of the total of 19 hypotheses, the empirical data supported seven. In addition, one hypothesis got marginal ($p < 0.1$) support from the empirical data, but the lack of statistical power of the tests suggests a cautious approach to the interpretation of that result.

9 DISCUSSION AND CONCLUSIONS

This study was designed to answer two critical questions about the nature of market orientation in markets for technology: What are the components of behavioral market orientation in markets for technology?, and what are the performance implications of market orientation in markets for technology? These questions have now been addressed in the light of the established market orientation, technology management, entrepreneurship and strategy literature. Also, 91 biotechnology ventures have been consulted in the process of answering the questions. The purpose of this final chapter is to discuss the main findings of the study and make the theoretical and managerial contributions of the research explicit. I start by summarizing the answers to the two research questions, after which the theoretical, managerial and methodological contributions of the research are assessed in more detail.

To assess the components of behavioral market orientation, I adopted a qualitative research approach. This approach is similar to Kohli and Jaworski's (1990) seminal contribution that has laid the foundation for behavioral market orientation research. A qualitative research approach allowed me to understand the components of market orientation from the perspective of the practitioners in the field. The components of this market orientation can be summarized under three topics. First, although assessment of customer needs is the cornerstone of market orientation, defining customers is not simple. Even though the study firms represent a uniform field of economic activity, namely biotechnology, there is a lot of variation in the stakeholder groups that the respondents call customers. For some firms, customers are the potential licensors of the firms' innovations. For others, customers equal scientific research laboratories, hospitals or health management organizations. Many firms perceive end users of the products as customers, but many do not. This challenge in defining customers was also discovered by Kohli and Jaworski (1990).

Second, of the three components of behavioral market orientation, namely market intelligence generation, dissemination and responsiveness, the first stands out in importance in young firms in markets for technology. The dissemination of market intelligence is sometimes challenging because of the different mental models of R&D and business people, but in general the departmental boundaries in young, small firms are lower than in larger companies. With regard to responsiveness, the study firms' options are often limited because changes to products and development procedures are heavily regulated by institutions like the FDA in the US. Market intelligence generation, however, is perceived as an important activity by the study firms, and firms engage in both formal and informal market intelligence generation activities. Kohli and Jaworski (1990) also point out that in addition to formal market intelligence generation, firms access market knowledge through informal means; "For example, R&D engineers may obtain information at scientific conferences" (Kohli and Jaworski 1990, 5). However, on the MARKOR scale that measures behavioral market orientation, the role of informal intelligence generation is minimal. Future measurement of market intelligence generation in a technology-intensive environment should account for the fact that informal means are the main access to market knowledge for many firms.

Third, firms in markets for technology often access market knowledge through the network of firms and individuals that they are linked to with ties of varying strength. Organizations that are positioned further downstream in the industry value chain often contribute to the market knowledge of upstream technology-intensive ventures. This finding is in line with the results of Hernández-Espallardo and Arcas-Lario (2003), who show that in a channel partnership where the downstream firm is the leader, this company has superior market knowledge that can be transferred to its upstream partner.

The performance implications of market orientation were studied together with those of entrepreneurial orientation and technological capability. Some of the hypothesized relationships were confirmed, whereas others did not hold in empirical testing. The significant relationships are illustrated in Figure 19. Market knowledge from stakeholders, the proxy for a network's effects on a firm's market orientation, is not related to the internal market orientation of a firm. Neither is the measurement related to any of the performance outcome variables. The possible explanation is that these effects take time to develop, and the current cross-sectional data is not good enough for testing the relationship. The fact that the network measurement was not related to a firm's internal market orientation means that future studies that hope to tap the network aspects of market intelligence generation have to develop separate instrument(s) for the measurement of the construct; MARKOR is not able to capture the variation in market knowledge that external stakeholders bring to a firm's market intelligence generation.

As illustrated in Figure 19, market orientation partly overlaps with the construct of entrepreneurial orientation (similar to the findings of Atuahene-Gima & Ko 2001). Entrepreneurial orientation, again, partly overlaps with the firm's technological capabilities (R&D intensity). This finding is similar to Atuahene-Gima and Ko (2001, 56), who explicitly state that entrepreneurial orientation is "akin to technological orientation because it increases the firm's ability and will to acquire new technical knowledge to build new technical solutions to meet new and latent needs of users". The relationships between the constructs in this study, however, were not tested using a factor analysis because of data limitations. One of the avenues for future research would be the examination of discriminant / convergent validity of the scales used to measure the study constructs. The overlap between the independent variables could have caused problems of multicollinearity in the regression models, but this was controlled using the VIF estimates.

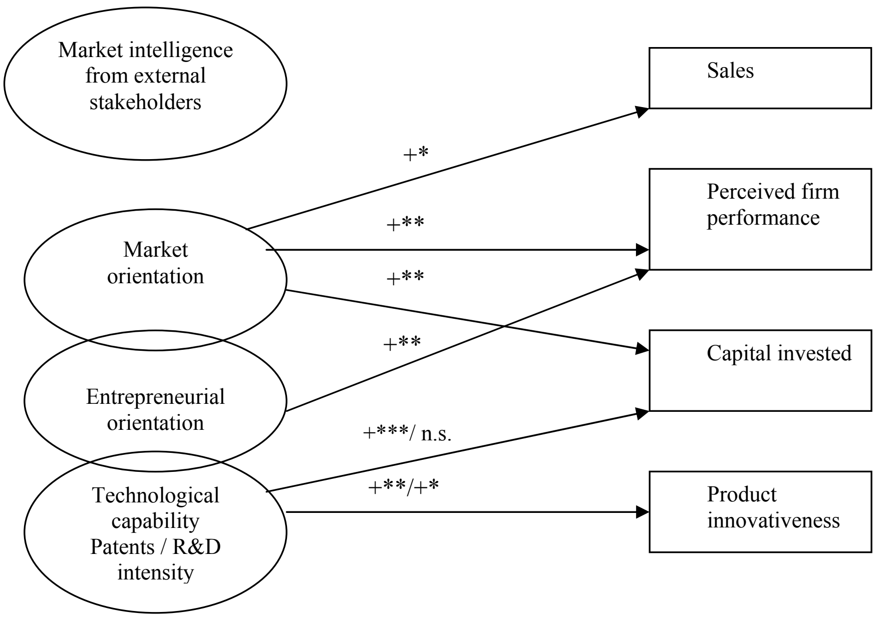

Figure 19: Findings of the empirical study concerning the consequences of market orientation[43] *** Significance p< 0.01, ** Significance p< 0.05, * Significance p< 0.1

[43] The significance levels indicated in the figure are the strongest that emerged either in the full model with all variables or in the partial model with control variables and each respective predictor.

Market orientation shares a positive relationship with the level of sales (marginal), perceived firm performance and capital invested in the firm, as illustrated in Figure 19. These findings are in line with the bulk of the literature on market orientation that has established a link between market orientation and positive firm performance outcomes (see Rodriguez Cano et al. 2004). Contrary to expectations, market orientation is not related to the product innovativeness measurements. Technological capability is a positive predictor of product innovativeness, and patent count is also positively associated with capital invested in the firm. These findings are in line with previous literature suggesting that investors evaluate both the technology/product aspects of the firm as well as its market potential when making investment decisions (see, e.g., Tyebjee & Bruno 1984; Mason & Stark 2004; Shepherd & Zacharakis 1999).

The lack of links between market orientation and product innovativeness is most likely a result of the fact that the kinds of innovations developed by these firms are typically disruptive in nature. The level of disruptiveness of a company's technology was not measured in this study, but, based on the description of the biotechnology field (Chapter 2), it is clear that these firms typically develop innovations that are disruptive in nature. In biotechnology markets, continuous innovations are typically introduced by companies that are not dependent on outside investments and, hence, can afford to have lower expectations for return on investment. The lack of link between market orientation and product innovativeness is in line with Veryzer (1998), who concludes that successful discontinuous new product development processes may not be as customer driven as continuous new product development. Ideas about new applications for emerging technologies are not apt to come from present customers. In addition, in terms of time and product familiarity, discontinuous innovation is more distant from the end market than continuous innovation; development spans of new products in medical technology take years or decades, and in the end an innovation may be incompatible with the customers' cultural values or with previously adopted ideas (Rogers 1962).

Unlike what was expected, entrepreneurial orientation is not related to product innovativeness. This is surprising since the domain of the entrepreneurial orientation construct covers innovativeness, proactiveness and risk taking (Miller 1983). The lack of relationship may be explained by the fact that entrepreneurial orientation measures innovativeness as an attitude and "culture" within the firm, whereas the innovativeness measurement used as a dependent variable in this study only focuses on *product* innovation. It does not take account of innovativeness as far as it pertains to managerial practices, process improvements and continuous non-product types of innovations. It is very possible that the kind of innovativeness measured by the entrepreneurial orientation construct materializes in the form of new product innovations as well, but, especially in a field like biotechnology, these developments take time.

Entrepreneurial orientation is not related to capital invested in the firm either. A *post hoc* analysis of this finding suggests that firms operating in a technology-intensive environment do not necessarily benefit from being more entrepreneurially oriented than their competitors; the mere fact that these firms operate in a technology-intensive environment exhibits a level of innovativeness, proactiveness and risk taking. Also, Walter et al. (2006) found that entrepreneurial orientation did not have a direct effect on sales growth, sales per employee or profit attainment in a sample of university spin-off firms (technology intensive firms). However, even if not related to financial performance, entrepreneurial orientation may still produce worthwhile non-financial contributions (Zahra 1993). For example, Walter et al. (2006) find that entrepreneurial orientation contributes to the relational capital of the firm. In this study, entrepreneurial orientation is positively related to perceived performance of a firm as rated by the respondents in the empirical study. Longitudinal data collection will reveal whether the hypothesized positive effects of entrepreneurial orientation occur over time.

9.1 Theoretical contribution of the research

9.1.1 Contributions to market orientation literature

The domain of market orientation construct. In the existing research, behavioral market orientation has been conceptualized as market intelligence generation, dissemination and responsiveness. These three components have typically been measured in empirical studies using a version of the Kohli & Jaworski MARKOR scale. Most studies have made an implicit assumption that all the three components of behavioral market orientation co-vary, and also that they all bear similar importance in terms of performance outcomes. The evidence provided from the field of commercial biotechnology in this study shows that there may be circumstances under which a firm is well informed about its customers and competition on all levels of an organization, but still its capabilities to act in accordance with this market knowledge are limited. Firms in markets for technology typically invest heavily in R&D, and in order to attract venture capitalists' and other investors' money to their projects these firms need to communicate the commercial potential of the projects. The accountability of these firms to their investors is one reason why explorative R&D strategies that are sensitive to new market signals cannot be pursued. Once a firm is set on a path towards the development of a kind of a product or service that investors want to put their money in, changing course becomes expensive, if not impossible. It is not only investors' expectancies that limit the responsiveness of these ventures to market signals; the highly regulated institutional environment of commercial biotechnology also has a similar effect. Firms that develop products that have to go through clinical trials face a regulatory environment in which it is hard to step away from a path once chosen.

The finding that the three components of behavioral market orientation – generation, dissemination and responsiveness – have differing levels of importance is in line with the research results of Greenley (1995), which illustrate that firms represent different forms of market orientation. Greenley (1995) analyzed survey responses to a Narver-Slater battery of market orientation items by clustering them, and found five distinct clusters of firms. Even though the largest cluster of firms exhibited high levels of each of the three components of Narver-Slater market orientation (customer orientation, competitor orientation and interfunctional coordination), the other clusters exhibited strong emphasis on selected parts of market orientation (Greenley 1995). For example, Greenley's (1995) second cluster of firms was characterized by competitive focus and responsive actions to competitors' moves. Firms in the third cluster represented high focus on customer needs; identifying and satisfying customer needs and monitoring customer satisfaction (Greenley 1995). Using a Kohli-Jaworski market orientation conceptualization, this study describes firms that have a strong need for market intelligence generation, lower barriers for intelligence dissemination than typical incumbents, and few opportunities for rapid, reactive actions based on market knowledge.

In accordance with a somewhat positivistic line of thinking, researchers typically strive to build constructs and models that explain as much variance in the target phenomenon (e.g. firm performance) as possible. Even though some studies have reported non-significant results regarding the market orientation-performance relationship, most empirical studies have still established a positive link between the two. To ensure this positive link there is a temptation to expand the scope of the market orientation measurement. Some recent studies have expanded market orientation from its original focus on customers and competitors to include constituencies like employees (Darroch and McNaughton 2003) or proactive market-seeking activities (Narver et al. 2004). The ways in which interviewees in this empirical study spoke about their customers (inductive approach) would initially encourage a researcher to integrate a variety of new stakeholders to the domain of market orientation: Business-to-business customers, medical doctors, patients, hospitals, investors and regulators, as well as insurance companies / third-party payers are all "customers" of biotechnology ventures. The question is, how far are we willing to stretch the boundaries of the market orientation concept? Certainly, the larger the construct and the wider its measurement, the more variance in a dependent variable like firm performance will end up being explained. However, for the development of a parsimonious theory of market orientation it may actually be better to be able to explain "more with less", even if this means that the theory is only applicable to firms operating in more traditional industries with a well-defined customer base.

Defining market oriented behaviors. Qualitative evidence gathered during the current research process reveals that even though firms in markets for technology do exhibit market-oriented behaviors (i.e., they collect market intelligence, they distribute that intelligence, and they respond to it), these behaviors are not completely similar to the kinds of market-oriented behaviors suggested in the previous literature. For example, proactive market intelligence is often channeled to a firm as a "by-product" of technological collaboration. Firms also learn about their customers, like potential licensors, in scientific forums like technology conventions or through research advances reported in scientific journals. These forums have not been considered loci of learning about markets in the traditional market orientation literature. This brings us back to the question about the proper domain of market orientation. If items like "Representatives of our firm periodically attend scientific conventions" or "We collaborate with a variety of technology partners in order to learn about future customers and competition" are added to the market orientation scales, we are widening the domain of the underlying market orientation construct. If the construct of market orientation should be kept separate from, for example, the construct of technological capabilities, entrepreneurial orientation and learning, adding these kinds of items may be detrimental.

Having said this, I think the recent developments in the literature that have made a distinction between proactive and reactive market orientation and their measurement are mostly welcome. Even though these two concepts of proactive and reactive market orientation are somewhat overlapping, they may be defined to be different enough in order to justify different measurement items for the two.

I would assume that companies in markets for technology show high values for proactive market orientation (future-oriented learning about customers, customer related stakeholders and competition) and rank lower on the reactive market orientation dimension (listening to existing customers' needs and wants, and responding to them in a timely manner). In this study, the measurements for entrepreneurial orientation and market orientation share a significant positive correlation. This is most likely due to the fact that the market orientation measurement adapted from the Kohli-Jaworski MARKOR includes forward-looking items about future customers (proactiveness). Proactiveness is also a key component in the entrepreneurial orientation of the firm (Miller 1983; Covin and Slevin 1989).

The locus of market orientation. Traditionally, market orientation has been studied as a phenomenon within one organization. MARKOR items that have been used to tap the "market intelligence generation" aspect of behavioral market orientation have assumed that a firm performs a set of in-house activities in order to learn about its customers and competition. Evidence from the sample of firms in this study suggests that in the case of small networked firms, in-house activities that have been designed to collect market information only produce a part of the total market knowledge that ends up being relevant for the organization. In the sample firms, formal market research is typically complemented (and sometimes totally replaced) by *ad hoc* kinds of activities as well as market intelligence sharing with other firms and industry friends. For example, marketing partners and licensors, i.e. partners that have a downstream position in the industry value chain, were ranked as important contributors to market intelligence generation by the sample firms. Also, informal contacts (industry friends) have a high ranking. Furthermore, partners that typically represent technological rather than market knowledge, like universities and R&D / technology partners, were also considered to be an important source of market intelligence. These findings suggest that the measurement of market orientation of a firm should take account of the contributions that partnering organizations make to the market intelligence generation of a focal firm. The empirical study showed that these contributions are especially important when they come from organizations that are positioned further down in the industry value chain (closer to the end customers). Also, market knowledge not only gets disseminated within the boundaries of a single firm but actually within a network of actors, like a social network of local biotechnology entrepreneurs.

Market orientation and firm performance. The interest of researchers that have studied market orientation in the past has mostly been on establishing a link between a firm's level of market orientation and its performance. This study makes a contribution in this respect. The empirical evidence here suggests that there is a positive link between a firm's level on market orientation and (1) capital invested in the firm and (2) the manager's subjective assessment of the firm's performance. However, technological capability (patent count) is a more important predictor of capital invested than market orientation. Also, there is marginal support for the hypothesis that suggests a positive link between a firm's market orientation and sales. The different effect sizes for the models depending on the performance measurement emphasize the importance of robustness in hypothesis testing. Depending on the selected performance measurement, market orientation's contribution can be judged to be anything between insignificant and highly significant. Half of the sample firms had zero sales at the time of the interview. The fact that market orientation turned out to be a marginally significant predictor of sales suggests that market orientation may actually develop over time during the early years of a technology venture's development towards commercialization and higher sales. In line with Thieme and Song (2002), I conclude that for radical innovation projects being developed in turbulent markets like biotechnology, development teams should concentrate more on technology issues and less on the potential market in the early stages. Market intelligence gathering activities are beneficial later, at the product commercialization and sales stage. Even though not tested or supported by the current cross-sectional data, future research could investigate the following a priori model (Figure 20) concerning the effects of technological capabilities and market orientation. Rather than agreeing with the established view that market orientation affects performance through innovativeness, customer loyalty and quality (as demonstrated by the meta-analysis of Kirca et al. 2005), I suggest that in markets for technology market orientation does not affect innovativeness but moderates the relationship between superior, technology-based innovations and financial performance (like sales outcomes).

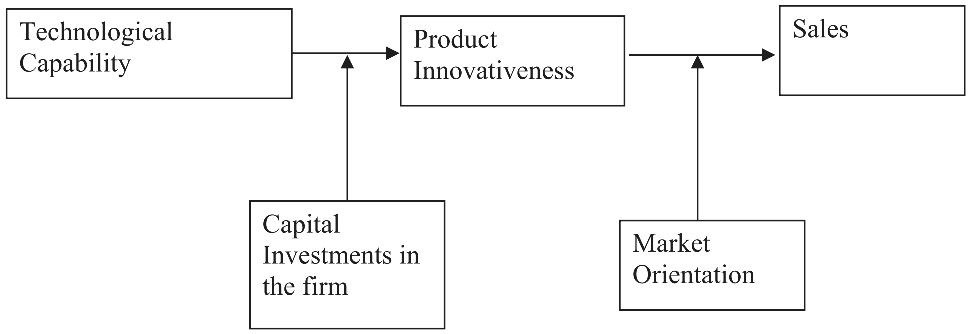

Figure 20: Model for future research concerning causal relationships between study concepts

The empirical data in this study supports the first link in Figure 20, namely the effects of technological capability on product innovativeness. Heterogeneous resource positions (patents) explain why firms innovate differently (Henderson & Cockburn 1994; Knott 2003). This supports the general notion of the knowledge-based view in that knowledge is the principle productive resource of the organization (Kogut & Zander 1992; Nonaka 1994). Because sales or licensing fees / royalty and milestone payments from customer companies only start to flow to a biotechnology venture after a lengthy period of product development, the cross-sectional data in this study did not establish a link between product innovativeness and sales. However, it is likely that in the long run this positive relationship will emerge. Also, a high level of available capital could speed up the transfer of technological capabilities into commercial products. Hence we would hypothesize capital investments as a positive moderator between technological capability and product innovativeness. The empirical data in this study supported a positive relationship between the level of market orientation and the level of sales. However, in the long run, as outlined in Figure 20, market orientation may serve as a positive moderator between product innovativeness and sales.

Compared with previous research studies that have empirically examined the market orientation-performance relationship, the effect sizes of the models in this study are rather typical. Table 1 lists effect sizes found in some recent empirical studies and, for comparison, presents the effect sizes from the models in this study. Maybe the most interesting comparison between the existing research and this study can be made by contrasting the results of Appiah-Adu and Ranchhod (1998) with those of this study. In the context of UK-based biotechnology companies, Appiah-Adu and Ranchhod (1998) examined the effect of market orientation on Managing Directors' subjective responses to questions assessing the results of new product success, market share growth, profit before tax/sales and overall performance in the past three years on a 1-7 Likert scale. The regression analysis results of Appiah-Adu and Ranchhod (1998) show that market orientation has positive implications on market share growth, profit margins and overall performance, with the adjusted r-squared values varying from .23 to .31. These values are not far from the values achieved in this study, even though the performance measurements employed are different. Interestingly, market orientation did not contribute to new product success in the Appiah-Adu and Ranchhod (1998) study. Similarly, market orientation in this study was not related to product innovativeness. Together, these findings provide support for the relationships indicated in Figure 20: product innovations in biotechnology seem to be based on technological capabilities and assets, whereas the role of market orientation is to contribute at the commercialization and sales stage of these innovations.

Kohli and Jaworski (1990) propose that the greater the technological turbulence of an industry, the weaker the relationship between market orientation and business performance should be. Given that biotechnology is a dynamic industry and packaged foods, for example, could be classified as a less turbulent industry, we would expect market orientation's contribution to firm performance to be lower in biotechnology than in packaged foods. However, both the effect sizes in this study (.09 - .50) and those of Appiah-Adu and Ranchhod (1998) (.23 - .31) from biotechnology are not clearly lower than those of Kyriakopoulos and Moorman (2004) from the packaged foods industry (0.13- 0.18 for market orientation's main effects). Also, rose growing could be characterized as an industry of limited turbulence. Verhees and Meulenberg (2004) studied the market orientation-performance relationship among rose growers and found that the effect size in that industry is .26. Again, this is not higher than the effect sizes in this study or in Appiah-Adu and Ranchhod (1998). However, since the measurements of market orientation and performance, as well as analysis techniques, vary from one study to another, reliable comparisons are hard to make. Verhees and Meulenberg (2004) did find that among rose growers there is a positive effect of customer intelligence on product innovation[44], which contradicts my findings in biotechnology startups. Among the biotechnology startups in this study, entrepreneurs are keen on new technologies and products, and mitigated by customer market intelligence (See also Takayama & Watanabe 2002). On the other hand, entrepreneurs who are less driven by technologies in a

[44] Also Pelham & Wilson (1996) found that market orientation did influence new product success.

specific domain are stimulated to innovate by customer market intelligence (Verhees & Meulenberg 2004).

As a conclusion, the results of this study in comparison with studies from other empirical settings do not unambiguously support Kohli and Jaworski's (1990) prediction about industry effects. In their 1993 empirical article, Jaworski and Kohli also reached the same conclusion: the link between market orientation and performance appears to be robust among contexts characterized by varying levels of market turbulence, competition and technological turbulence.

Table 31: Comparison of the research results with some recent studies on the market orientation-performance relationship.

Reference	**Industry context**	**MO measurement**[45]	**Effect size of positive market orientation (MO) – performance relationship (Adjusted R2 or equivalent)**	**Effect size (adjusted R2) in this study using the KJ measurement**
Appiah-Adu and Ranchhod (1998)	Biotechnology	NS	0.23- 0.31	For models with controls and market orientation variables, MO is significant in three out of four models. MO is a significant / marginally significant predictor of capital invested in the firm per year, sales and perceived firm performance. The adjusted r-square values are 0.22, 0.50, and 0.09 respectively. Compared with previous studies (columns on the left), these values are not extraordinary.
Harris (2001)	Mixed	NS	0.13-0.26	
Farrell and Oczkowski (2002)	Manufacturing	NS	0.45	
Matsuno, Mentzer and Özsomer (2002)	Manufacturing	KJ	0.379 - 0.724	
Lai (2003)	Quality management	KJ	0.46-0.76 (correlation coefficients) → variance explained 0.21-0.58	
Kyriakopoulos and Moorman (2004)	Packaged foods	KJ	For main effects only, 0.13-0.18	
Sin, Tse, Yau, Lee and Chow (2004)	Mixed	NS	0.035- 0.422	
Hult, Ketchen and Slater (2005	Mixed	NS adapted	0.57-0.61	
Kara, Spillan, and DeShields (2005)	Small and medium-sized firms	KJ	0.36	
Matsuno, Mentzer and Rentz (2005)	Manufacturing	NS and a new scale	0.10-0.25	

[45] Two of the most extensively used measurements of market orientation are the ‘‘MARKOR’’ scale (KJ) developed by Kohli and Jaworski (1990) and Kohli, Jaworski and Kumar (1993), and the ‘‘MKTOR’’ scale developed by Narver and Slater (1990) (NS).

A surprising finding from this study is that market orientation only makes a small positive contribution to managers' perceptions of their firms' performance. The results of an earlier meta-analysis show that the relationship between market orientation and business performance is stronger when a subjective scale rather than an objective scale is used to measure business performance (Rodriguez Cano et al. 2004). In this study the increase in adjusted r-squares from a regression model with only control variables to a model with a market orientation variable is just .01 (perceived firm performance as a dependent variable). For comparison, with sales as a dependent variable, the increase from a control model to a model with market orientation is .10. For capital investments as a dependent variable, the corresponding change is .03. Even though surprising, this finding actually reduces the likelihood that the instruments in this study are subject to a significant common method bias. This potential common method bias has been a source of major critique for studies that have used subjective performance assessment as the primary dependent variable, but does not seem to be a problem here.

9.1.2 Market orientation as a resource

In the language of the strategy literature, and, more specifically, resource-based view, viewing market orientation as a resource of a firm suggests that this resource leads to competitive advantage in the markets, which, again generates economic rents for the market-oriented firm – provided that MO is a rare, valuable and inimitable resource among its competitors. In assuming that market orientation has performance consequences for a firm, marketing researchers actually make an implicit assumption that MO is a strategic resource, and that the resulting economic rents are appropriated by the firm in question. However, recent literature on rent appropriation suggests that the case may not be as straightforward as this. Coff (1999) (see also Coff and Lee 2003) actually suggests that a resource-based advantage may result in relatively little rent observable in measurements of a firm's performance. Performance measures typically capture only the rent that is not appropriated by the most powerful stakeholders, like entrepreneurs and key employees in the case of young biotechnology firms. The lack of observability of outcomes of MO in a firm's performance does not (necessarily) mean that MO does not create rents. Rather, it may be that the rents generated by MO are appropriated by, for example, partnering firms downstream in the industry value chain. Also, this rent appropriation may take a longer time. Hence not only is the measurement of a firm's performance in the sample of young, knowledge-intensive firms challenging at best, but it may also be that even with the "right" measurements of a firm's performance, the rent generation potential of market orientation remains unnoticed.

"Objective" performance measurements, like a firm's sales, return on investment, personnel growth or market share, are intended to directly record outcomes and are frequently assumed to be free of systematic bias and random error. Researchers typically avoid the use of a subjective performance measurement since there is a danger of obtaining a false positive (i.e., Type I error) when using subjective rather than objective measurements (Dawes, 1999). For example, Rodriguez Cano et al. (2004) warn that subjective measurements of business performance may cause the correlation coefficient of the relationship between market orientation and business performance to be artificially inflated. However, if we believe that instead of (or in addition to) firms, managers and key employees also appropriate rents from market orientation (Castanias and Helfat 1991, 2001), it may actually turn out that managers' opinions are needed in order to assess the rent generation by the firm as a whole. If this is the case, the "problematic" subjective assessment of a firm's performance by the managers would actually turn out to be the most accurate measurement of a firm's rent generation, instead of the more "objective" sales or profit measurements. For example, there are few objective measurements for the estimation of a firm's learning about its markets. This learning may not result in economic rents that can be appropriated by the firm in the form of higher sales or faster growth. Instead, the rent could be appropriated when the firm negotiates a licensing agreement with a partner firm and is able to land with a deal with more favorable terms than if the firm had not possessed certain knowledge about its markets. These kinds of economic rents generated by market-oriented behavior cannot be measured via firm level performance outcomes.

Simultaneous examination of market orientation, entrepreneurial orientation, and technological capability allows us to make conclusions about their relative importance for the performance of the study firms. Entrepreneurial orientation did not have positive effects on any dependent variables other than perceived firm performance. This suggests that entrepreneurial posture in markets for technology is not a strong predictor of performance; by definition, all firms in the field are innovative, proactive and prone to risk taking. Technological assets make an important contribution to capital invested in the firm as well as product innovativeness. Market orientation, for its part, contributes to increased capital investments, perceived firm performance and sales (marginal). Overall, these positive effects of market orientation lead us to conclude that even in such a science-driven environment as markets for technology, market orientation is an important resource in a firm. With this study, we are definitely one step closer to concluding that market orientation matters in all fields of economic activity.

9.1.3 The potential of market orientation in entrepreneurship research

Similar to the early developments of the leadership literature, the entrepreneurship literature has moved away from its original focus of a trait-based assessment of "who is an entrepreneur?" towards studying the cognitive processes of entrepreneurs, the social impacts of entrepreneurial behavior and, increasingly, the processes through which entrepreneurial behaviors are manifested. In these process descriptions, entrepreneur's recognition or discovery of a business opportunity plays an important role. According to the popular Austrian view among entrepreneurship researchers, the markets are in disequilibrium, which enables entrepreneurs to discover market imbalances that offer ways to earn economic rents. In this discovery process, knowledge of markets and ways to serve these markets are important distinguishing factors between entrepreneurs and those who do not perceive the opportunities (Denrell et al. 2003; Shane 2000; Kirzner 1979, 1997).

Market orientation is a firm level construct and hence lends little to the understanding of individuals' (entrepreneurs') opportunity recognition processes. However, entrepreneurship is not only a characteristic of individuals but, increasingly, is also being studied as an organizational phenomenon. Intrapreneurship or corporate entrepreneurship are attributes often used to describe entrepreneurial incumbents. The key components of corporate entrepreneurship, i.e. entrepreneurial orientation (Miller 1983), were assessed in the study firms and it turned out that entrepreneurial orientation is positively related to market orientation. However, the lack of direct performance effects from entrepreneurial orientation seems to suggest that these effects take time to develop, whereas market orientation is a more concrete and behavioral construct. Furthermore, market orientation's effects on performance can be seen within a shorter period of time.

One could argue that being informed of customers and competitors throughout the whole organization (i.e. organization-wide market orientation) is a necessary prerequisite for opportunity recognition within existing organizations. The informational basis of entrepreneurial discovery on the level of individuals can be expanded to the organizational level via the market orientation construct.

As described in the theoretical background to this research, the differences between new firms and incumbents can be understood along a continuum from efficiency of current operations and exploitation of existing knowledge on the one hand and exploration of new knowledge and search for new ideas on the other. Market orientation can be beneficial for both exploitative as well as explorative learning strategies of organizations, and being market oriented can lead to discovering new business opportunities in firms that strive for efficiency of current operations as well as in firms that look to expand beyond their current knowledge base.

The difficulty of showing the contribution of market orientation to opportunity discovery comes from the challenges in operationalizing business opportunities. Individuals and organizations are constantly discovering opportunities, but only act on a small proportion of them. For example, if new products developed by firms are used as a proxy for opportunity discovery in these organizations, only a small proportion of the total number of entrepreneurial discoveries ends up being captured. Just as the final version of this dissertation only reflects a small proportion of all the thoughts and ideas that I have had during the research process, so the new products introduced to the markets only show the peak of the iceberg of entrepreneurial ideas in any one firm.

However, if it can be shown that the new solutions launched on the markets (or in the case of markets for technology, the new knowledge that is being commercialized by any one firm) are a function of a firm's market orientation, technological capability and risk taking propensity, we could get closer to estimating market orientation's contribution to opportunity discovery. Assuming that a risk-taking propensity is the construct that determines which proportion of the identified business opportunities ends up being pursued to product launch, and assuming that we can measure this risk-taking propensity with the entrepreneurial orientation items, we can estimate the number of discovered opportunities in any one firm per the number of new product launches. This (estimated) number of discovered opportunities could be used as a dependent variable, and the contribution of market orientation and technological capability to a firm's opportunity recognition could be estimated. This provides an interesting avenue for future research

9.2 Methodological contribution

The mixed use of quantitative and qualitative methodology in this study has allowed me to understand the phenomenon of market orientation in markets for technology in a more profound way that would have been possible with a single methodological approach. First, the use of a qualitative preliminary study made it possible to formulate hypotheses about the antecedents and consequences of market orientation in a way that reflects the peculiarities of markets for technology and, more specifically, biotechnology. The question then arises, if the hypotheses are so relevant, why do only seven out of the total of nineteen hold in empirical testing?

A larger sample size may be needed in order to detect relationships between the variables. Also, the hypotheses were based on existing literature that has typically studied large firms in various manufacturing industries and the like. The hypotheses that did not receive support in this study should further inspire future research to reflect the peculiarities of industry contexts such as markets for technology. For example, the reason why no relationship was detected between market orientation and a firm's innovativeness may be that there is no such relationship. This finding seemingly contradicts most of the existing market orientation literature, which generally recommends using market orientation to develop and maintain a firm's performance. However, it is worth noting several distinguishing features of markets for technology. First, the firms in these markets rely on the creation of completely new knowledge and solutions to maintain and drive demand. In this environment, market orientation may have a marginal role in comparison with technological capabilities, as illustrated in the regression results. Second, companies downstream in the industry "value chain" (in the case of biotechnology, these would typically be large pharmaceutical companies) are the most frequent purchasers of the outputs of the sample firms. These customer companies demand creative new products that are potential blockbusters in previously unexploited markets. These customer companies themselves represent innovators, early adopters and opinion leaders who pride themselves on being in the forefront of new technologies. Investors are aware of this, and they may emphasize technological criteria over market criteria in their investment decision-making.

Going back to the benefits of using mixed methods in this study, it is clear that the use of both quantitative and qualitative data made it possible to investigate different but still overlapping facets of market orientation. The consequences of market orientation were mostly studied in the light of numerical data, whereas the components of the market orientation construct itself were revealed with qualitative data.

The qualitative interview approach gave the interviewees a possibility to construct their own market orientation concepts. This process was helpful since it revealed that even within the rather homogenous group of sample firms, the content of market orientation (i.e., who the customers are, what the competition is like, what the sources of market intelligence are) is far from uniform. Market orientation measurement should be sensitive to these differences in firms' ways of approaching their markets. By imposing a standard format of market orientation on respondents' minds when rating a firm's market orientation, researchers that collect data via standardized mail questionnaires lose a lot of the richness of the market orientation construct. By tailoring the items more specifically towards the target population, researchers could not only improve the predictive power of their models but also gain deeper insights into the contingent nature of the market orientation construct.

However, one major limitation of a mere qualitative research approach is that it tells little about dynamics on the population level. Based on the research experience reported in this monograph, qualitative data collection and analysis alone can easily lead the researcher to believe that every case firm is such a special instance that any generalizations would not do justice to this heterogeneity. However, even though every firm studied here certainly is different and every entrepreneur likes to describe his or her firm as a very special kind of case, there are also general patterns in the ways that these firms behave. If I had not "forced" the interviewees to evaluate their respective firms' behaviors along standardized, numerical scales, these patterns would have most likely have remained unnoticed, even with a very careful analysis of the qualitative data.

9.3 Managerial contribution

Market intelligence generation in markets for technology. The research reported here has uncovered many ways in which managers of young firms in markets for technology can guide their organizations towards market orientation without the kinds of resource commitments typical in larger firms. For example, many interviewees indicated that academic publications are an important source of market knowledge for them. Managers with backgrounds in science and technology are used to reading academic texts and maybe they are able to derive hints for commercial applications from that literature. Firms also interact with their current customers or future customer base as well as opinion leaders in order to understand the markets. Some firms consider their partner companies an important source of market knowledge. This often follows naturally from these partners' downstream position in the industry supply chain. Sometimes firms learn about their markets via competitor-based collaboration. However, when this is the case, firms need to be aware of what constitutes anti-competitive behavior. Also, on some occasions, venture capitalists can provide their portfolio firms with access to market databases and reports that these firms would not otherwise purchase. Finally, firm managers' personal industry friends can be an important source of market knowledge. Utilizing these kinds of sources of market knowledge can help firms in generating market intelligence without the kinds of resource commitments that would be needed for the more traditional in-house market research.

Overcoming challenges in developing company-wide market orientation. This study has identified bottlenecks that prevent the integration of market knowledge into research and development. Based on this study, technology venture managers that want to integrate market aspects into their companies' R&D should be aware of the following traps: (1) excessive focus on science and technology instead of, e.g., asking future end users of products for their opinions on product features; (2) excessive focus on meeting development milestones instead of visioning end products in the markets one day; (3) forgetting the development of internal communication within a firm, especially in the times of rapid growth; and (4) failing to understand the different goals and mental models of scientists vs. business people. Avoiding these traps can help firms in achieving organization-wide market orientation.

Even though low hierarchies and centralization of small organizations usually make firms' internal communication easier, managers should still pay special attention to the challenges of bridging boundaries between the scientific and business personnel. At best, everyone in the firm is aware of the customer- and competitor-related aspects, and can channel market information from the environment to the firm whenever possible. The study results show that sometimes technology partners, academic conferences and literature, or universities can be sources of market intelligence for a firm. For this intelligence to be channeled to the firm, the people with access to these communication channels have to have the skills to recognize the relevant market information for the company. This is why disseminating market intelligence and, hence, increasing the firm's "absorptive market capacity" is important for science-based companies.

Overcoming competition myopia. The empirical study shows that biotechnology firm managers have remarkable difficulties in identifying competition. The typical answers of "*we do not currently have competition*" or "*we are not at that stage yet that we would think about competition*" to the question about competitors reveal the managers' competitive "myopia". In markets for technology the competitive landscape has to be defined and studied broadly, bringing into view not only close competitors but more distant rivals and potential future competitors as well. Rather than similarities in type of technology or product, managers should focus on similarities in use.

To accomplish this I refer to Peteraf and Bergen (2003) and suggest scanning the competitive terrain from two directions simultaneously, i.e. comparing firms on the basis of market-side as well as resource-side characteristics. In consumer goods markets, for example, competitive commonalities on the market side are obviously germane for identifying product market rivals. In markets for technology, identifying this market-side competition is more complicated. When products are still non-existent and on the level of ideas or laboratory tests, it requires imagination and proactiveness to see the market-side competition. What will the end markets look like when our products are launched? What are the solutions available to end customers nowadays to tackle the problems that will be solved by our product? Who are our customers in the first place – if we sell our ideas to other companies, which other firms are competing for the money of these companies? Or does our competition actually emerge from within our customer companies' own organizations? Is the "not invented here" syndrome still alive?

In addition to markets, it is essential to look for commonalities on the resource side as well. Firms compete on the basis of their resources and capabilities; they are the underlying competitive drivers. Similarities among firms' capabilities provide information about the potential of firms to produce similar products, whereas similarities among product characteristics only tell us about actual competitors. Firms with capabilities similar to those of a technology company do not necessarily compete with it currently, but may do so in the near future (Peteraf & Bergen 2003).

Positive effects of market orientation. This study has shown that market orientation has positive effects on sales and capital invested in the firm, and also on the managers' overall positive perception of their firm's performance. Because biotechnology start-ups are often early entrants to their respective fields, they may be compelled by the scientific advances and demonstrate low levels of market orientation in the absence of direct market competition. However, the competitive intensity of an industry is likely to be stronger over time, and over time firms are bound to demonstrate higher market orientation levels in order to gain market share and to achieve profitability (Gauzente 2001).

9.4 Limitations of the study

Empirical estimation of knowledge and its production and transfer is challenging. Research results concerning knowledge, innovation and technological change have been shaped by the nature of the data that has been available to scholars for analyses. Such data have always been incomplete (Acs & Audretsch 2005), and this research is no exception.

The main limitations of this study include single informant bias and limited statistical conclusion validity as a result of the small sample size. The single informant problem is typical for studies conducted in small firm settings. In this study, comparisons of patent figures as well as sales turnover reported by the interviewees with data from secondary sources were completed to ensure the reliability of the data. These comparisons indicate that even though the self-reported numbers are not exactly similar to those available from the secondary sources, there is no evidence that the measurements used would be biased estimators. The depth of data collected through the personal interviews increases internal as well as construct validity.

Combining qualitative and quantitative approaches in a single study does not come without sacrifices. Most of the limitations of this study result from time and resource constraints in the data collection. Strictly speaking, the kind of cross-sectional design of this study does not allow causal inferences. Longitudinal studies would provide a better understanding of the nature of the relationships between market- and technology-related variables and performance indicators. An additional limitation of this research – like many other studies - is the reliance on self-reported judgments. While appropriate to the design, future research might combine internal self-report measurements with other internal and external measurements, which would enhance the generalizability of the findings.

Generalizability of the results to other industries. The empirical data in this study was collected from a single industry, namely medical biotechnology. Biotechnology markets are a prime example of markets for technology (Arora et al.2001). In addition to biotechnology there are numerous fields of business that share similar market features typical of markets for technology. I suggest that the results of this study can and should be applicable within the context of a number of other knowledge-intensive, high-technology industries. The main findings of this study should also hold for other industries in which the market conditions are similar to those in biotechnology.

As examples of markets for technology, Arora et al. (2001) discuss the growing market for chip design modules in the semiconductor business as well as the software, biotechnology and chemical processing markets. Chip design modules in the semiconductor industry are characterized by the need for reusing knowledge and design, and standard architectures, and a need for partitioning complex technological problems. In this kind of market for technology the number of firms that license their technology rather than engage in downstream operations is growing rapidly. Although some types of software are akin to products, the software also often proves to be a powerful instrument for codifying knowledge and technologies. Also, there are many firms in this industry that focus on licensing their technology rather than moving downstream to the businesses where their technologies are finally used. Chemical processing markets are one of the first examples of specialist producers of engineering and technological knowledge serving a large number of downstream firms. Specialization, technological knowledge and licensing to downstream customers are features that all these sectors share with the biotechnology business. What is more, in all these industries specialization relies heavily on patents and intellectual property rights. Patents are increasingly being used as a means to define the property rights on inventions to facilitate the trade of these property rights; the creation and enforcement of intellectual property is extremely important. These similarities described here lead to the conclusion that even though the more detailed manifestations of market orientation are industry specific (e.g. the specialist / opinion leader role of star scientists and medical doctors in biotechnology is occupied by other kinds of scientists and industry leaders in software and chemical processing) the general picture and the overall ingredients of market orientation in these sectors are similar.

Generalizability of the results to other geographical locations. The empirical study firms come from five locations on two continents. This has benefits for external validity. Even though firms in the US differ from those in Finland and Sweden along some demographic criteria (most importantly, capital investments in the US-based firms are much larger than investments in the Nordic firms), there were no major differences between US vs. Nordic firms as far as the content of market orientation or its performance consequences are concerned. This is strong evidence of the external validity of the research results across geographical locations.

9.5 Future research directions

In addition to the "usual suspects" for future research directions (need for more longitudinal research, need to collect more objective data about young, small firms, and the need to expand the geographic scope of this study to further increase external validity), I would like to mention some not-so-obvious ideas for future research in addition to the model that has already been suggested for future research (Figure 20).

First, the earlier literature demonstrated how a firm has to find a balance between wide focus, specialization, experimentation and efficiency. Berry (1996) and Berry & Taggart (1998) have suggested that a technology firm develops from initial beginnings that are based on technological specialization towards a wider focus and exploration of market knowledge. However, as illustrated by the findings in my preliminary empirical study, firms in markets for technology often evolve from a wide focus to specialization and exploitation. An empirical study of these development patterns that shift between market and technology orientation as well as exploration and exploitation would require longitudinal data; following technology firms over time and investigating their changing strategic orientations. This insight definitely warrants future research.

The unit and level of analysis of this research has been a firm. Thus only limited conclusions can be drawn on a regional level. However, the interviews have been conducted in five biotechnology cluster areas with very different kinds of development paths. As mentioned above, it looks like the geography-based differences in sourcing of market knowledge are almost non-existent. Regional variation only comes into play in the sense that some of the stakeholders that firms use as sources of market knowledge are area-specific (local venture capitalists, regional biotechnology associations). Based on the empirical study, a proposition for future research addresses the geography of market knowledge: given the codified nature of market knowledge, physical proximity to sources of market knowledge is expected to be less important for knowledge dissemination than in the case of more tacit technological knowledge. In the case of technological knowledge, the importance of proximity to knowledge sources has been studied using patent data and citations as a proxy for knowledge. Similar kinds of proxies for somewhat objective measurement of market knowledge dissemination between organizations are scarce. It is likely that future research will have to rely on self-reported measurements when assessing market knowledge. However, based on the economic geography literature as well as existing studies in the knowledge management domain, further research could shed light on the geographical aspects of market knowledge. Contrary to the findings of Jaffe, Trajtenberg & Henderson (1993), Almeida & Kogut (1999) and Zucker & Darby (1996) regarding technological and scientific knowledge dissemination in biotechnology, I would propose that physical proximity is *not* an important factor for biotechnology firms' sourcing of market knowledge.

Heirman and Clarysse (2004) argue that pre-founding R&D efforts and intangible assets such as team tenure, experience of founders and collaborations with third parties are important for innovation speed in research-based start-ups. Technology start-ups differ significantly in their starting conditions and these differences have a significant effect on the time it takes to launch the first product. Studying performance in start-ups faces a unique challenge compared with studies in larger firms. That challenge is that the new product development does not necessarily begin when the company is founded. It is probable that start-ups differ significantly in their pre-founding conditions, including market knowledge. Consequently, to make a fair assessment of the performance as well as the level of market orientation of a start-up firm we need to look into pre-founding behaviors in addition to the obvious current conditions.

Based on the qualitative data, as well as the previous research, it seems obvious that technology firms evolve from initial beginnings that are focused on science and technology towards a greater orientation towards customers and competition. Because of data limitations (uniform sample and cross-sectional data), I am unable to provide further quantitative evidence to support this claim. Future research should look at this development over time in a longitudinal research setting, and the performance implications of the level of market orientation over time should also be studied. In addition to studying existing firms, it would be interesting to look into firms or projects that have ceased to exist. This would provide more convincing evidence on the role of market orientation than the mere study of successful firms, which are always subject to "survival bias".

10 SUMMARY

Firms that specialize in the creation of knowledge and new technology are an important part of many technology-intensive industries today. However, there is little guidance in the management literature on how managers should behave in the presence of markets for technology. This research contributes to this research gap through an analysis of market orientation in markets for technology. The two extraordinary features of markets for technology that make market orientation an especially relevant concept for research are (1) the science-driven nature of new product development, and (2) the demand conditions that are characterized by unmet customer needs. Given the increasing importance of markets for technology as well as market-oriented thinking in today's business world, this study is worthwhile and presents a contribution to the marketing literature as well as the technology management literature.

Biotechnology is a representative field of markets for technology, and it is also the context of the empirical study of this research. Even though small and medium-sized enterprises in biotechnology pursue a variety of strategies to commercialize their innovations, a large share of them rely on licensing out their product ideas at a point during the R&D process instead of taking innovations all the way to the end markets themselves. Typical for markets for technology, biotechnology companies often end up in simultaneous collaborative, competitive and market exchange relationships with each other. However, the driving reason behind this development is not necessarily the establishment of a long-term customer relationship but visioning and developing uses for novel technological solutions.

In the marketing domain, researchers have mainly been preoccupied with linking market knowledge and orientation to a firm's performance. Even though the results from these studies are somewhat mixed, the general trend in this line of research proves that being market oriented enhances a firm's performance. In the entrepreneurship literature, researchers have suggested that market information gaps present sources of entrepreneurial opportunities waiting to be discovered. Given the importance of market orientation, the purpose of this research is twofold: (1) to consolidate practitioners' understanding of market orientation with existing academic literature to describe market orientation in markets for technology; and (2) to assess selected performance implications of a firm's market orientation.

The focal concept of the current research, i.e. market orientation, was first defined in the marketing literature as an organization-level culture comprising values and beliefs about putting the customer first in business planning. Since then, market orientation has been studied both as a cultural phenomenon and as a set of behaviors relating to (1) organization-wide market intelligence generation through decision support systems, marketing information systems and marketing research efforts, (2) dissemination of the intelligence across functions in a firm, and (3) organization-wide responsiveness (actions) based on this intelligence. In addition to the marketing literature, this research derives ideas from a research-based view of the firm and network literature in order to describe market orientation in markets for technology.

The guiding principles behind the choice of methods for the empirical study can be described with the term pragmatism; I use mixed methods because I believe it makes the data collection and analysis more accurate and the inferences more useful. During the research process I have gone through phases of both inductive as well as deductive reasoning. This has required data that are comprehensive enough to allow induction, but also rigorous enough to allow for the testing of hypotheses and deduction. The first phase of the empirical data collection only involved qualitative data collection (interviews). In the second phase, both quantitative and qualitative data were collected simultaneously from firms to allow hypothesis testing. Some of the qualitative data was codified into quantitative form for the analysis, and some was analyzed in the original, qualitative form.

The unit of analysis in this research is the firm, and the informants are company CEOs. Preliminary case studies of six biotechnology firms in the Philadelphia area were conducted in 2003. Based on the preliminary case studies and existing literature, I constructed the main research instrument, which combines open-ended questions with a structured questionnaire. With this instrument I collected empirical data via face-to-face CEO interviews in small, young, and research-intensive biotechnology firms in the US, Sweden and Finland in 2003-2004. In each geographical area, biotechnology organizations' member listings have provided the basic directory from which the populations of interest have been identified. The firms included in the study are independent R&D-based biotechnology firms with 250 employees or less, service firms excluded. Personal, one- to two-hour structured interviews were conducted in 85 such companies in Pennsylvania (n=13), Florida (n=19), Bay Area, CA (n=27), Finland (n=19) and Sweden (n=7). The first ten interviews also served as a pilot test for the questionnaire. Face-to-face interviews increase the validity of the data collected. They are also probably the only way to reach the smallest firms, from which scarce secondary data is available. The mean size of these sample firms is 38 employees, and 81 per cent of the firms employ 50 people or less. An average firm was six years old at the time of the interview, and about half of the firms had no sales income.

The results of this research show that the understanding of market orientation in markets for technology cannot be solely based on the marketing literature. Market knowledge is a strategic resource for small, young firms in these markets, and its development should be analyzed in the light of the market orientation literature and a resource-based view of the firm, as well as network theories. Also, depending on the industry context, the contents of market intelligence are likely to vary. Hence the use of uniform scales for the measurement of market orientation across industries is not advisable.

The research results show that, sometimes, market knowledge exchange is "just" a by-product of business relationships that are established for other kinds of purposes. Technology partners (like universities and R&D partners) as well as licensors of technological innovations provide small biotechnology firms with customer and competitor knowledge. In addition, entrepreneurs' personal industry friends are also a source of market intelligence in many firms. Organizations positioned close to end customers in the industry value chain (licensors, marketing partners) are more important sources of market knowledge for the study firms than organizations upstream in the value chain.

Based on the logic of absorptive capacity, there should be a link between a firm's internal market orientation and the amount of market knowledge channeled to the firm from various industry stakeholders (environment). However, such a link was not found in this study. Future research should attempt to operationalize market knowledge from the external environment based on firm-specific ties; depending on the firm, the kinds of organizations that contribute to market knowledge generation vary. A more specific measurement of market intelligence generation from stakeholders could be more directly linked to a firm's internal market orientation. Also, if market knowledge from partners has an impact on organizational outcome variables, the mechanisms of that impact are more complex than the linear ones predicted in the hypotheses.

Market orientation in markets for technology has a strong proactive flavor; companies need to anticipate their future customers' needs and the development of the markets in general. The MARKOR-based market orientation measurement of this study includes proactive items, and, probably because of this, the measurement of market orientation was found to positively correlate with the measurement of entrepreneurial orientation. In the analyses of predictors of a firm's performance, market orientation was analyzed together with entrepreneurial orientation, which measures firm's innovativeness, proactiveness and risk-taking. Technological capability predictors were also contrasted with the effects of market orientation in the analyses.

Overall, a firm's behavioral market orientation has a positive impact on its sales levels (marginally significant), as well as the managers' perceptions of the performance of their firms. Market orientation also has a positive effect on the amount of capital invested in a firm. However, this effect is not as large as that of technological capability (measured as the number of patents and R&D investment). Furthermore, market orientation has no relationship with innovativeness, whereas a firm's technological capability - especially the number of patents - has a positive effect on innovativeness. This is probably due to the nature of innovations in biotechnology; the kinds of product innovations developed by the R&D-based firms are truly disruptive in nature. In this environment, market orientation may contribute positively to commercialization (sales) but not to actual product innovativeness.

Surprisingly, entrepreneurial orientation is not related to innovativeness, capital invested in the firm, or sales. In an environment where all firms are innovative, proactive and prone to risk taking by definition, additional entrepreneurial posture does not bring extra benefits – at least in the short term. Even though entrepreneurial orientation is not related to product innovativeness, it has a positive relationship to the R&D intensity of the firm. Thus it may be an indicator of long-term commitments to innovativeness.

Finally, the US-based firms seem to differ from the Northern European firms in some respects. For example, location is a significant predictor of capital invested as well as managers' assessments of their firm's performance; American managers tend to rate their firm's performance in a more positive light.

The results of the study are reflected in light of the current understanding of the market orientation concept. The results welcome the recent developments in the marketing domain that have tried to incorporate proactive dimensions in the measurement of market orientation; the form of market orientation is, indeed, related to the industry context as well as the strategy choices of a firm. More specifically, the more traditional market orientation conceptualization seems to reflect the peculiarities of Kirznerian opportunity recognition (entrepreneurship), reactive strategies that focus on exploitation of current capabilities, single firm focus and development of incremental innovations. Market orientation in markets for technology also has to account for Schumpeterian market disruptions (entrepreneurship), proactive and explorative strategies and establishing the locus of this orientation within a network of actors, as well as the development of radical, new-to-the-world innovations (new product development). Even though there is a need for these kinds of refinements to the market orientation concept in markets for technology, the good news for the marketing domain from this study is that even in such a science- and technology-driven field as modern biotechnology, firms do exhibit market-oriented behaviors and these behaviors do have certain implications for performance.

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Appendix 1: Interview guide, Preliminary study

Market orientation and networks study

This is an interview survey designed to find out about the market orientation of small and medium-sized biotechnology firms. In particular, the purpose is to discover the effects contacts with other firms have on that market orientation. You will be asked some questions about you firm first and then a list of questions related to the business network of your firm and how you collect information on your markets.
Thank you for your time,

Maija Renko,
Doctoral student
Turku School of Economics and Business Administration, Finland

Firm Level Data
Company name

____

Position of person answering survey (e.g. CEO, Business development manager)

____

The nature of your business and the biotechnology industry (e.g. drug discovery company, fully integrated pharmaceutical company, medical device firm)

____

The number of employees as at July 2003 - full-time__________________
- part-time______________________

The approximate annual turnover of the firm in 2002

____

Do you currently sell products or services? Yes / No

If yes, do you have a separate sales and / or marketing department in your firm? ____
If no, do you plan to sell products or services straight to market on one day or is your business strategy based on licensing out innovations?
____

Background questions

1. Who do you see as the customers of your firm?

2. Who are the competitors of your firm?

3. What kinds of and how many relationships does your firm have with other firms?

Type of partner firm	**No of partners**	**What kinds of relationships in general (Close / distant relationship; intensive / limited communication…)**
Suppliers		
R&D, technology partners (business entities)		
University collaborations		
Licensors (You license out your innovations to these firms)		
Licensees (You license in innovations from these firms)		
Contract manufacturing		
Joint marketing and distribution deals		
Business consultants		
Venture capitalists		
Something else, what?		

The firm's internal market orientation
Intelligence generation, all firms:

1. What are the **most important sources of market-related data** for your firm?

- Do you do **in-house market research**?

- Do you **outsource market research**?

- Do you **attend seminars / expos / fairs** for the purpose of getting information on markets (customers, potential customers, competitors, etc)?

- Do you **subscribe to some databases** that contain information on end markets? Databases that contain information on potential business partners?

- Does your company **meet customers or potential customers** to find out what products/services they will need in the future?

  If yes, are the meetings formal or informal?

2.. How do you collect data on fundamental **shifts in the industry** (e.g. competition, technology, regulation)?

- Do you **collect industry information by informal means**, like through discussions with friends, talk with trade partners, etc?

3. Do you review the likely effects of changes in your business environment (like regulatory changes, insurance issues) on end customers?

- Do you talk with or survey those (e.g. medial doctors) who can influence your end users' purchases?

Intelligence generation, only firms with sales:
4. Do you measure **customer satisfaction**? (Informally/ systematically: Occasionally / frequently) **If yes**, what do you do with the data that you collect concerning customer satisfaction? (data analysis, responsiveness?)

Intelligence dissemination, all firms

1. How would you describe the relations between people working in marketing/sales in your firm and other functions /"departments"?

2. Does **the top management** of your firm often discuss the **competitive situation** in the market?

3. Do you **regularly hold interdepartmental meetings** to discuss market trends and developments? Who attends these meetings?

4. When one department / person finds out something important about the market (e.g. customers, competitors), how does this information flow to the other departments / people?

Responsiveness, all firms

1. Does your company review the product/service development efforts to ensure that they are in line with what customers / potential customers want?

2. Would you say the activities of the different departments / functions in your company are well coordinated?

3. Would you say that your business plans are more driven by technological advances than by market research?

<u>Network's effect on the firm's market orientation</u>

1. What is the importance of various kinds of business partners in sourcing market-related data?

Type of partner firm	**Role as a source of market-related data to your firm (data on end users, competitors, business partners, regulatory affairs, etc)**
Suppliers	
R&D, technology partners (business entities)	
University collaborations	
Licensors (You license out your innovations to these firms)	
Licensees (You license in innovations from these firms)	
Contract manufacturing	
Joint marketing and distribution deals	
Business consultants	
Venture capitalists	
Something else, what?	

2. Do representatives of your firm hold meetings to **discuss market trends and developments with representatives of other organizations**? If yes, what kinds of organizations? Are the meetings more formal or informal?

3. When you or your partner firm finds out something important about the market (e.g. customers, competitors), does this information flow over the company borders?

4. Can you describe a recent event in which one (or more) of the companies you collaborate with had an important role to play and in which you got market-related information?

5. What is the role of various **industry associations** for your firm as a source of market-related data?

6. Are your decisions to engage in joint R&D activities with other firms based on what you know about market needs or on the requirements of technologies?

Indicate to what extent does each of the following philosophies help guide your business operation.

	Does **not** describe my organization **at all**	Does not describe my organization	**Mostly** does not describe my organization	Neutral	**Partly** describes my organization	Describes my organization	Describes my organization **very well**
The key to business success is producing quality goods and services at a reasonable cost. Good products and services sell themselves. If possible, products and services should be standardized to keep costs down.							
The key to business success lies in persuading potential customers to buy your goods and services, through advertising, personal selling or other means. Potential customers must be informed and convinced of the benefits of the products.							
The key to business success is to integrate all company activities and personnel toward satisfying customers, while providing satisfactory profits for the firm. The firm should find out what benefits customers want and then provide these benefits through goods and services.							
The key to business success lies in satisfying the important stakeholders (‘‘publics’’) of the company. These publics include customers, employees, stockholders, governmental agencies, suppliers and the public at large. All of their interests should be considered when making decisions.							
The key to business success is the ability and will to acquire a substantial technological background and use it in the development of new products / services. This includes the activities of R&D as well as technological scanning. Success is achieved by being more innovative than competitors.							

When you think about the **formal** relationships your company has with other **firms in R&D** (technology partners), these relationships have benefited your firm in

	strongly disagree	disagree	partly disagree	neutral	partly agree	agree	strongly agree
Knowing more exactly the products the customers will demand in the future							
Rapidly detecting the changes in the customers' preferences							
Rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)							

When you think about the **formal** relationships your company has with other **firms for the purposes of commercializing your inventions, marketing and/or distributing them** (licensors, distributors), these relationships have benefited your firm in

	strongly disagree	disagree	partly disagree	neutral	partly agree	agree	strongly agree
Knowing more exactly the products the customers will demand in the future							
Rapidly detecting the changes in the customers' preferences							
Rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)							

When you think about the **formal** relationships your company has with **universities or other non-profit research organizations**, these relationships have benefited your firm in

	strongly disagree	disagree	partly disagree	neutral	partly agree	agree	strongly agree
Knowing more exactly the products the customers will demand in the future							
Rapidly detecting the changes in the customers' preferences							
Rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)							

When you think about the **formal** relationships your company has with **venture capitalists and business consultants**,
these relationships have benefited your firm in

	strongly disagree	disagree	partly disagree	neutral	partly agree	agree	strongly agree
Knowing more exactly the products the customers will demand in the future							
Rapidly detecting the changes in the customers' preferences							
Rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)							

When you think about the **informal** relationships you or other managers in your firm have with **friends and alike** in the industry or related industries,
these relationships have benefited your firm in

	strongly disagree	disagree	partly disagree	neutral	partly agree	agree	strongly agree
Knowing more exactly the products the customers will demand in the future							
Rapidly detecting the changes in the customers' preferences							
Rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)							

The relationships that your firm has with other firms and organizations have overall contributed to

	strongly disagree	disagree	partly disagree	neutral	partly agree	agree	strongly agree
Your firm gets information about potential customers in your domestic markets							
Your firm gets information about potential customers abroad							
Your firm gets information on potential business partners in e.g. marketing							
Your firm gets information on what is happening in competing firms							
Your firm gets information on what is happening on the regulatory front of your business							
Your firm gets information on new technology trends							
Your company has increased its ability to regularly improve the products it has to meet customers' needs							
Your company has become involved in joint new product development processes with other organizations							
Your company has become involved in industry promoting activities (e.g. fairs and seminars)							
Your firm jointly subscribes to market data with other firms							
Your firm jointly outsources market research with other firms in the same industry							

Appendix 2: Interview guide, Main study

Market orientation and networks study

This is an interview survey designed to find out about the market orientation of small and medium-sized biotechnology firms. In particular, the purpose is to discover the effects that contacts with other firms have on that market orientation.

You will be asked some questions about you firm first and then a list of questions related to the business network of your firm and how you collect information on your markets.

Thank you for your time,

Maija Renko,
Doctoral student
Turku School of Economics and Business Administration, Finland

Company name		Year founded	
Name of person answering survey			
Position of person answering survey			
Date and place of interview			

Firm level data

The nature of your business and the biotechnology industry		Drug discovery/ development company
		Fully integrated pharmaceutical company
		Diagnostics firm
		Medical device firm
		Tool /platform company
		Else, what?
Phase of most advanced product		Marketed by our partner company
		Marketed by our company
		Late stage clinical development (III-IV)
		Early stage clinical development (I-II)
		Preclinical development
		Else, what?
When will / did the most advanced product reach the markets (year)		

The number of employees as at October 2003	Full-time	The number of employees as at October 2002	Full-time
	Part-time		Part-time

Do you currently sell products?	Yes	Our original product(s) is on the market through a licensing agreement	We have our own distribution and sales	We sell through a partner company	
		Approx. annual turnover in 2002 USD EUR	Share of product sales	%	
			Share of service sales	%	
		Approx. annual turnover in 2001 USD EUR	Share of product sales	%	
			Share of service sales	%	
		Return on sales last year			
		Percentage of sales generated by new products last year		%	
	No	In the future we plan to…	Have our original product(s) on the market through a licensing agreement		
			Have our own distribution and sales		
			Sell through a partner company		

Do you have a separate sales / marketing department in your firm?	YES / NO
Has your company been started by an individual or by a team?	INDIVIDUAL / TEAM

Firm origin	University spin-off	Independent venture	Other, what?
	Industrial spin-off	Government research institution / initiative (like NIH)	
Firm structure	Privately held	University-owned	Other, what?
	Publicly held	Government-owned	
R&D intensity	R&D expenses comprise ______ __% of all the expenses of our company.		
Capital raised by Oct 2003	USD		

Company characteristics and performance

Over the past three years in the firm, what is the number of …	#
New **inventions** for which the firm has filed domestic or international patent application(s)	
Therapeutic areas where these inventions are useful (your own estimate)	
End products that are / have been developed based on this / these inventions in your firm or your partners	
Domestic patent **applications**	
International patent **applications** (essentially the same application submitted to multiple countries counts as one)	
Domestic patent **approvals**	
International patent **approvals** (essentially the same approval in multiple countries counts as one)	
Countries of international patent applications / approvals	Applic / Approv /
New product introductions to the **markets**	
New product development **projects** started	
New **process** introductions	

Which one of the following five alternatives best describes your company? (please choose one)

1. Our firm's most important partnerships with other organizations are actually **the informal contacts** (e.g. friendships) the individuals in our management team have	
2. Our firm's most important partnerships are with a number of **(non-profit) technology partners and universities**	
3. Our firm's most important partnerships are with a number of **commercial companies**	
4. Our firm's most important partnership is actually our relationship with **one major, dedicated partner company**	
5. Our firm does **not** have any important partnerships with outside parties	

Which one of the following five alternatives best describes the commercial potential of your firm's most advanced product development project? (please choose one)

We **do not yet know** if this product we are developing has any commercial potential.	
We **know** that this product we are developing has commercial potential **in a number of markets** (e.g. various indications) but **we DO NOT yet know for which market(s)** we are actually developing this product.	
We **know** that this product we are developing has commercial potential **in a number of markets** (e.g. various indications) **and we DO already know for which market(s)** we are actually developing this product. However, we are not selling the product yet.	
We **know** that this product we are developing has commercial potential in **one market** and we aim to launch this product in that market.	
This product **is already marketed** and generates sales.	

Please rank these performance indicators with the scale given in the right hand column.	1=very weak; 2=weak; 3=neutral; 4=good; 5=very good				
Our firm's overall performance relative to major competitors last year.	1	2	3	4	5
Only firms with sales: Our firm's sales growth last year.	1	2	3	4	5
Only firms with sales: Our firm's market share growth in our primary market last year.	1	2	3	4	5
Our firm's progress in the development of our lead product last year.	1	2	3	4	5
Our firm's progress in overall product development last year.	1	2	3	4	5
Capital invested in our firm last year relative to major competitors.	1	2	3	4	5
Our firm's success in completing business deals with other firms last year.	1	2	3	4	5

Background questions

1. Who do you see as the customers of your firm?
2. Who are the competitors of your firm?
3. What are the most important sources of market related data for your firm?
4. What kinds of challenges are there when you try to integrate the market intelligence into your R&D?
5. How would you describe the relationships between people working in marketing / sales in your firm and other "departments"?
6. Do representatives of your firm hold meetings to discuss market trends and developments with representatives of other organizations? If yes, what kinds of organizations? Are the meetings more formal or informal?
7. Do you have a joint marketing committee or equivalent with a partnering company? If yes, what is its role?

Business philosophy

Indicate the extent to which each of the following philosophies helps guide your business operations.

	Does not describe my organization at all	Does not describe my organization	Neutral	Describes my organization	Describes my organization very well
The key to business success is producing quality goods and services at a reasonable cost. Good products and services sell themselves. If possible, products and services should be standardized to keep costs down.					
The key to business success lies in persuading potential customers to buy your goods and services, through advertising, personal selling, or other means. Potential customers must be informed and convinced of the benefits of the products.					
The key to business success is to integrate all company activities and personnel toward satisfying customers, while providing satisfactory profits for the firm. The firm should find out what benefits customers want and then provide these benefits through goods and services.					
The key to business success lies in satisfying the important ''publics'' of the company. These publics include customers, employees, stockholders, governmental agencies, suppliers and the public at large. All of their interests should be considered when making decisions.					
The key to business success is the ability and will to acquire a substantial technological background and use it in the development of new products / services. This includes the activities of R&D as well as technological scanning. Success is achieved by being more innovative than competitors.					

Relationships and market orientation

The relationships that your firm has with other firms and organizations help your firm in that…	strongly disagree	disagree	neutral	agree	strongly agree
Your firm gets information about potential customers in your domestic markets					
Your firm gets information about potential customers abroad					
Your firm gets information on potential business partners					
Your firm gets information on what is happening in competing firms					
Your firm gets information on what is happening on the regulatory front of your business					
Your firm gets information on new technology trends					
Your company becomes involved in joint new product development processes with other organizations					
Your company becomes involved in industry promoting activities (e.g. fairs and seminars)					
Your firm jointly subscribes to market data with other firms					
Your firm jointly outsources market research with other firms in the same industry					

Market orientation

Please indicate how well the following descriptions apply to your company.	Scale: 1 = strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree	Possible comments
Our company meets end customers or potential end customers of our products at least once a year to find out what their future needs are.	1 2 3 4 5	
Our company meets opinion leaders (e.g. recognized medical doctors) at least once a year to find out about the future needs of our end customers.	1 2 3 4 5	
Individuals from our R&D and / or manufacturing departments interact directly with customers to learn how to serve them better.	1 2 3 4 5	
Our company conducts market research in-house.	1 2 3 4 5	
Our company outsources market research.	1 2 3 4 5	
Our company subscribes to industry (market) databases	1 2 3 4 5	
Our company is slow to detect changes in our customers' or potential customers' product/service preferences.	1 2 3 4 5	
We often talk with or survey those who can influence our end users' purchases (e.g. medical doctors)	1 2 3 4 5	
We collect industry information by informal means (e.g. lunch with industry friends)	1 2 3 4 5	
In our company intelligence on our competitors is generated independently by several individuals / departments.	1 2 3 4 5	
Our company is slow to detect fundamental shifts in our industry (e.g. competition, technology, regulation).	1 2 3 4 5	
Our company periodically reviews the likely effect of changes in our business environment on customers (e.g. regulation, competition, technology).	1 2 3 4 5	
A lot of informal "hall talk" in our company concerns our competitors' tactics or strategies.	1 2 3 4 5	
Our company holds regular interdepartmental meetings to discuss market trends and developments.	1 2 3 4 5	
Our company holds regular meetings with other companies to discuss market trends and developments.	1 2 3 4 5	
Our company's marketing personnel / business development personnel spend time discussing customers' future needs with the other functions.	1 2 3 4 5	
Our company periodically circulates documents (e.g. newspapers, e-mail alerts) that provide information on customers.	1 2 3 4 5	
When something important happens to customers in our (potential) markets, the whole company knows about it within a short period.	1 2 3 4 5	
Our company disseminates data on customer satisfaction at all levels in the company on a regular basis.	1 2 3 4 5	

There is minimal communication between people in this firm concerning market developments.	1 2 3 4 5	
There is a lot of market-related communication between individuals in our top management team.	1 2 3 4 5	
When someone in our firm finds out something important about the market (e.g. customers, competitors), he / she is slow to share this information with others.	1 2 3 4 5	
Our company interacts with the regulators and legislators that determine industry standards.	1 2 3 4 5	
Understanding markets drives new product development efforts in this company.	1 2 3 4 5	
For one reason or another, our company tends to ignore changes in our customer's product/service needs (e.g. makes no response to the changes)	1 2 3 4 5	
Our company periodically reviews our product/service development efforts to ensure that they are in line with what customers / potential customers want.	1 2 3 4 5	
Our business plans are driven more by technological advances than by market research.	1 2 3 4 5	
Several departments get together periodically to plan a response to changes taking place in our business environment.	1 2 3 4 5	
Our firm gets together periodically with other firms/organizations to plan a response to changes taking place in our business environment.	1 2 3 4 5	
The product lines we develop depends more on internal politics than real market needs.	1 2 3 4 5	
We are quick to respond to changes in the way our competitors behave.	1 2 3 4 5	
The activities of the different departments / functions in our company are well coordinated.	1 2 3 4 5	
Our company takes no action on customer's complaints.	1 2 3 4 5	
Our company educates customers (potential customers) in the use of our products.	1 2 3 4 5	
Even if our company came up with a good marketing plan, our company probably would not be able to implement it in a timely fashion.	1 2 3 4 5	
Our company has little interaction with industry regulators and legislators.	1 2 3 4 5	
When we find out that customers are unhappy with the quality of our product / service, we take corrective action immediately.	1 2 3 4 5	
When a product of our company is / will be on the market we modify / will modify it if our customers would like us to do so.	1 2 3 4 5	

Entrepreneurial orientation

Please select the number on the scale (in the middle column) that best describes your company:
1= the description in the left-hand column describes your firm very well
2= the description in the left-hand column describes your firm more than the description in the right-hand column
3= neutral
4= the description in the right-hand column describes your firm more than the description in the left-hand column
5= the description in the right-hand column describes your firm very well

How many new lines of products or services has your firm marketed since 2000		
No new lines of products or services	1 2 3 4 5	Very many new lines of products or services
Changes in product or service lines have been mostly of a minor nature	1 2 3 4 5	Changes in product or service lines have usually been quite dramatic
How many new lines of products or services does your firm have under research and development right now?		
No new lines of products or services	1 2 3 4 5	Very many new lines of products or services
In general, top managers in my firm favor….		
A strong emphasis on the marketing of tried and true products or services	1 2 3 4 5	A strong emphasis on R&D, techno-logical leadership, and innovations
In dealing with competitors, my firm . . .		
Is very seldom the first business to introduce or be involved in the development of new products/services, administrative techniques, operating technologies, etc.	1 2 3 4 5	Is very often the first business to introduce or be involved in the development of new products/services, administrative techniques, operating technologies, etc.
In dealing with competitors, my firm . . .		
Typically seeks to avoid competitive clashes, preferring a "live-and-let-live" posture	1 2 3 4 5	Typically adopts a very competitive, "undo-the-competitors" posture
In general, the top managers at my firm . . .		
Have a strong proclivity for low-risk projects (with normal and certain rates of return)	1 2 3 4 5	Have a strong proclivity for high-risk projects (with chances of very high returns)
In general, the top managers at my firm . . .		
Believe that, owing to the nature of the environment, it's best to explore it gradually via careful, incremental behavior	1 2 3 4 5	Believe that, owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve the firm's objectives
When confronted with decision-making situations involving uncertainty, my firm. . .		
Typically adopts a cautious, "wait-and-see" posture in order to minimize the probability of making costly decisions	1 2 3 4 5	Typically adopts a bold, aggressive posture in order to maximize the probability of exploiting potential opportunities

Scale:
1 = strongly disagree;
2= disagree;
3= neutral;
4= agree;
5= strongly agree

With this scale from 1 to 5 (above), please indicate if you disagree or agree with the statements made to you for each of the partner groups of your firm listed below. If some of these partners do not apply for your firm (i.e. you do not have these kinds of partner firms) please let the interviewer know.

1. Suppliers of equipment

2. Contract research and manufacturing companies

3. R&D, technology partners (business entities)

4. University and other non-profit collaborations

5. Licensors (You license out your innovations to these firms)

6. Licensees (You license in innovations from these firms)

7. Marketing and distribution partners

8. Business consultants

9. Venture capitalists

10. Governmental (national / state) organizations (technology promotion, etc)
11. Industry associations

12. Informal contacts like friends

Scale: 1 = strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree

	Market intelligence generation										**Market intelligence dissemination**										**Responsiveness to market intelligence**									
	These companies (see column on left) are **a source** of market intelligence for our firm					We perform **joint activities** with these companies (see column on left) **to source** market intelligence					These companies (see column on left) promote us to distribute market intelligence **within our own firm**					We share market intelligence generated within our firm **with these companies** (see column on left)					These companies (see column on left) promote **us** to act based on what we know about markets					These companies (see column on left) **collaborate** with us to act based on what we know about markets				
Suppliers of equipment	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Contract research and manufacturing companies	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
R&D, technology partners (business entities)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
University and other non-profit collaborations	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Licensors (You license out your innovations to these firms)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Licensees (You license in innovations from these firms)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Marketing and distribution partners	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Business consultants	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Venture capitalists	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Governmental (national / state) organizations (technology promotion, etc)	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Industry associations	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Informal contacts like friends	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

Scale: 1 = strongly disagree; 2= disagree; 3= neutral; 4= agree; 5= strongly agree						
When you think about the **formal** relationships your company has with **suppliers of equipment**, these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has with **contract research and manufacturing companies,** these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has with **R&D, technology partners (business entities),** these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has with **universities and other non-profit organizations**, these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	…rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has with **licensors** (You license out your innovations to these firms), these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has with **licensees** (You license in innovations from these firms), these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5

When you think about the **formal** relationships your company has with **marketing and distribution partners**, these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has with **business consultants**, these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has **with venture capitalists**, these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has with **governmental (national / state) organizations** (technology promotion, etc), these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about the **formal** relationships your company has **with industry associations**, these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5
When you think about **the informal contacts like friends,** these relationships have benefited your firm in…	… knowing more exactly the products that your customers want now and will demand in the future	1	2	3	4	5
	… rapidly detecting the changes in the environment (competitors, technology, regulations, etc.)	1	2	3	4	5

Appendix 3: Adaptation of the MARKOR scale.

R denotes a reverse coded item.

Scale item in Jaworski and Kohli (1993)	Scale item in this study	Comments
Market intelligence generation		
Our company meets customers at least once a year to find out what Products / services they will need in the future.	Our company meets end customers or potential end customers of our products at least once a year to find out what their future needs are. Our company meets opinion leaders (e.g. recognized medical doctors) at least once a year to find out about the future needs of our end customers.	Potential end customers are included because most sample firms do not have sales for the time being. Opinion leaders are included because, based on the preliminary study, they were deemed to be important in reflecting end users' preferences and needs. Also, inspired by Narver et al.'s (2004) proactive market orientation item: "We work closely with lead users who try to recognize customer needs months or even years before the majority of the market may recognize them."
Individuals from our manufacturing department interact directly with customers to learn how to serve them better.	Individuals from our R&D and / or manufacturing department interact directly with customers to learn how to serve them better.	R&D is included in addition to manufacturing because most sample firms do not have manufacturing.
Our company does a lot of in-house market research.	Our company conducts market research in-house. Our company outsources market research.	Sample firms do not necessarily have resources to conduct market research in-house but they may still outsource these services.
Our company is slow to detect changes in our customers' product / service preferences (R)	Our company is slow to detect changes in our customers' or potential customers' product / service preferences (R)	Potential customers included.
Our company polls customers at least once a year to assess the quality of our products / services.		Item deleted. Quality in medical biotechnology is mostly not determined by customers but regulators, such as the FDA or EMEA.
We often talk with or survey those who can influence our end users' purchases.	We often talk with or survey those who can influence our end users' purchases (e.g. medical doctors)	

Scale item in Jaworski and Kohli (1993)	Scale item in this study	Comments
We collect industry information by informal means (e.g. lunch with industry friends)	We collect industry information by informal means (e.g. lunch with industry friends)	
In our company intelligence on our competitors is generated independently by several departments.	In our company intelligence on our competitors is generated independently by several individuals / departments.	Departmental boundaries are unclear in the smallest firms.
Our company is slow to detect fundamental shifts in our industry (e.g. competition, technology, regulation). (R)	Our company is slow to detect fundamental shifts in our industry (e.g. competition, technology, regulation). (R)	
Our company periodically reviews the likely effect of changes in our business environment on customers (e.g. regulation, competition, technology).	Our company periodically reviews the likely effect of changes in our business environment on customers (e.g. regulation, competition, technology).	
Intelligence dissemination		
A lot of informal "hall talk" in our company concerns our competitors' tactics or strategies.	A lot of informal "hall talk" in our company concerns our competitors' tactics or strategies.	
Our company holds interdepartmental meetings at least once a quarter to discuss market trends and developments	Our company holds regular interdepartmental meetings to discuss market trends and developments. Our company holds regular meetings with other companies to discuss market trends and developments.	Intelligence dissemination can also take place between companies.
Our company's marketing personnel spend time discussing customers' future needs with the other functional departments.	Our company's marketing personnel / business development personnel spend time discussing customers' future needs with the other functions.	Small firms are more likely to have business development personnel before marketing / sales. See also Narver et al.'s (2004) item: "We continuously try to discover additional needs of our customers of which they are unaware." And "We brainstorm on how customers use our products and services."
Our company periodically circulates documents (e.g. reports, newsletters) that provide information on customers.	Our company periodically circulates documents (e.g. newspapers, e-mail alerts) that provide information on customers.	

Scale item in Jaworski and Kohli (1993)	Scale item in this study	Comments
When something important happens to a major customer in our market, the whole company knows about it within a short period.	When something important happens to customers in our (potential) markets, the whole company knows about it within a short period.	Potential customers included.
Our company disseminates data on customer satisfaction at all levels in the company on a regular basis.	Our company disseminates data on customer satisfaction at all levels in the company on a regular basis.	
There is minimal communication between marketing and manufacturing departments concerning market developments. (R)	There is minimal communication between people in this firm concerning market developments. (R)	Departments not relevant for the smallest firms; rather, communication blocks arise between individuals.
When one department finds out something important about the market (e.g. customers, competitors) it is slow to alert the other departments. (R)	When someone in our firm finds out something important about the market (e.g. customers, competitors) he / she is slow to share this information with others. (R)	
Responsiveness		
It takes our company a long time to decide how to respond to our competitors' price changes (R)	Our company interacts with the regulators and legislators that determine industry standards.	Prices in medical markets are often determined together with regulators or third-party payers. Firms that license out their inventions receive royalties and milestone payments rather than sales income.
Principles of market segmentation drive new product development efforts in this company.	Understanding markets drives new product development efforts in this company.	
For one reason or another, our company tends to ignore changes in our customer's product/service needs (e.g. makes no response to the changes) (R)	For one reason or another, our company tends to ignore changes in our customer's product/service needs (e.g. makes no response to the changes) (R)	
Our company periodically reviews our product / service development efforts to ensure that they are in line with what customers want.	Our company periodically reviews our product / service development efforts to ensure that they are in line with what customers / potential customers want.	Potential customers included.

Scale item in Jaworski and Kohli (1993)	Scale item in this study	Comments
Our business plans are driven more by technological advances than by market research. (R)	Our business plans are driven more by technological advances than by market research. (R)	
Several departments periodically get together to plan a response to changes taking place in our business environment.	Several departments periodically get together to plan a response to changes taking place in our business environment. Our firm periodically gets together with other firms / organizations to plan a response to changes taking place in our business environment.	Responsiveness can also take place as a collaborative effort.
The product lines we sell depends more on internal politics than real market needs. (R)	The product lines we develop depends more on internal politics than real market needs. (R)	Most sample firms do not have sales yet.
If a major competitor of our company were to launch an intensive campaign targeted at our customers, our company would implement a response immediately.	We are quick to respond to changes in the way our competitors behave.	
The activities of the different departments in our company are well coordinated.	The activities of the different departments / functions in our company are well coordinated.	Departments not relevant for the smallest firms.
Our company takes no action on customers' complaints. (R)	Our company takes no action on customers' complaints. (R)	
Even if our company came up with a good marketing plan, our company probably would not be able to implement it in a timely fashion. (R)	Even if our company came up with a good marketing plan, our company probably would not be able to implement it in a timely fashion. (R)	
We are quick to respond to significant changes in our competitors' pricing structures.	Our company has little interaction with the industry regulators and legislators. (R)	Pricing issues are still irrelevant for most sample firms. Instead, the regulators in medical markets determine the prices and have major influence on trends in consumption. New item also inspired also by Narver et al. (2004) "We extrapolate key trends to gain insight into what users in a current market will need in the future."
When we find out that customers are unhappy with the quality of our product / service,	When we find out that customers are unhappy with the quality of	

Scale item in Jaworski and Kohli (1993)	Scale item in this study	Comments
we take corrective action immediately.	our product / service, we take corrective action immediately.	
When our company finds that customers would like us to modify a product / service, the departments involved make concerted efforts to do so.	When a product of our company is / will be on the market we modify / will modify it if our customers would like us to do so.	

Appendix 4: Pilot testing of the final questionnaire, relevant issues and actions taken.

Item in the questionnaire	Comment(s) by the interviewees	Number of interviewees reporting (n=10)	Action taken
Firm level data: ROS and % of sales generated by new products last year	Difficult to assess.	2	Not an issue for respondents from firms with no sales. Question kept as such for firms with sales.
Company characteristics and performance: Number of therapeutic areas where firm's inventions are useful.	How do you define a therapeutic area?	4	Formulating a definition for a therapeutic area:
Company characteristics and performance: Countries of international patent approvals.	Impossible to count, patents filed by areas, e.g. US, EU, not by national states only.	7	Question changed to "Do you file your patents internationally?"
Company characteristics and performance: New process introductions.	What is a process introduction? Not relevant for small R&D firms.	10	Question dropped.
Questions about collaboration with other firms to identify market trends, etc.	Where are the limits of anticompetitive behavior? Collaboration with competitors may be illegal.	2	Questions kept as such, but comments taken into account when analyzing the data.
Subjective performance assessment on the 1-5 scale	"What do you mean by competitors?"	2	Respondents given the clarification that for each statement they should think of the relevant competition in the case of that question.
Open question about joint marketing committee (#7)	The question is a yes-no question unlike other open-ended questions, that call for a verbal answer.	1	None.
Statement #1 in Business Philosophy (Part 4)	The sentences within the statement are controversial. You can agree with one part of the statement but not another.	2	None. The statement has been used by Harris 2002, Harris 2001, Deng and Dart (1994) and Peterson (1989)

Part 5, Relationships and market orientation, first two statements.	Difficult to distinguish between customers in domestic and international customers. By definition, the customer base is global.	3	Statements combined to “Your company gets information about potential customers”. The words “in domestic markets” and “abroad” dropped.
Part 6, MARKOR scale	No departments or even different “functions” in small firms → statements about dissemination of information not relevant.	2	None. In each of the 85 interviews the respondent was encouraged to comment on the statements that felt irrelevant for his / her firm for one reason or another.

Appendix 5: Descriptive figures from the main empirical study

These tables summarize the descriptive figures from the sample firms in the main empirical study. Key features are discussed in Chapter 8.1.

Table 32: Position of interviewees

Position	*N*	*Percentage*
CEO	48	57
Founder	2	2
CEO and Founder	19	22
Vice President, Bus. Dev.	16	19
Total	***85***	***100***

Table 33: Interviews by county and city/state

Country of interview	*N*	*%*	*Area / city*	*N*	*%*
USA	58	68	Pennsylvania	13	15
			California, Bay Area	26	31
			South Florida	19	22
Finland	20	24	Helsinki	6	7
			Turku	12	14
			Tampere	2	2
Sweden	7	8	Gothenburg	7	8
Total	***85***	***100***		***85***	***99***

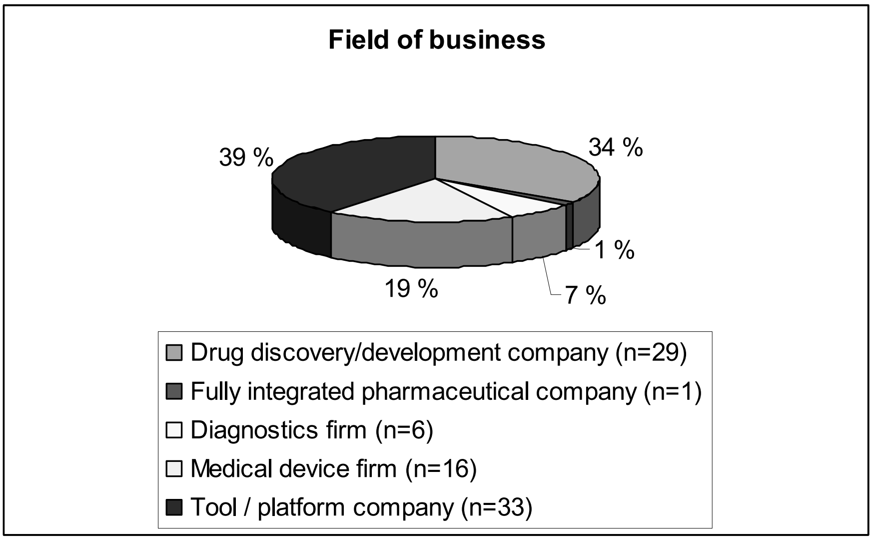

Figure 21: Sample companies by field of business

Table 34: Phase of most advanced product

Phase of most advanced product	*N*	*Percentage*
Marketed by our partner company	16	19
Marketed by our company	24	28
Late stage clinical development (Phase III-IV)	16	19
Early stage clinical development (Phase I-II)	6	7
Preclinical development	19	22
Other / Not applicable	4	5
Total	***85***	***100***

Table 35: Summary statistics of selected demographic variables

Variable	***Mean***	***Median***	***Standard Deviation***	***Minimum-Maximum***	***N***
Number of employees, current	38	16	50,57	1-249	85
Age of firm, years	6	5	4,09	0-23	85
Capital raised by the firm, USD thousands	27 068	7 000	50 262,46	0-315 000	70
Share of R&D expenses out of total expenses, %	60	73	30,10	0-100	80

Table 36: Distribution and sales methods and current sales, cross-tabulation

		Distribution and sales method (realized for firms with sales, planned for firms with no sales)			
		Product(s) on market through a licensing agreement	Own distribution and sales	Selling through a partner company	***Total***
Does the company currently sell products?	NO	14	13	15	***42***
	YES	6	32	5	***43***
Total		***20***	***45***	***20***	***85***

Table 37: Company demographics, selected nominal variables.

Company started by…	***N (85)***	***Percentage (100)***
…team	59	69
…individual	26	31
Firm origin	***N (85)***	***Percentage (99)***
University spin-off	25	29
Industrial spin-off	17	20
Independent venture	41	48
Other	2	2
Firm structure	***N (85)***	***Percentage (100)***
Privately held	72	85
Publicly held	12	14
University-owned	1	1
Firm has a separate sales / marketing department	***N (85)***	***Percentage (100)***
Yes	35	41
No	50	59
Entrepreneur has previously started another business (serial entrepreneur)	***N (79[46])***	***Percentage (93)***
Yes	30	35
No	49	58

[46] Data for 6 cases missing. This data was collected from secondary sources, mostly online, after the actual interviews. This biographical information was not available for six interviewees.

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