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ABSTRACT OF THE DISSERTATION

THE ROLE OF MARKET KNOWLEDGE IN RECOGNIZING AND EXPLOITING ENTREPRENEURIAL OPPORTUNITIES IN TECHNOLOGY INTENSIVE FIRMS

by

Maija Renko

Florida International University, 2008

This dissertation focuses on entrepreneurial opportunity recognition by integrating Schumpeterian opportunity development view with a Kirznerian opportunity discovery theory as well as insights from literature on entrepreneurial orientation. A longitudinal sample of new biotechnology ventures was analyzed. The results show the importance of early market knowledge and technology knowledge as well as an entrepreneurial company posture for subsequent opportunity recognition. Furthermore, the results show that new ventures with more market knowledge are able to gather more equity investments, license out more technologies, and achieve higher sales than new ventures with lower levels of market knowledge.

Market Knowledge and Entrepreneurial Opportunities in Biotechnology

MAY, 2008

EXECUTIVE SUMMARY ON A RESEARCH PROJECT COMPLETED BY
MAIJA RENKO D.SC. (ECON. & BUS. ADM.), PH.D.

"Our customers? We have a lot of customers. Patients, physicians, managed care organizations, regulatory organizations, state and federal government, our distribution chain…"

Innovations and entrepreneurial opportunities in the biotechnology industry

Innovations have the power to make or break biotechnology ventures. New firms get started based on promising innovations, firms grow based on the progress they make in the development of their innovations, and failures of product candidates to deliver expected results in clinical trials can destroy companies. In academic entrepreneurship literature, the nature and origins of innovations have recently been studied under the topic of "entrepreneurial opportunity recognition". The purpose of this research was to understand the role of market knowledge in entrepreneurial opportunity recognition in biotechnology firms. How do opportunities for the creation of goods and services come into existence? Why some people, and not others, discover and exploit these opportunities? More specifically, what is the role of idiosyncratic market knowledge and new scientific knowledge in the creation of entrepreneurial opportunities? And how are different modes of action used to exploit entrepreneurial opportunities?

A research study was completed to answer these questions. Originally, eighty five CEOs and Business Development Managers of young, small biotechnology ventures were interviewed using a structured questionnaire as well as open ended questions. These interviews were completed in 2003-2004. The companies consulted for the research are independent, small and medium-sized medical biotechnology companies in Finland, Sweden, the San Francisco Bay area, Pennsylvania (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 the San Francisco 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).

A follow-up survey was sent to the same companies in the summer of 2007. At this stage out of the original 85 companies, eight had completely ceased to exist and seventeen had merged or been acquired by another company. Hence, out of the 85 companies interviewed in 2003-2004, sixty were still operating as independent businesses in the summer of 2007. 70% (42 companies) of these firms completed the follow-up survey.

"Our partnering decisions are driven by what we believe to be the most efficient way for meeting perceived market needs, as we see them. An important question to ask in the case of every partnership in the industry is why did the firm really enter the partnership. The ultimate driver for many collaborations in biotech is simply access to capital."

The sample and firm survival

The firms included in the study are independent R&D-based biotechnology firms with 250 employees or less. They are active in R&D in human therapeutics (drug discovery & development), diagnostics, medical devices, or technology research that helps in developing the aforementioned classes of products. In 2003-2004, one- to two-hour structured interviews were conducted face-to-face with company CEOs or business development managers in 13 such companies in Pennsylvania, 19 companies in Florida, 27 companies in the San Francisco Bay area, CA, 19 companies in Finland, and 7 companies in Sweden. At that time, the average size of these sample firms was 38 employees (81% of the firms employed 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 sample firms invest heavily in R&D: On average, 60 per cent of all company expenses were categorized under the umbrella of "R&D expenses". 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) was 80 per cent or more.

By the summer of 2007, 15 firms had ceased to exist, been acquired, or had merged with another firm. An analysis was completed to distinguish those companies that were still in operation as independent businesses from those that were not. It turns out that those firms that indicated strong focus on generating market intelligence and disseminating it within the firm in 2003-2004 were significantly more likely to be involved in a merger or acquisition (M&A) by the summer of 2007 than less market oriented firms. What is more, those firms that quit between the initial interviews and the follow-up (3.5 year time lag) had exhibited a significantly lower level of market orientation in the initial data collection phase than surviving firms and those involved in M&A. This negative effect could have been expected based on the marketing literature that emphasizes the positive performance and survival effects of market knowledge and market oriented company culture. However, the positive association between market knowledge and ending up acquired or merged is not captured in the existing empirical literature on market orientation or market knowledge. In the current biotechnology environment, where opportunities for investors' successful exit through an initial public offering are few, M&As offer an alternative exit strategy and improved liquidity.

Market knowledge was measured with an instrument originally developed by Kohli, Jaworski & Kumar (1993). The measure captures the behaviors of a firm that are geared towards understanding customers and competitors throughout the company. Sample items from this instrument include: "We often talk with or survey those who can influence our end users' purchases (e.g. medical doctors)"; "Our company's marketing personnel / business development personnel spend time discussing customers' future needs with the other functions" and "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".

How do opportunities for the creation of goods and services come into existence?

Recognizing an entrepreneurial opportunity means perceiving a possibility to introduce innovative (rather than imitative) goods or services to a marketplace through either the founding and formation of a new venture, or significant improvement of an existing venture.

Entrepreneurial opportunity recognition in this research is measured through a combination of the following four items:
- number of new inventions for which the firm has filed domestic or international patent application(s)
-number of therapeutic areas where these inventions are useful
-number of domestic patent applications, and
-number of international patent applications.

Scientific developments in biology, chemistry, and medicine create opportunities to introduce new biotechnology innovations to the marketplace. However, the path from a scientific advance to a commercial product is a long and risky one. According to an economics-based view that is prevalent in the field of entrepreneurship research, an entrepreneur recognizes opportunities to introduce new products to the marketplace because of his superior market knowledge. Because of individuals' unique experiences and knowledge base, the commercial opportunities they see in any one scientific advance vary significantly. For example, advances in understanding the human genome can create opportunities for improved diagnostic devices, personalized drugs, new kinds of medical devices, or technology platforms that can be further utilized by R&D based companies. **The specific opportunity that an entrepreneur or an existing company sees in a scientific discovery depends on their idiosyncratic understanding of customers, markets, and ways to serve markets**.

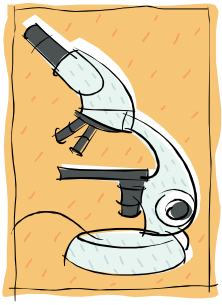
The hypotheses of the study specify different mechanisms through which market knowledge and technology knowledge interact to produce entrepreneurial opportunities. To summarize the findings of the empirical study with regard to the antecedents of opportunity recognition, **technology knowledge that is captured in the form of patents does, indeed, contribute to subsequent opportunity recognition**. The patents that a firm possessed in 2003-2004 were a significant predictor of the number of entrepreneurial opportunities that the firm recognized between 2004 and 2007. **However, the positive linear relationship between technology knowledge and entrepreneurial opportunity recognition only exists when a firm also has a high level of market knowledge**. This finding contradicts much of the previous literature, which has suggested that when dealing with radically new technology knowledge and developing radically new products – like the sample ventures are doing - conventional market knowledge would be of limited utility. The finding about the interaction of market knowledge and technology knowledge emphasizes that a mere understanding of technology and science is not enough for entrepreneurial opportunity recognition. In order for entrepreneurs or entrepreneurial firms to recognize business opportunities they need to understand markets and customers in addition to technology.

In addition to the knowledge possessed by a firm, company culture and the way the company is managed can influence the firm's ability to identify new business opportunities. Previous literature in the field of entrepreneurship talks about the importance of "entrepreneurial alertness" (Kirzner 1979): Entrepreneurs, being more alert, perceive reality more accurately and are better at inferring the likely implications and consequences of critical factors. In the context of existing firms, **entrepreneurial orientation** captures the essence of a firm's alertness to new opportunities in the environment. Entrepreneurial orientation stands for a company culture and behavior that emphasizes **innovativeness, proactiveness and risk-taking** (Covin and Slevin 1991). Innovativeness reflects a tendency to support new ideas, novelty, experimentation, and creative processes. Proactiveness refers to a posture of anticipating and acting on future wants and needs in the marketplace before competitors do. With such a forward-looking perspective,

proactive firms can be expected to capitalize on emerging opportunities. Risk-taking is associated with a willingness to commit large amounts of resources to projects where the cost of failure may be high or where the outcomes are unknown.

Based on previous literature it was expected that organizations that have a high level of entrepreneurial orientation are more prone to focus attention and effort towards opportunities. Indeed, the empirical tests revealed that **entrepreneurial orientation is an important predictor of opportunities recognized by the sample firms**. Regardless of whether a firm's level of market knowledge is low, medium, or high, a high level of entrepreneurial orientation enhances a firm's capability to recognize opportunities. As a conclusion, firms that have a tendency to support new ideas and creative processes (innovativeness), act on future wants and needs in the marketplace before competitors do (proactiveness), and are willing to commit large amounts of resources to projects where the outcomes are unknown (risk taking) recognize more opportunities than firms that lack these qualities.

Alternative explanations: Why some people, and not others, discover and exploit opportunities?



This research focused on understanding the knowledge based resources as well as company culture that promote innovativeness in an organization. In addition to the mechanisms studied here, there are alternative approaches to the study of antecedents of opportunity recognition. For example, the heuristic-based logic approach argues that individuals and situations do vary in the extent to which these decision shortcuts - called heuristics - are used. The decisions that lead to the recognition of innovative opportunities may require significant leaps in thinking, leading to innovative ideas that are not always very linear and factually based. A heuristic-based logic often enables entrepreneurs to make sense of uncertain and complex situations more quickly. Relative to more orthodox approaches to decision making, heuristic-based logic can perhaps expedite opportunity recognition.

"We have a good, collaborative relationship with J&J, we work together. However, market data from J&J is minimal because it is irrelevant for us, we are still just doing animal studies. We are still six years away from the market, and when the time comes J&J will do the marketing of the first product."

Both market knowledge and new scientific knowledge are needed!

Firms that want to stay in the forefront of innovation have to invest in technology knowledge as well as market knowledge. In addition, they have to ensure that the firm stays alert to opportunities arising from the environment. Hence, an organizational posture that emphasizes **innovativeness, proactiveness**, and **risk taking** is beneficial when it comes to opportunity recognition.

In a science driven field like biotechnology, investments in the development of market knowledge base are often forgotten. 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:

- Does everyone in our firm understand who our future customers are?
- Does everyone in the firm know who our competitors are?
- Do we create incentives for all employees to channel market information from the environment to the firm whenever possible?
- Do we have established procedures for continuously monitoring of changes in our future customer base?
- Do we understand our indirect competition? What are the relevant substitutes for our product today and ten years from now?

How are opportunities exploited? Implications for firm performance

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, many of these measurements are irrelevant. In this study, biotechnology ventures' performance was assessed by looking at

- The amount of capital invested in the firm (per year),
- Firm's success in licensing out innovations,
- The amount of sales in 2006 (not all sample firms had sales income, so sales data are only available for some firms)
- Sales growth between 2002 and 2006 (again, these data are only available for some firms)

It was hypothesized that the number of entrepreneurial opportunities recognized by a firm should positively impact the firm's subsequent performance. Also, market knowledge was expected to have a positive effect on the commercialization success. Out of the four performance measures chosen for the study, **entrepreneurial opportunities impacted subsequent equity investments in the firm**. They did not affect sales growth, absolute sales, or licensing success. The lack of relationships between entrepreneurial opportunities recognized and these subsequent profit potential measurements is most likely due to the time needed to convert opportunities recognized into actual dollars or euros. Investors, who base their decisions on the future potential of a venture, are, indeed, influenced by the amount of opportunities the firm has recognized. However, more time than the 3.5 years allowed in this research design will need to elapse before these opportunities are turned into concrete sales or even licensing deals.

"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."

The research results show that **market knowledge has positive effects on sales, technology licensing, and capital invested in the firm**. Better understanding of a firm's current and future customers contributes to investor's increased belief in the firm's ability to break through in the markets. Better understanding of a firm's current and future customers also contributes to potential partners' increased willingness to buy into the firm's technology base (positive effect on technology licensing and sales). The exact mechanism behind this effect is open to speculation, but it is likely that a young firm that knows about its markets and customers is better able to convince potential licensees of the value of its technologies. This finding adds to the increasing body of literature on technology licensing which has, regardless of its recent growth, remained focused on large corporations, universities, and macro-level drivers of efficiency in the markets for technology. Finally, the positive relationship between market knowledge and subsequent sales turnover is in line with those numerous studies in the marketing domain that have established a link between market knowledge and sales. The lack of relationship between market knowledge and sales growth is probably due to the nature of this growth in the sample firms: For many firms, this percentage is very high since their initial sales levels were minimal.

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 knowledge and orientation in the absence of direct market competition. However, the positive linkages detected here between market knowledge and the three important aspects of a young venture's profit potential should urge managers to invest in market intelligence generation and efficient dissemination within their respective organizations.

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Financial support for the research from the following foundations and departments is gratefully acknowledged: Ewing Marion Kauffman Foundation, Foundation for Economic Education in Finland, The Eugenio Pino and Family Global Entrepreneurship Center at Florida International University, The Department of Management and International Business at Florida International University, and The Center for International Education and Research (CIBER) at Florida International University.

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