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COMMERCIALIZATION STRATEGY AND PERFORMANCE OF TECHNOLOGY STARTUPS

by

Irfan Ahmad

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of
Master of Engineering in Telecommunications Technology Management

Department of Systems and Computer Engineering

Carleton University

Ottawa, Canada, K1S 5B6

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**COMMERCIALIZATION STRATEGY AND
PERFORMANCE OF TECHNOLOGY STARTUPS**

Submitted by

Irfan Ahmad

in partial fulfillment of the requirements for the degree of
Master of Engineering in Telecommunications Technology Management

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ABSTRACT

This research examines how the capability platform of a technology startup affects performance. The capability platform includes privileged assets, capital availability, and special relationships. Five hypotheses were tested using data drawn from 93 startups in North America. A startup's performance was measured in two ways: number of new products introduced in the market and the amount of venture capital raised by the startup during the first three years of operations. The results suggest that: (i) the number of partners established by a startup is positively associated with the number of new products introduced, (ii) the level of market related experience of the top management team is positively associated with the amount of venture capital raised by the startup, and (iii) the shorter the time to first round of venture capital financing increases the number of new products introduced and the amount of venture capital raised in the first three years.

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TABLE OF CONTENTS

ABSTRACT.....	iii
ACKNOWLEDGEMENTS.....	iv
TABLE OF CONTENTS.....	v
LIST OF TABLES.....	vii
LIST OF FIGURES	ix
LIST OF APPENDICES.....	x
1. INTRODUCTION	1
1.1 Objective.....	1
1.2 Relevance.....	2
1.3 Contributions.....	3
2. LITERATURE REVIEW	5
2.1 Privileged assets.....	6
2.2 Capital availability.....	9
2.3 Special relationships	11
2.4 Performance of technology startups.....	16
2.5 Market scope and performance of startups	20
2.6 Lessons learned from literature review.....	21
3. RESEARCH MODEL AND HYPOTHESES DEVELOPMENT.....	24
3.1 Research model.....	24
3.2 Hypotheses development	27
3.2.1 Privileged assets.....	27
3.2.2 Capital availability.....	29
3.2.3 Special relationships	30
4. RESEARCH METHOD.....	37
4.1 Unit of analysis	37
4.2 Study period	37
4.3 Sample selection	38
4.4 Data collection and variable definitions	39
4.4.1 Market experience of TMT	40
4.4.2 Time to VC funding.....	40
4.4.3 Number of technology partners	40
4.4.4 Number of strategic partners.....	41
4.4.5 Number of channel partners.....	41

4.4.6	Partner heterogeneity	42
4.4.7	Number of venture capital firms that invest in a startup.....	42
4.4.8	Number of new products.....	43
4.4.9	Amount of venture capital	43
4.4.10	Global and non-global opportunity.....	44
4.5	Measurement of variables	45
4.6	Data analysis	46
5.	RESULTS	49
5.1	Sample.....	49
5.2	Descriptive statistics	51
5.3	Pearson correlation coefficients.....	54
5.4	Stepwise and ordinary least squares regression	58
5.5	Validity of results based on global and non-global opportunity.....	64
5.6	Summary of the results organized by hypothesis	67
6.	DISCUSSION OF RESULTS	71
6.1	Privileged assets and the two dimensions of performance	71
6.2	Capital availability and the two dimensions of performance.....	72
6.3	Special relationships and the two dimensions of performance	73
7.	CONCLUSIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH.....	78
7.1	Conclusions.....	78
7.2	Limitations	80
7.3	Suggestions for future research.....	81
	REFERENCES	84

LIST OF TABLES

Table 1. Measurement of variables.....	45
Table 2. Descriptive statistics	52
Table 3. Descriptive statistics with transformations	53
Table 4. Pearson correlation coefficients for elements of capability platform	55
Table 5. Pearson correlation coefficients for two dimensions of performance	56
Table 6. Pearson correlation coefficients for elements of capability platform and two dimensions of performance.....	58
Table 7. Stepwise regression with number of new products as the dependent variable and five elements of capability platform as the potential explanatory variables.....	59
Table 8. Model 1: Results of OLS regression with number of new products as the dependent variable and total number of partners and time to VC funding as the potential explanatory variables	60
Table 9. Model 2: Results of OLS regression with number of new products as the dependent variable and market experience of TMT and time to VC funding as the potential explanatory variables	61
Table 10. Model 3: Results of OLS regression with number of new products as the dependent variable and partner heterogeneity and time to VC funding as the potential explanatory variables	61
Table 11. Stepwise regression with amount of venture capital as the dependent variable and four elements of capability platform as the potential explanatory variables	63
Table 12. Results of OLS regression with number of new products as the dependent variable and total number of partners and time to VC funding as the potential explanatory variables: Global sample.....	65
Table 13. Results of OLS regression with number of new products as the dependent variable and total number of partners and time to VC funding as the potential explanatory variables: Non-global sample.....	65
Table 14. Results of OLS regression with amount of venture capital as the dependent variable and time to VC funding and market experience of TMT as the potential explanatory variables: Global sample.....	66

Table 15. Results of OLS regression with amount of venture capital as the dependent variable and time to VC funding and market experience of TMT as the potential explanatory variables: Non-global sample.....	67
Table 16. Summary of test results organized by hypothesis.....	68

LIST OF FIGURES

Figure 1. Elements of capability platform and startup's performance.....	25
Figure 2. Startups in the sample sorted by the 'year founded'	50
Figure 3. Startups in the sample sorted by the 'industrial sector'	51

LIST OF APPENDICES

Appendix A. Definitions of new and significantly improved products	92
Appendix B. List of the companies in the sample	94
Appendix C. Scatter plots of dependent variables with independent variables	97
Appendix D. Studentized deleted residual analysis for regression model of table 8.....	106
Appendix E. Studentized deleted residual analysis for regression model of table 11	109

1. INTRODUCTION

This research examines the types of capabilities that the founders of technology startups should develop to increase company performance.

1.1 Objective

This research examines how a startup's capability platform affects its performance. A capability platform is comprised of privileged assets, capital availability, and special relationships (Baghai, Coley, and White, 2000).

The specific elements of a startup's capability platform that were examined in this research include: (i) market experience of the top management team (TMT), (ii) time to venture capital (VC) funding, (iii) total number of partners publicly acknowledged by the startup, (iv) partner heterogeneity, and (v) the number of venture capital firms that funded the startup. The research examines how these five elements affect the number of new products a startup introduces and the amount of venture capital it raises during the first three years of operations.

The five key elements of capability platform examined in this research were identified from the review of the literature. The market related experience of TMT is a dimension of privileged assets; time to VC funding is a dimension of capital availability; and the number of partners acknowledged by a startup, partner heterogeneity, and the number of venture capital firms that invest in the startup are dimensions of special relationships.

1.2 Relevance

This research is relevant for at least two reasons. First, this study provides insights about what kind of capabilities should be pursued to commercialize new products and improve company performance. These insights will be most relevant to founders of technology startups.

Second, this research provides insights to organizations responsible for regional development as to what makes technology startups grow. Regional development organizations will be able to use the results to design programs that support the establishment and growth of technology startups.

Within five years, about half of all startups suffer a quiet death¹ (Schutjens and Wever, 2000). Failure may have a negative connotation; it may even have a stigmatizing effect.

The survival of startups is essential to a regional economy. New firms foster technological innovations of industries (Tushman and Anderson, 1986), create new jobs, and generate new wealth for society (Lee, Lee, and Pennings, 2001). Due to this job creation and wealth generation effect, regional authorities may be interested in this research. It may help them design programs to stimulate the growth of successful startups.

¹ The rate of startups' death was quoted from a research study carried out in the Netherlands. The death rate may be different for North American startups.

1.3 Contributions

This research makes at least three contributions. First, this study examines how a startup's capability platform affects its performance. There is lack of research on the relationship between capabilities and performance of technology startups. Two indicators are used to measure a startup's performance: new product introduction and the amount of venture capital raised by the startup. Studies focused on public companies use performance metrics such as sales growth, employment growth, return on investments (ROI), and return on assets (ROA). Similar data for technology startups is not publicly available.

Second, the results of this research may help founders and investors increase the value of a startup by prioritizing their investments in the activities that increase a startup's performance. This increases the chances of success of a startup and all the stakeholders involved in the new venture.

Third, the results highlight the importance of raising venture capital early, establishing large number of partners, and the extent of TMT experience with the addressable market. These results add to what is known by academics in the nascent empirical literature of startup commercialization. The existing literature on startup commercialization recommends the establishment of relationships anchored around cooperation (Gans, Hsu, and Stern, 2002; Gans and Stern, 2003). This research recommends raising venture capital early, the establishment of large number of partners, and attracting and retaining members of the TMT who have experience with the addressable market.

The thesis is organized into seven chapters. Chapter 1 is the introduction. Chapter 2 reviews the academic literature and provides the lessons learned from it. Chapter 3 describes the theoretical basis for the research and develops the hypotheses anchored around it. Chapter 4 describes the research strategy and method to be used. It also includes the unit of analysis, criteria for sample selection, data collection and data analysis. Chapter 5 provides the results obtained when testing the hypotheses. Chapter 6 discusses the results obtained. Finally, chapter 7 provides the conclusions, limitations and suggestions for future research.

2. LITERATURE REVIEW

The literature that is relevant to this research includes the capabilities for effective commercialization strategy and performance measures for technology startups.

Commercialization begins when a business identifies a way to use scientific or engineering advances to meet a market need and continues through design, development, manufacturing ramp-up, and marketing, and includes later efforts to improve the product (Nevens, Summe, and Uttal, 1990). The existing literature for technology startups links the strategy to commercialization environment. According to Gans et al. (2002), the relative returns to cooperation are high for startups that have obtained formal protection for their intellectual property (IP). Projects able to obtain IP protection, funded by venture capital firms, and associated with higher revenues are all more likely to be commercialized through cooperation (Gans et al., 2002). According to Gans and Stern (2003), when IP protection is strong and complementary assets are held by incumbent firms, startup firms generate more innovative rents if they pursue cooperative options.

This chapter is organized into six sections. The first section reviews the literature on privileged assets as the capabilities which stand out in shaping the performance of technology startups. The second section reviews the literature on capital availability from venture capital firms and explains how the capital availability affects the development path of technology startups. The third section examines the literature on special relationships, which perform very important role in the procurement of complementary resources and identification of entrepreneurial opportunities. The fourth section examines the literature on different ways of measuring performance of technology startups. The

fifth section explains how the market scope affects the relationship between commercialization strategy and competitive aggressiveness of technology startups. Finally, the sixth section of this chapter presents the lessons learned from literature review.

2.1 Privileged assets

Resource based view (RBV) of the firm regards the firm as a bundle of resources and suggests that startups focus on accumulation of resources that are valuable, imperfectly tradable, and hard to imitate to get competitive advantage (Lee et al., 2001). Privileged assets are physical or intangible assets that are hard to replicate and confer competitive advantage on their owner. They include distribution networks, brands and reputation, customer information, infrastructure, and intellectual property (Baghai et al., 2000). The RBV perspective as developed by Collis and Montgomery (1995) conceptualizes companies as collections of physical and intangible assets and capabilities. These assets and capabilities determine how efficiently and effectively a company performs its functional activities (Collis and Montgomery, 1995).

According to Barney (1991), most conspicuous resources that affect the firm's competitive advantage are those that are valuable, scarce, imperfectly tradable, and hard to imitate. A firm is a system of productive resources, both tangible and intangible. Tangible resources include financial and physical assets, while intangibles include technological and market knowledge, management skill, organizational routines, and a firm's brand image and corporate reputation (Barney, 1991). Because intangibles tend to

expand with use, they are often carried in excess capacity and are able to support a greater level and breadth of activity than are tangible resources (Roberts and McEvily, 2005). Although some key intangibles may be freely available, all of the complementary resources required to exploit them are not. Introducing new products may therefore impose resource costs on a firm's existing products. Roberts and McEvily (2005) in their study on pharmaceutical industry provided the evidence of resource cannibalization and suggested that product market experience helps offset some of these costs. Therefore, experience within product-markets improves the company's ability to manufacture, market, and distribute its new products

The successful commercialization of an innovation requires that the know-how in question be utilized in conjunction with other capabilities or assets. Complementary assets are defined as assets that need to be employed to package new technology so that it is valuable to the end user (Jorde and Teece, 1990). Services such as marketing, competitive manufacturing and after-sale support are almost always needed (Teece, 1986). Access to these specialized assets often has a greater effect on the success of firms than the early development of the technology, particularly in regimes of weak appropriability, which is a common situation (Teece, 1986).

Some of the assets that combine to produce and deliver an evolving set of products are critical determinants of new product success. They include the range of complementary assets that result from past participation in product markets (Teece, 1986). In other words, a firm's assets often develop as a function of its different experiences.

Technological knowledge develops as a result of a specific history of technological experience, while complementary assets (e.g., market related knowledge, product reputations, distribution channels, and customer contacts) develop as a result of a specific history of product market participation (Nerkar and Roberts, 2004). Extensive market knowledge is an important complement to a firm's technological knowledge, as it tries to combine its knowledge elements into new products that better meet customer needs (Nerkar and Roberts, 2004).

The growth and development of a firm depend on its ability to introduce new products over time. To do this successfully, it requires technological knowledge, the ability to combine knowledge elements into valuable new products, and the complementary assets, that facilitate the manufacturing, sales, and distribution of those products (Nerkar and Roberts, 2004). Factors internal to the firm include knowledge and skills brought into the firm by entrepreneurs and workforce, which they obtained through earlier experience (Romijn and Albaladejo, 2002). According to Bruderl and Preisendorfer (1998) the strengths and weaknesses of the founders are themselves the strengths and weaknesses of the firms and assumed the startup is an extension of the founder.

After spending many years in the industry entrepreneurs build up a network of social contacts with suppliers, buyers, potential partners, and complementary resource holders. Eisenhardt and Schoonhoven (1990) found that semiconductor startups whose founding top management teams had greater prior joint work experience (i.e. more well established working relationships) exhibited higher initial sales growth. Three major dimensions of

prior knowledge are important to the process of entrepreneurial discovery: prior knowledge of markets, prior knowledge of ways to serve markets, and prior knowledge of customer problems (Shane, 2000). Important prior knowledge about markets might include information about supplier relationships, sales techniques, or capital equipment requirements that differ across markets (Von Hippel, 1988).

2.2 Capital availability

Financial capital is one of the basic resources necessary for the survival and daily operation of businesses, especially for new ventures (Hui, 2004). Capital availability increases the organizational slack or liquidity position of a firm. Organizational slack as defined by Bourgeois (1981) is 'that cushion of actual or potential resources which allows an organization to adapt successfully to internal pressures for adjustment or to external pressure for change in policy as well as to initiate change in strategy with respect to external environment'. Companies with high levels of liquidity have the ability to execute a greater number of actions (Ferrier, 2001). High liquidity permits the firm to experiment with strategic innovation, investments in development and, sales or support. Entrepreneurs who discover opportunities for new ventures often do not control the resources needed to pursue them, they must enlist the patronage of outside investors (Shane and Stuart, 2002).

Initial resources stocks may have enduring effects on organizational performance (Baron, Burton, and Hannan, 1996), perhaps evincing a positive feedback dynamic in the resource accumulation process in which initial advantages amplify over time. Eisenhardt

and Schoonhoven (1990) in their study on U.S. semiconductor firms provided the evidence that initial, small, or even chance advantages created new advantages in the future, multiplying advantages in what was apparently a positive-feedback system. Their findings suggested that the effects of initial conditions exhibited positive feedback behavior and were amplified, not diminished, with time.

Ties to venture capital firms and capital availability

An important source of financing, when startups are in early stage of development, is the venture capital firms that provide capital to startups in exchange for equity and managerial control. VC financing impacts the development path of a startup company (Hellmann and Puri, 2000). In addition, venture capital firms aid startup by offering a network of contacts and potential partners as well as providing experience in corporate governance (Hellmann and Puri, 2000). Since participating venture capital firms have an incentive to make the venture succeed, they provide management related know-how to the startups by having a seat on the board, create access to professionals, and initiate the change of top management team when the startups fall short of the expectation of the venture capitalists (Gorman and Sahlman, 1989). Their involvement will further alleviate the hesitancy of potential suppliers, buyers, investors, and employees when considering their commitment to the startup. Their equity participation signals to others that the new venture enjoys favorable prospects. The effect of venture capital is particularly pronounced in the early stages of a company's development (Hellmann and Puri, 2002; Hsu, 2004).

Hui (2004) found that more direct ties to venture capital firms and more indirect ties via venture capital firms gave startups lower failure likelihood and higher sales revenues, with the exception of the relationship between the number of direct ties and sales revenues, which was an inverted U-shape. Venture capital firms provide management related know-how to the startups by having a seat on the board, providing access to professionals, and initiating the change of the top management team (Gorman and Sahlman, 1989). Consequently, ties with more VC firms might increase TMT diversity and create extra seats on the advisory board. Increased TMT diversity experiences high interpersonal conflicts that have a negative impact on the agreement-seeking behaviors (Knight, Pearce, Smith, Olian, Sims, Smith and Flood, 1999). According to Knight et al. (1999), TMT diversity has negative effects on strategic consensus.

Venture capital firms benefit their companies through a variety of activities such as mentoring, strategic advice, certification to outside stakeholders, professionalization of the company, corporate governance and recruitment of senior management (Hellmann and Puri, 2000). On the other hand, obtaining VC financing also has its costs. The close involvement of venture capital firms can be time consuming for the entrepreneurs and entrepreneurs can also experience a significant loss of control (Hellmann and Puri, 2000).

2.3 Special relationships

Relationships are one of the most important yet least discussed capabilities. Relationships with existing customers and suppliers can provide growth opportunities and should be nurtured (Baghai et al., 2000). Collaboration across companies, especially supplier-

customer partnerships, provides a source of advantage. Companies stretch their own capacity through relationships, adding a partner's competence to their own (Kanter, 1990). The firm's networking capability with suppliers, customers, and knowledge creating organizations asserts a decisive influence on its innovativeness (Chang, 2003). The firm cannot innovate in isolation. They need to establish an effective innovation network of customers, suppliers, competitors, universities and research institutions.

By configuring effective alliance networks at founding, startups access social, technical and commercial competitive resources that normally require years of operating experience to accumulate, buffering themselves from hazards typically faced by new firms and sowing seeds of future opportunities to develop their alliance networks (Baum, Calabrese, and Silverman, 2000). Participation in collaborations is indicative of an ability for interactive knowledge sharing that may prove very beneficial for further exploitation of knowledge and thus inter-firm linkages promote innovativeness (Caloghirou, Kastelli, and Tsakanikas, 2004).

In the context of new business ventures, internal capabilities are not enough for new ventures to enjoy a superior performance, since they are very likely to be deficient of complementary resources. In order for new ventures to fully extract value from their internal capabilities, they should have relational capabilities through which they can mobilize complementary external resources (Lee et al., 2001) and identify more rewarding opportunities. Alliances improve the strategic position of firms in competitive

markets by providing resources from other firms that enable them to share costs and risks, and enhance legitimacy (Eisenhardt and Schoonhoven, 1996).

Technology development partnerships are increasingly used as a strategy for entering new market segments, defined both geographically and organizationally (Angel, 2002). Angel (2002) defines technology development partnerships as ‘contractual agreements among firms for the primary purpose of technology development’. Technology development partnerships are of interest because they are thought to enhance innovation and economic performance. Technology often demands the simultaneous use of different sets of skills and knowledge bases in the innovation process. The number of partnerships a firm maintains can affect its innovative output positively by providing three substantive benefits: knowledge sharing, complementarities, and scale (Ahuja, 2000). When firms collaborate to develop a technology, the resultant knowledge is available to all partners. Second, collaboration facilitates bringing together complementary skills from different firms. Technology often demands the simultaneous use of different sets of skills and knowledge bases in the innovation process. By tapping into development competencies of other firms, firms can enhance their own knowledge base and thereby improve their innovation performance. A third positive effect emerges through scale economies in research that arise when larger projects generate significantly more knowledge than smaller projects (Ahuja, 2000).

Firms engage in external partnerships to harness both the resources of the partner firms and those of the network of firms as a whole (Angel, 2002). Strategic partners span

multiple geographies and offer unique value to customers through the breadth and depth of their sales, service and support organizations combined with integrated solutions that leverage the strengths of both the focal firm and partner product portfolios. Strategic partnerships assist technology startups to perform better in two ways. First, allies share risk and resources, gain knowledge, and obtain access to markets (Hitt, Dacin, Levitas, Arregle, and Borza, 2000). Technology startups as less resource rich firms generally seek technical, managerial, and financial resources through alliances as emerging market firms seek those resources through alliances with developed market firms (Hitt et al., 2000). Second, strategic partnerships can help startups in procuring resources from third parties through the signaling role of the alliance (Stuart, Hoang, and Hybels, 1999).

Strategic partnerships with established companies signal to third parties that the startups stand a good chance of success. The enhanced legitimacy helps the startup to dispel hesitation among resource holders who are concerned with the chance of harvesting their investments in the startups. A firm's strategic alliances influence its capabilities as well as others' perceptions of its capabilities (Baum et al., 2000). By forming strategic alliances, startups can thus potentially access social, technical and commercial competitive resources that normally require years of operating experience to acquire (Ahuja, 2000).

Due to their youth and small size, startups have little experience in the markets for which their innovations are most appropriate, and they have at most two or three technologies at the stage of potential market introduction (Gans and Stern, 2003). Teece (1986, 1988)

identified a set of four important complementary assets: manufacturing, distribution channels, and sales and servicing resources. Powerful products and, to some degree, great brands, no longer provide sustainable differentiation to customers. Effective distribution channels cannot be owned during early years of startups' founding; however, access to established distribution channels is conceivably available through alliances. Alliances can often improve the market power of a firm, either because the alliance partner is a customer for the product or because the distribution channels and buying power of the partners can be combined (Eisenhardt and Schoonhoven, 1996).

Startups can enhance their early performance by, at the time of their founding, 1) establishing an alliance network, 2) configuring the network to provide efficient access to diverse information and capabilities with minimum costs of redundancy, conflict and complexity, and 3) allying with potential rivals that provide more opportunity for learning and less risk of intra-alliance rivalry (Baum et al., 2000). Growth in the number of a firm's alliances increases potential partner redundancy: alliances can be redundant to the extent that they provide access to the same information (Burt, 1992) or complementary capabilities. Increasing the number of alliances without considering partner diversity can create inefficient configurations that return less diverse information and capabilities for greater cost than a smaller non-redundant set (Baum et al., 2000). Ferrier (2001) argued that a heterogeneous team increases a firm's action diversity which increases its performance. According to Ferrier (2001), increased action diversity also adds to the total number of actions in addition to actions of different types thereby increasing a firm's performance. Therefore, startups with heterogeneous partners have

access to a high level of experiential breadth and market resources that enable them to take more diverse actions.

2.4 Performance of technology startups

For new business ventures, profitability, such as return on investment, may not be an appropriate performance indicator, because many of them are still in the stage of product development. Return on investment or on capital is often a useless indicator as many startups have failed before generating any profit. Abnormal return and market valuation from the stock market are not useful for this study, since most of startups are not enrolled in the stock market (Lee et al., 2001).

Introduction of new products

The innovation process describes activities and their results which lie between the conception of an idea and its introduction to the market (Ernst, 2001). When the technical requirements of an idea are realized successfully through R & D, the result is an invention. Launching an invention on the market requires resources from other parts of the organization e.g., production and marketing. The successful introduction of an invention into the market or into production is termed a product or process innovation (Ernst, 2001).

Inventive performance can be defined as the achievements of companies in terms of ideas, sketches, models of new devices, products, processes, and systems (Ernst, 2001; Freeman and Soete, 1997). Inventive performance is frequently measured in the context

of patents where both raw counts of patents and patent citations are taken as the actual measures. Technological performance can be defined as the accomplishment of companies with regard to the combination of their R & D input, as an indicator of their research capabilities, and their R & D output in terms of patents (Hagedoorn and Cloudt, 2003). Innovative performance in the narrow sense refers to results for companies in terms of the degree to which they actually introduce inventions into the market, i.e. their rate of introduction of new products, new process systems or new devices (Freeman and Soete, 1997). In that case new product announcements can be applied as an indicator of innovative performance.

A broader understanding of innovative performance encompasses the three previous measures of performance as it indicates the achievement in the trajectory from conception of an idea up to the introduction of an invention into the market (Ernst, 2001). This broad innovative performance therefore overarches the measurement of all stages from R&D to patenting and new product introduction. In other words, this definition of innovative performance in the broad sense focuses on both the technical aspects of innovation and the introduction of new products into the market, but it excludes the possible economic success of innovations as such (Ernst, 2001; Freeman and Soete, 1997; Hagedoorn and Cloudt, 2003).

Without innovation, young organizations have to rely on traditional ways of doing business; traditional products and services, traditional distribution channels, etc. Head to head competition with established players is bound to result in failure due to resource

shortcomings, scale diseconomies, and questionable reputation. As a result, startups should differentiate themselves from incumbents by introducing products, processes or marketing innovations (Lee et al., 2001).

Tanev (2004) measured the innovation performance by number of technologically new products, processes, and services introduced by a firm in the past three years. In a recent study, Souitaris (2002) measured innovation performance by means of seven variables drawn from the Oslo manual (1997) available at Organization for Economic Co-operation and Development (OECD):

- the number of incrementally innovative products introduced in the last 3 years
- the number of radically innovative products introduced in the last 3 years
- the number of innovative manufacturing processes introduced in the last 3 years
- the percentage of current sales due to incrementally innovative products introduced in the last 3 years
- the percentage of current sales due to radically innovative products introduced in the last 3 years
- the expenditure on innovation in the last 3 years over current sales (including R&D funding and capital expenditure on innovative manufacturing processes)
- the number of patents acquired in the last 3 years

Amount of venture capital

For VC funded startups; cumulative amount of venture capital raised is an important dimension of performance measure. Previous studies have used multiple dimensions to measure startups' performance. Baum et al. (2000) used R & D spending growth and employment in non-R & D and R & D employees as three of the five dimensions of performance measure in their study. Hagedoorn and Cloudt (2003) used R & D expenditures, patent counts and citations, and new product announcements as four indicators of performance measure.

A resource holder's decision to support a startup depends on his or her appraisal of the attractiveness of the opportunity identified by the entrepreneur. However a set of uncertainties and information asymmetries encumber the evaluation of new ventures and complicate the process of contracting between resource holders and new ventures (Shane and Stuart, 2002). Uncertainty about the quality of startups in part arises from the simple fact that young companies have very short performance track records and thus do not lend observable histories to the task of evaluating their quality.

The venture capitalists typically fund their portfolio companies in a series of financing rounds (Lerner, 1994). According to Lerner (1994), experienced venture capital firms primarily syndicate first round investments to venture investors with similar level of experience. In later rounds, established venture capital firms syndicate investments to both their peers and to less experienced capital providers. When experienced venture capital firms invest for the first time in later rounds, the firm is usually doing well

(Lerner, 1994). After first financing round, the new ventures receive second and later stage financing rounds depending on the market conditions and development of the firm between rounds (Shane and Stuart, 2002). Thus, a firm that has an attractive opportunity to exploit and performs better to achieve the goals, as judged by independent venture capital firms, would be eligible to get more amount of VC funding.

In their study on performance of university startups, Shane and Stuart (2002) found that the cumulative amount of VC funding had by far the greatest effect on the rate of initial public offerings (IPO) for startups. This in turn implies that much of the variance in new venture's performance is attributable to the factors that affect the amount of VC funding raised by the new venture. This is consistent with the findings of Lerner (1994) that when experienced venture capital firms invest for the first time in later rounds, the firm is usually doing well.

2.5 Market scope and performance of startups

Market scope is expected to affect the relationship between elements of capability platform and two dimensions of performance. Market scope refers to the breadth of the market addressed by the technology startups. Sajjad (2004) developed a model that related commercialization strategy with two dimensions of competitive aggressiveness of technology startups and concluded that market scope affects the relationship between commercialization strategy and competitive aggressiveness. Sajjad (2004) in his study on 60 technology startups provided the evidence that:

- (i). global startups are more aggressive than non-global startups in terms of action volume and action diversity, and
- (ii). VC financing is positively associated with action diversity and is not related to action volume for global startups.

A company was assumed to be operating in a global market if the company addressed global customers and operating in a non-global market if it addressed Canada/US market (Sajjad, 2004).

2.6 Lessons learned from literature review

This section provides the lessons learned from the literature review:

Privileged assets and startup's performance

TMT members' market related experience is the most important and marketable asset a startup can possess during early years after their founding. Market related experience enable the firm to garner complementary external resources and attract financial capital. Market experience of TMT provides market related knowledge, customer contacts, and familiarity with the customer problems.

Extensive market knowledge is an important complement to a firm's technological knowledge, as it tries to combine its knowledge elements into new products that better meet customer needs (Nerkar and Roberts, 2004).

Capital availability and startup's performance

Financial capital is one of the basic resources necessary for the survival and daily operation of businesses, especially for new ventures (Hui, 2004). Capital availability increases the liquidity position of a firm, and earlier capital availability permits the startups to experiment with the inventions and commercialize the inventions in the form of products during initial years of their founding. Earlier capital availability opens up a way for the startup to prove the potential attractiveness of opportunity and attract more capital to expand the development and commercialization activities.

Special relationships and startup's performance

Companies stretch their own capacity through relationships, adding a partner's competence to their own. Relationships with technology, strategic, and channel partners help startups pursue the opportunities they target and provide a source of advantage.

Internal capabilities are not enough for new ventures to enjoy a superior performance, since they are very likely to be deficient of complementary resources. To create more value from capabilities at hand, firms should mobilize relational capabilities through which they can have access to complementary external resources, and perform better.

Innovation - an important measure of startup's performance

For new business ventures, profitability, such as return on investment, may not be an appropriate performance indicator, because many of them are still in the stage of product development. Without innovation, young organizations have to rely on traditional ways

of doing business; traditional products / services, traditional distribution channels, etc. Head to head competition with established players is bound to result in failure. As a result, startups should differentiate themselves from incumbents by introducing products, processes or marketing innovations (Lee et al., 2001).

Amount of venture capital - an important measure of startup's performance

Multiple performance indicators can offer a better understanding of startup's performance. In addition to other factors, venture capital firms provide a series of financing to companies depending on the attractiveness of the opportunity and how well the company performs in pursuing the opportunity. Cumulative amount of venture capital raised by a startup, therefore, is an important measure of performance during early years of the startup's operation.

Lack of studies on the relationship between capabilities and performance of startups

There is a lack of research on the relationship between capabilities (including financial capital and relational capabilities) and performance of startups during early years of their operations. Most of the previous studies have focused on established or small firms and measured the performance using financial metrics.

3. RESEARCH MODEL AND HYPOTHESES DEVELOPMENT

This chapter is organized into two sections. The first section explains the research model used in this study. The second section provides the hypotheses anchored around the research model.

3.1 Research model

The objective of this research is to examine how five key elements of a startup's capability platform affect its performance. Figure 1 illustrates the research model used to anchor this research. The left hand side of the model shows the elements of a company's capability platform as conceptualized by Baghai et al. (2000). In addition to operational skills, the definition of capability includes three other classes of resources: privileged assets, growth-enabling skills, and special relationships (Baghai et al., 2000). All of these elements confer advantage to firms. The capability platform conceptualized by Baghai et al. (2000) is consistent with the RBV of the firm (Barney, 1991; Collis and Montgomery, 1995; Baum et al., 2000; Lee et al., 2001).

The operational skills include R&D related activities and were not considered in this study because the focus here is commercialization. The key elements of capability platform examined in this research include: (i) market experience of TMT, (ii) time to VC funding, (iii) total number of partners acknowledged by the startup, (iv) partner heterogeneity, and (v) the number of venture capital firms that invested in the startup.

Figure 1. Elements of capability platform and startup's performance

Privileged assets are physical or intangible assets that are hard to replicate and confer competitive advantage on their owner (Baghai et al., 2000). The market related experience of firms' TMT members is used to operationalize privileged assets. This is consistent with Shane (2000), and Nerkar and Roberts (2004). TMT members' experience with the market of the startup provides access to specific customers, established channels, and area-specific reputations.

Earlier capital availability permits the startup to experiment with the inventions and commercialize the innovations during initial years of their founding. Therefore, earlier capital availability is a dimension that captures growth-enabling skills for startups. The time to first occurrence of VC funding is used to operationalize capital availability. This is consistent with Shane and Stuart (2002).

Relationships with customers, suppliers, and other firms in the industry help startups pursue the opportunities they target by providing access to resources. The relationships are captured by the breadth and heterogeneity of partners, and ties to venture capital firms that invest in the startups. The use of total number of partners and partner heterogeneity to capture relationships is consistent with Ahuja (2000) and Baum et al. (2000). The use of number of venture capital firms that invest in a startup is consistent with Hui (2004).

Startups' performance in this research is measured using two indicators; number of new products introduced in the market, and the amount of venture capital raised by the startups in the first three years of operations. The use of new product introduction as a performance indicator is consistent with Hagedoorn and Cloudt (2003), and Tanev (2004). The use of cumulative amount of venture capital as a performance indicator is consistent with Lerner (1994), and Shane and Stuart (2002).

3.2 Hypotheses development

In this section, five hypotheses were developed anchored around the research model shown in figure 1.

3.2.1 Privileged assets

Privileged assets include distribution networks, brands and reputation, customer information, infrastructure, and intellectual property (Baghai et al., 2000). Privileged assets also include the complementary assets that result from past participation in product markets (Teece, 1986). A firm's assets often develop as a function of its different experiences. Technological knowledge develops as a result of a specific history of technological experience, while market related knowledge develops as a result of a specific history of product market participation (Nerkar and Roberts, 2004). Brands and reputation, and manufacturing facilities can only be developed over time through an evolutionary process.

Market related knowledge and customer information

After spending many years in an industry, people build up a network of social contacts with suppliers, buyers, potential partners, and complementary resource holders. Teece (1986) first argued that a firm derives maximum benefit from its technological achievements if it also possesses an appropriate set of market related assets. Experience within product-markets improves the company's ability to manufacture, market, and distribute its new products (Roberts and McEvily, 2005).

New information about a technology might be complementary with prior information about how particular markets operate; leading the discovery of entrepreneurial opportunity to require prior information about those markets (Shane, 2000). Founders' prior knowledge about markets might include information about supplier relationships, sales techniques, or capital equipment requirements that differ across markets (Von Hippel, 1988).

New information about a technology might be complementary with prior information about a customer problem, such that discovery of entrepreneurial opportunity might require information about customer needs (Shane, 2000). With deeper product-market experience, a firm has a better understanding of customer needs, and is therefore better able to tailor new offerings to meet those needs (Nerkar and Roberts, 2004). The market related experience of a firm's TMT members gives the firm access to specific customers, established channels, and area-specific reputations, all of these facilitate introduction of new products in the market.

Startups often do not control the resources to pursue the opportunities they discover; they must enlist the patronage of outside investors (Shane and Stuart, 2002). Startups do not have proven performance track records to attract external financing. The founders and TMT members of startups vary in their ability to obtain the support of resource holders, and this variance affects the startup performance. Startups with founding teams that have experience in the target market are more likely to acquire external funding for their ventures. More experience in the market results in having pre-established relationships

with venture investors that increase the dollar amount of money raised in venture capital. Therefore,

Hypothesis 1. Market experience of TMT is positively associated with a startup's performance.

The complementary hypotheses are:

Hypothesis 1a. Market experience of TMT is positively associated with the number of new products introduced by a startup.

Hypothesis 1b. Market experience of TMT is positively associated with the amount of venture capital raised by a startup.

3.2.2 Capital availability

Typically, venture capital firms fund companies using a series of financing rounds (Lerner, 1994). VC funding is a repeatable event. For a startup, the first round of venture financing is a significant milestone (Shane and Stuart, 2002). Financial capital is one of the basic resources necessary for the survival of a new venture (Hui, 2004). Capital availability increases organizational slack or the liquidity position of a firm. Earlier capital availability permits the startups to experiment with the inventions and commercialize the innovations during their early years. Therefore, shorter time to first round of VC funding enables the startups to introduce more new products during their early years.

The process of product development and introduction, after first round of funding, is a predominant determinant of second and later stage financing rounds. The earlier commercialization of the innovations enables the startup to show growth in number of sales and number of new customers wins. All these result in larger amount of venture capital raised by the startup. Therefore,

Hypothesis 2. Time to VC funding is negatively associated with a startup's performance.

The complementary hypotheses are:

Hypothesis 2a. Time to VC funding is negatively associated with the number of new products introduced by a startup.

Hypothesis 2b. Time to VC funding is negatively associated with the amount of venture capital raised by a startup.

3.2.3 Special relationships

Relationships with customers, suppliers, and other firms in the industry provide startups access to resources that would otherwise be acquired over time through a gradually evolutionary process. Following are the partner types that enable firms to stretch their capacity, adding a partner's competence to their own.

Technology partners

Angel (2002) defined technology partnership as 'contractual agreement among firms for the primary purpose of technology development'. The number of partnerships a firm

maintains can affect its innovative output positively by providing three substantive benefits: knowledge sharing, complementarity, and scale (Ahuja, 2000). When firms collaborate to develop a technology, the resultant knowledge is available to all partners. Second, collaboration facilitates bringing together complementary skills from different firms. Technology development often demands the simultaneous use of different sets of skills and knowledge. By tapping into development competencies of other firms, firms can enhance their own knowledge base and thereby improve their innovation performance. A third positive effect emerges through scale economies in research that arise when larger projects generate significantly more knowledge than smaller projects.

Strategic partners

Instead of joint R&D and joint technology development, the strategic partners meet interoperability or certification requirements to ensure maximum customer value.

Strategic partners span multiple geographies and offer unique value to customers through the breadth and depth of their sales, service and support organizations combined with integrated solutions that leverage the strengths of both the focal firm and partner product portfolios.

Channel partners

Due to their youth, small size, and financial constraints, startups cannot own all the privileged assets during their early years. Startups gain access to established distribution channels through alliances, partnerships, and other form of relationships with external resource holders. Alliances can often improve the market power of a firm, either because

the alliance partner is a customer for the product or because the distribution channels and buying power of the partners can be combined (Eisenhardt and Schoonhoven, 1996). Startups can make distribution agreements with local and worldwide resellers, value added resellers (VARs), distributors and system integrators to increase their market reach.

A greater number of technology, strategic, and channel partners acknowledged by a startup, extends its reach and market penetration. This in turn enables the startup to introduce new products in the market. Moreover, a startup having a greater number of partners is better positioned to find market opportunities and obtain referrals. The involvement of partners enhances startup's legitimacy which helps dispel hesitation among resource holders who are concerned with the chance of harvesting their investments in the startups and results in more dollars raised in venture capital. Therefore,

Hypothesis 3. Total number of partners acknowledged by a startup is positively associated with the startup's performance.

The complementary hypotheses are:

Hypothesis 3a. Total number of partners acknowledged by a startup is positively associated with the number of new products introduced by the startup.

Hypothesis 3b. Total number of partners acknowledged by a startup is positively associated with the amount of venture capital raised by the startup.

Partner heterogeneity

Several factors including redundancy, internal conflict, and complexity are especially likely to influence the effectiveness of a startup's alliance configuration (Baum et al., 2000). Cumulatively, growth in the number of a firm's alliances increases potential partner redundancy: alliances can be redundant to the extent that they provide access to the same information (Burt, 1992) or complementary capabilities. Consequently, increasing the number of alliances without considering partner diversity can create inefficient configurations that return less diverse information and capabilities for greater cost than a smaller non-redundant set. Ferrier (2001) argued that a heterogeneous team increases a firm's action diversity which increases its performance. Startups with heterogeneous partners have access to a high level of experiential breadth and market resources that enable them to take more diverse actions. According to Ferrier (2001), increased action diversity also adds to the total number of actions in addition to actions of different types thereby increasing a firm's performance.

Therefore,

Hypothesis 4. Partner heterogeneity is positively associated with a startup's performance.

The complementary hypotheses are:

Hypothesis 4a. Partner heterogeneity is positively associated with the number of new products introduced by a startup.

Hypothesis 4b. Partner heterogeneity is positively associated with the amount of venture capital raised by a startup.

Ties to venture capital firms

Venture capital firms provide capital to startups in exchange for equity and managerial control. The strength of a firm's network comes from the number of direct ties it has and from the number of indirect ties to which those direct ties are linked (Hui, 2004). Hui (2004) found that a greater number of direct ties to venture capital firms and a greater number of indirect ties via venture capital firms decrease the likelihood of failure for startups, with the exception of the relationship between the number of direct ties and sales revenues, which is an inverted U-shape. Venture capital firms provide management related know-how to the startups by having a seat on the board, providing access to professionals, and initiating the change of the top management team (Gorman and Sahlman, 1989). Consequently, ties with more VC firms might increase TMT diversity and create extra seats on the advisory board. Increased TMT diversity experiences high interpersonal conflicts that have a negative impact on the agreement-seeking behaviors (Knight et al., 1999). The increased TMT diversity and larger size of advisory board would result in spending more time on resolving the internal conflicts than expediting the organizational processes which, in turn, retards the rate at which a startup introduces new products in the market. Therefore,

Hypothesis 5. The number of venture capital firms that invest in a startup is negatively associated with the number of new products introduced by the startup.

Following is a list of hypotheses developed in this section:

Hypothesis 1. Market experience of TMT is positively associated with a startup's performance.

Hypothesis 1a. Market experience of TMT is positively associated with the number of new products introduced by a startup.

Hypothesis 1b. Market experience of TMT is positively associated with the amount of venture capital raised by a startup.

Hypothesis 2. Time to VC funding is negatively associated with a startup's performance.

Hypothesis 2a. Time to VC funding is negatively associated with the number of new products introduced by a startup.

Hypothesis 2b. Time to VC funding is negatively associated with the amount of venture capital raised by a startup.

Hypothesis 3. Total number of partners acknowledged by a startup is positively associated with the startup's performance.

Hypothesis 3a. Total number of partners acknowledged by a startup is positively associated with the number of new products introduced by the startup.

Hypothesis 3b. Total number of partners acknowledged by a startup is positively associated with the amount of venture capital raised by the startup.

Hypothesis 4. Partner heterogeneity is positively associated with a startup's performance.

Hypothesis 4a. Partner heterogeneity is positively associated with the number of new products introduced by a startup.

Hypothesis 4b. Partner heterogeneity is positively associated with the amount of venture capital raised by a startup.

Hypothesis 5. The number of venture capital firms that invest in a startup is negatively associated with the number of new products introduced by the startup.

4. RESEARCH METHOD

This chapter has six sections and explains the research methodology. The first three sections describe unit of analysis, study period, and sample selection criteria respectively. The fourth section provides the sources of data collection and definitions of variables used in this study. The fifth section describes variable measurement scheme. Finally, the sixth section explains the steps used to perform data analyses.

4.1 Unit of analysis

The unit of analysis is a startup that develops technology products. A startup is defined as a company recently formed that has not experienced an IPO or acquisition.

4.2 Study period

The study period includes the first three years of a technology startup established between January 1998 and February 2002.

A lag of three months was used between the elements of a startup's capability platform and performance indicators for the purpose of accounting for the effect of these capability elements on performance. For example, take a company established in February 2002. For this company the study period was from February 2002 to January 2005 and the performance indicators were recorded from February 2002 to April 2005. The use of two lagged dependent variables (number of new products introduced by a startup, and the amount of venture capital raised by a startup), while accounting for the effect of independent variables, is consistent with the literature (Mosakowski, 1993; Lee et al.,

2001; Hagedoorn and Cloudt, 2003). The lagged dependent variable model would be a more rigorous test of the effects of firm characteristics on firm performance (Mosakowski, 1993). The length of the lagging period was selected to keep the sample size optimum for regression analysis. A lag of one year, for example, would have reduced the sample size by 20, as it is obvious from the bar graph of figure 2 in section 5.2.

4.3 Sample selection

The sample was drawn from a list of 887 North American technology startups included in the directory of technology startups maintained by convergedigest.com.

The startups in the directory were listed by the technology or the sector they operate. The directory included startups from six sectors: optical, silicon, wireless, DSL, voice, and P2P. The examination of the companies' mission statements and opportunity descriptions led to an updated list of sectors and include: Internet/IP products, network security, photonics, semiconductor, software, and wireless. These sectors were used to explain the sample by bar graphs in section 5.1. As an example, a company that develops wireless LAN products was listed in the 'wireless' sector.

The following criteria were used to select the sample from the list of 887 startup companies:

- 1 Startup must develop products, be funded by venture capital firms, and was established between January 1998 and February 2002.

- 2 Startup was not a subsidiary or part of a multinational company during the study period.
- 3 Another company did not acquire the startup during the study period.
- 4 Startup maintained press releases and archives in its website since its inception².
- 5 Startup that did not maintain all press releases but missing data was available on one of the data sources described in section 4.4.

4.4 Data collection and variable definitions

Data was collected from: (i) companies' websites, (ii) Business & Company Resource Center database at <http://www.gale.com>, (iii) <http://www.convergedigest.com>, and (iv) the OCRI database at <http://www.ottawacapitalnetwork.com>.

The press releases and news articles available at the companies' websites were used as the main source of data collection. The Business & Company Resource Center database contains press releases of companies from different industries. These press releases include announcements related to products, news about strategic alliances and funds raised by the companies. The database covers more than 1500 technical and non-technical journals.

The news archives maintained by [convergedigest.com](http://www.convergedigest.com) under the 'startup' section contain news releases from the last quarter of 2001 to December 2004 and searchable records

² Most of the startups maintained press releases for the past five years only. This limited the selection of startups that were founded in 1998 and 1999.

back to 1996 including funding history by date and amount. For some of the Canadian startups, the OCRI database was used to collect information on VC financing.

4.4.1 Market experience of TMT

The TMT included members of top management such as the CEO and the people who reported directly to the CEO. Typically, the people reporting to the CEO included the executives who were responsible for finance, sales, engineering, manufacturing, and marketing (Eisenhardt and Schoonhoven, 1996).

Market experience of TMT was measured as sum of the number of years of experience, in the market the startup targets, that each member of the TMT had at the time the startup was founded.

4.4.2 Time to VC funding

Time to VC funding was measured by counting the number of months from the date of startup's inception to the first occurrence of VC funding.

News releases containing VC financing information were used to obtain the date when the startup received its first round of financing.

4.4.3 Number of technology partners

The number of technology partners was measured by counting the number of companies with which the startup collaborated for the purpose of new product development.

The technology partners acknowledged by a startup were identified from press releases that included information on:

- Collaborating with other companies for joint R & D
- Using other firm's resources for joint technology development
- Using other firm's products or technology to complement with its own products
- Integrating other firms' products into its own products

4.4.4 Number of strategic partners

The number of strategic partners was measured by counting the number of companies with which the startup cooperated for the purpose of delivering interoperable solutions to customers.

The strategic partners acknowledged by a startup were identified from press releases that included information on:

- Partnering with vendors to undertake interoperability testing
- Joint marketing and reference selling of interoperable solutions
- Joining partner programs of other companies to obtain certification of compatibility
- Announcement of joint solution to expand the reach of partner companies

4.4.5 Number of channel partners

The number of channel partners was measured by counting the number of companies with which the startup made agreements for the distribution of its products in existing and emerging markets.

The channel partners acknowledged by a startup were identified from press releases that included information on:

- Agreement with resellers and distributors both in local and worldwide markets
- Agreement with value added resellers and value added distributors who sell and support the products

4.4.6 Partner heterogeneity

Partner heterogeneity refers to the extent to which a startup's partners are comprised of many different types. Partner heterogeneity was measured on the basis of Herfindahl index, which is commonly used to measure the level of diversification (Ferrier, 2001).

$$H = 1 - \sum_{i=1}^3 p_i^2$$

Where 'H' is the heterogeneity measure and 'p' is the proportion of partners in each of the three partner types. Maximum value for 'i' is 3 to count for three types of partners. A startup with high partner heterogeneity has partners of many different types.

4.4.7 Number of venture capital firms that invest in a startup

The number of venture capital firms that invested in a startup was calculated by counting the total number of venture capital firms that participated in different rounds of startup financing.

The number of venture capital firms that invested in a startup was identified from press releases that included information on:

- Securing new financing from a venture capital firm or a group of venture capital firms
- Financing round, date and the amount of venture capital raised

4.4.8 Number of new products

The number of new products introduced by a startup was calculated by counting the total number of completely new and significantly improved products introduced in the market. The definitions and examples of completely new and significantly improved products are described in Appendix A.

The number of new products introduced by a startup was identified from press releases that included information on:

- Introduction, availability and pricing of startup's first product
- Introducing entirely new version of a product
- Introducing new features or enhancements to an existing product
- Introducing enhancements made to adopt new standards announced by IEEE or other standard bodies

4.4.9 Amount of venture capital

The amount of venture capital raised by a startup was measured as the sum of dollar amount raised in millions from venture capital firms in different financing rounds.

The amount of venture capital raised by a startup was identified from press releases that included information on financing round, date and the amount of dollars raised. For Canadian companies the currency was converted to US dollars by dividing the amount with 1.5; this conversion factor was mentioned in some of the news releases during study period.

4.4.10 Global and non-global opportunity

If a startup targets other markets in addition to North America it is assumed to be operating in global market and opportunity is assumed to be a global opportunity (Sajjad, 2004). Example of global markets include: Europe, Middle East, and Africa (EMEA); Asia pacific including Japan, China, Korea, etc.

The global opportunity targeted by a startup was identified from press releases that included information on:

- Making distribution or reseller agreement with a company operating in markets other than North America
- Opening a sales or marketing office in markets other than North America
- Appointment of a member in TMT to handle worldwide operations or sales

If there was no evidence of a startup targeting the global market it was assumed to be operating in a non-global market and the opportunity was assumed to be a non-global.

4.5 Measurement of variables

Table 1 provides the information about measurement of variables for data analysis purpose.

Table 1. Measurement of variables

Variable	Measurement
Market experience of TMT	Sum of the number of years of experience in the market the startup targets that each member of the TMT had at the time the startup was founded.
Time to VC funding	The number of months from the date of startup's inception to the first occurrence of VC funding.
Number of technology partners	Total number of companies with which the startup collaborated for the purpose of new product development during first three years of operations.
Number of strategic partners	Total number of companies with which the startup cooperated for the purpose of delivering interoperable solutions to customers during first three years of operations.
Number of channel partners	Total number of companies with which the startup made agreements for the distribution of its products in existing and emerging markets during first three years of operations.
Total number of partners	Sum of technology, strategic, and channel partners acknowledged by a startup during first three years of operations.

Partner heterogeneity	<p>Partner heterogeneity was measured on the basis of Herfindahl index:</p> $H = 1 - \sum_{i=1}^3 p_i^2$ <p>Where 'H' is the heterogeneity measure and 'p' is the proportion of partners in each of the three partner types.</p>
Number of venture capital firms	Total number of venture capital firms that invested in the startup in different rounds during first three years of operations.
Number of new products	Total number of completely new and significantly improved products introduced by a startup during first three years and three months of operations.
Amount of venture capital	Sum of dollar amount raised in millions from venture capital firms in different financing rounds during first three years and three months of operations.
Global	<p>Global = 1, if a startup targets global market</p> <p>Global = 0, if a startup does not target global market</p>

4.6 Data analysis

The SPSS software was used to analyze the data. To begin with, bar graphs showing the startups by the year they were founded and by the sectors they belonged to were produced.

The data was analyzed using a six-step process. In the first step, the descriptive statistics for all the variables used in this research were calculated. To decide whether a variable was normally distributed, its Kurtosis and Skewness statistics were examined. A variable was considered to be normally distributed when its skewness was within two times the standard error of the skewness statistic and kurtosis was within -2 and +2.

In the second step, square root transformations were used to convert the variables that were not normally distributed to give normally distributed characteristics.

The third step was to calculate Pearson correlation coefficients to determine associations between independent variables, between two performance variables and then between independent and two performance variables. The findings were used to decide the selection of best explanatory variables while using regression analysis.

The fourth step consisted in regressing two performance variables against the elements of capability platform using stepwise regression. The number of new products introduced in the market and the amount of venture capital raised by a startup were used as the dependent variables in stepwise regression.

The fifth step was to examine the potential explanatory variables that met the criteria for inclusion in the stepwise regression model. If some of the variables entered in the stepwise regression were correlated to each other, the best out of these correlated variables was selected by regressing these variables, one by one, with the variable or

variables that were not correlated to any of the potential explanatory variables. This step was performed using ordinary least squares (OLS) regression analysis and selecting the OLS regression model with the highest value of 'adjusted R square'.

Finally, in the sixth step the sample was split into global and non-global startups using the control variable 'global'. The two samples were regressed separately against two dimensions of performance using explanatory variables concluded in step five. The purpose was to examine the validity of results of step five based on the startup targeting a global or non-global opportunity.

5. RESULTS

This chapter has six sections. The first section describes the sample. The second section provides descriptive statistics. The third section provides the results obtained when correlating the variables using Pearson correlation coefficients. The fourth section provides the results obtained while testing hypotheses using regression analyses. The fifth section examines the validity of results obtained in section 5.4, taking into account the effect of market scope. Finally, the sixth section summarizes the results.

5.1 Sample

The sample consisted of 93 technology startups founded between January 1998 and February 2002. The companies were drawn from six different industrial sectors: Internet/IP products, network security, photonics, semiconductor, software, and wireless. Appendix B provides a complete list of the companies included in the sample. For each company, Appendix B provides the URL of the company's website and the year the company was founded.

Figure 2 provides a bar graph of the startups in the sample by the year the startups were founded. The majority of the companies in the sample were founded in 1999, 2000 and 2001.

Figure 2. Startups in the sample sorted by the ‘year founded’

Figure 3 provides a bar graph of the startups included in the sample by the industrial sector. The majority of the companies in the sample were from Internet/IP products and network security sectors.

Figure 3. Startups in the sample sorted by the 'industrial sector'

5.2 Descriptive statistics

Table 2 provides the descriptive statistics for the seven variables used in this research. To decide whether or not a variable was normally distributed, its kurtosis and skewness statistics were examined. A variable was considered to be normally distributed when its skewness was within 2 times the standard error of the skewness statistic and kurtosis was within -2 and +2.

The results in table 2 indicate that four variables out of seven are normally distributed: market experience of TMT, total number of partners, partner heterogeneity, and number of venture capital firms. The other three variables: number of new products, amount of venture capital, and time to VC funding are not normally distributed.

Table 2. Descriptive statistics

(Sample size = 93)

	Min	Max	Mean	Std. deviation	Skewness (Std. error .250)	Kurtosis (Std. error .495)	Normally distributed
Number of new products	1	15	5.69	3.075	.824	.168	No
Amount of venture capital (millions)	2	144	39.34	28.554	1.417	2.391	No
Market experience of TMT (years)	49	180	103.40	28.289	.374	-.258	Yes
Time to VC funding (months)	1	30	7.85	6.401	1.364	2.082	No
Total number of partners	0	17	6.10	4.628	.453	-.981	Yes
Partner heterogeneity	.000	.667	.348	.237	-.475	-1.317	Yes
Number of venture capital firms	1	11	4.92	2.203	.409	-.370	Yes

The transformations were attempted and the researcher managed to convert the remaining three variables to normally distributed variables using square roots of the original values.

The variables that were transformed include number of new products, amount of venture capital, and time to VC funding. Table 3 provides descriptive statistics for all the variables after the transformations were performed. The transformed variables are identified in the table by adding a 'SQRT' in parentheses after the name of the variable.

Table 3. Descriptive statistics with transformations

(Sample size = 93)

	Min	Max	Mean	Std. deviation	Skewness (Std. error .250)	Kurtosis (Std. error .495)	Normally distributed
Number of new products (SQRT)	1	3.873	2.299	.637	.271	-.505	Yes
Amount of venture capital (millions) (SQRT)	1.265	12.000	5.886	2.179	.470	.093	Yes
Market experience of TMT (years)	49	180	103.40	28.289	.374	-.258	Yes
Time to VC funding (months) (SQRT)	1	5.477	2.572	1.116	.387	-.276	Yes
Total number of partners	0	17	6.10	4.628	.453	-.981	Yes
Partner heterogeneity	.000	.667	.348	.237	-.475	-1.317	Yes
Number of venture capital firms	1	11	4.92	2.203	.409	-.370	Yes

5.3 Pearson correlation coefficients

Elements of capability platform

The statistic most frequently used to describe how well the model fits the data, when all the variables are normally distributed, is the Pearson correlation coefficient.

Table 4 provides the Pearson correlation coefficients for all the elements of privileged assets, capital availability, and special relationships. Two tailed tests at $p < 0.01$ showed the following associations:

- Market experience of TMT is associated with the total number of partners
- Market experience of TMT is associated with the number of venture capital firms
- Time to VC funding is associated with the number of venture capital firms
- Total number of partners is associated with the partner heterogeneity

Two tailed tests at $p < 0.05$ showed that market experience of TMT is associated with partner heterogeneity. No associations were found for $p < 0.10$.

Table 4. Pearson correlation coefficients for elements of capability platform
(Sample size = 93)

	Market experience of TMT	Time to VC funding (SQRT)	Total number of partners	Partner heterogeneity	Number of venture capital firms
Market experience of TMT	1 .				
Time to VC funding (SQRT)	-.081 .443	1 .			
Total number of partners	.451(***) .000	-.041 .696	1 .		
Partner heterogeneity	.217(**) .037	.016 .876	.504(***) .000	1 .	
Number of venture capital firms	.328(***) .001	-.281(***) .006	.023 .826	-.047 .652	1 .

* p < 0.10 (2-tailed)

** p < 0.05 (2-tailed)

*** p < 0.01 (2-tailed)

Two dimensions of performance

Table 5 provides Pearson correlation coefficients between two dimensions of performance. According to one-tailed test, the amount of venture capital raised by a startup is positively associated with the number of new products introduced by the startup. The correlation coefficient is 0.365, significant at $p < 0.01$.

Table 5. Pearson correlation coefficients for two dimensions of performance
(Sample size = 93)

	Amount of venture capital (SQRT)	Number of new products (SQRT)
Amount of venture capital (SQRT)	1 .	.365(***) .000
Number of new products (SQRT)	.365(***) .000	1 .

* p < 0.10 (1-tailed)

** p < 0.05 (1-tailed)

*** p < 0.01 (1-tailed)

Elements of capability platform and two dimensions of performance

Hypotheses 1, 3, and 4 posit that: market experience of TMT, total number of partners, and partner heterogeneity are positively associated with both the dimensions of performance. Hypothesis 2 posits that time to VC funding is negatively associated with both the dimensions of performance and hypothesis 5 posits that the number of venture capital firms that invest in a startup is negatively associated with the number of new products.

Table 6 provides Pearson correlation coefficients for all the elements of capability platform and two dimensions of performance.

One tailed tests of the alternative hypothesis at $p < 0.01$ showed the following associations:

- Market experience of TMT is positively associated with the number of new products
- Total number of partners is positively associated with the number of new products
- Partner heterogeneity is positively associated with the number of new products
- Market experience of TMT is positively associated with the amount of venture capital
- Time to VC funding is negatively associated with the amount of venture capital
- Number of venture capital firms that invest in the startup is positively associated with the amount of venture capital

One tailed tests of the alternative hypothesis at $p < 0.05$ showed the following associations:

- Time to VC funding is negatively associated with the number of new products
- Number of venture capital firms that invest in the startup is positively associated with the number of new products

One tailed tests of the alternative hypothesis at $p < 0.10$ showed the following association:

- Total number of partners is positively associated with the amount of venture capital.

Table 6. Pearson correlation coefficients for elements of capability platform and two dimensions of performance

(Sample size = 93)

	Number of new products (SQRT)	Amount of venture capital (SQRT)
Market experience of TMT	.546(***) .000	.411(***) .000
Time to VC funding (SQRT)	-.209(**) .022	-.427(***) .000
Total number of partners	.636(***) .000	.167(*) .054
Partner heterogeneity	.473(***) .000	.032 .380
Number of venture capital firms	.232(**) .013	.699(***) .000

* p < 0.10 (1-tailed)

** p < 0.05 (1-tailed)

*** p < 0.01 (1-tailed)

5.4 Stepwise and ordinary least squares regression

Stepwise regression was used to further explore the relationship between the two dimensions of performance and the elements of capability platform.

Number of new products as the dependent variable

Table 7 shows the results of the stepwise regression using number of new products as the dependent variable and the five elements of capability platform as the independent variables. The results show that four variables met the criteria for inclusion in the

stepwise regression. These four variables are total number of partners, market experience of TMT, partner heterogeneity, and time to VC funding.

Table 7. Stepwise regression with number of new products as the dependent variable and five elements of capability platform as the potential explanatory variables

(Sample size = 93)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	1.295	.214		6.061	.000	.530	26.969(***)	.000
Total number of partners	.052	.012	.377(***)	4.163	.000			
Market experience of TMT	.007	.002	.316(***)	3.934	.000			
Partner heterogeneity	.585	.223	.218(**)	2.630	.010			
Time to VC funding (SQRT)	-.098	.041	-.171(**)	-2.387	.019			

* p < 0.10

** p < 0.05

*** p < 0.01

Examination of table 4 shows that three of the four variables entered by the stepwise regression were correlated. These three variables are total number of partners, market experience of TMT, and partner heterogeneity. Time to VC funding was not correlated to any of these three variables. Therefore, OLS regression was performed while considering

each of these three correlated variables, one at a time, with the time to VC funding as the second potential explanatory variable. Three models were created using OLS regression and are described in the following section.

OLS regression models

Tables 8, 9, and 10 provide three models created using OLS regression analysis when total number of partners, market experience of TMT, and partner heterogeneity were considered one at a time with time to VC funding as the second potential explanatory variable.

Table 8. Model 1: Results of OLS regression with number of new products as the dependent variable and total number of partners and time to VC funding as the potential explanatory variables

(Sample size = 93)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	2.040	.145		14.061	.000	.425	35.005(***)	.000
Total number of partners	.087	.011	.628(***)	7.940	.000			
Time to VC funding (SQRT)	-.104	.045	-.183(**)	-2.311	.023			

* p < 0.10

** p < 0.05

*** p < 0.01

Table 9. Model 2: Results of OLS regression with number of new products as the dependent variable and market experience of TMT and time to VC funding as the potential explanatory variables

(Sample size = 93)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	1.301	.254		5.129	.000	.311	21.749(***)	.000
Market experience of TMT	.012	.002	.533(***)	6.139	.000			
Time to VC funding (SQRT)	-.095	.050	-.166(*)	-1.908	.060			

* p < 0.10

** p < 0.05

*** p < 0.01

Table 10. Model 3: Results of OLS regression with number of new products as the dependent variable and partner heterogeneity and time to VC funding as the potential explanatory variables

(Sample size = 93)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	2.171	.166		13.097	.000	.254	16.696(***)	.000
Partner heterogeneity	1.281	.242	.477(***)	5.294	.000			
Time to VC funding (SQRT)	-.124	.051	-.216(**)	-2.404	.018			

* p < 0.10

** p < 0.05

*** p < 0.01

Examination of 'adjusted R square' statistic for models 1, 2, and 3 reveals that model 1, presented in table 8, has the highest value of 'adjusted R square'. The F statistic is significant at $p < 0.10$. The regression coefficient for total number of partners is 0.628 and time to VC funding is -0.183. Both are in the expected direction and significant at $p < 0.10$. Therefore, total number of partners established by a startup and the time to VC funding are the best variables to explaining the variance in the number of new products introduced by the startup.

Appendix C provides scatter plots between the dependent and independent variables. Scatter plots shown in figures C2 and C3 verify the linear relationship between the dependent and independent variables for OLS regression model of table 8.

Appendix D provides plots of studentized deleted residuals. The stem & leaf plot of the residuals is shown in figure D1. The shape of the distribution is symmetric and the three outlying values are identified in figure D3, the box plot of the residuals. In the box plot of figure D3, the distribution is fairly symmetric, since the median is in the middle of the plot. Figure D2, the Q-Q plot of the residuals, shows the residuals are from a normal population because they fall close to the straight line. Figure D4, the scatter plot of predicted and observed values of the number of new products, shows the points are reasonably evenly distributed above and below the line with the exception of few points. These plots verify that the assumptions of normality and constant variance are met for the regression model of table 8.

Amount of venture capital as the dependent variable

Table 11 shows the results of the stepwise regression using amount of venture capital as the dependent variable. Time to VC funding, and market experience of TMT were the independent variables that met the criteria for inclusion in the stepwise regression. These variables are not correlated to each other as it was confirmed by referring to table 4. The regression coefficient for time to VC funding is -0.396 and market experience of TMT is 0.379. Both are in the expected direction and significant at $p < 0.10$. Therefore, time to VC funding and the market experience of TMT are the best variables to explaining the variance in the amount of venture capital raised by the startup.

Table 11. Stepwise regression with amount of venture capital as the dependent variable and four elements of capability platform as the potential explanatory variables

(Sample size = 93)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	4.854	.868		5.592	.000	.310	21.657(***)	.000
Time to VC funding (SQRT)	-.773	.170	-.396(***)	-4.559	.000			
Market experience of TMT	.029	.007	.379(***)	4.364	.000			

* p < 0.10

** p < 0.05

*** p < 0.01

Appendix C provides scatter plots between the dependent and independent variables. Scatter plots shown in figures C6 and C7 verify the linear relationship between the dependent and independent variables for OLS regression model of table 11.

Appendix E provides plots of studentized deleted residuals. The stem & leaf plot of the residuals is shown in figure E1. The shape of the distribution is symmetric and there are no outlying values for this regression model. Figure E2, the Q-Q plot of the residuals, shows the residuals are from a normal population because they fall close to the straight line. In the box plot of figure E3, the distribution is fairly symmetric, since the median is in the middle of the plot. Figure E4, the scatter plot of predicted and observed values of the amount of venture capital raised by the startup, shows the points are reasonably evenly distributed above and below the line with the exception of few points. These plots verify that the assumptions of normality and constant variance are met for the regression model of table 11.

5.5 Validity of results based on global and non-global opportunity

This part was an afterthought. The researcher decided to take into account the findings of Sajjad (2004) to examine the effect of market scope on the regression models shown in Tables 8 and 11. If a startup targets other markets in addition to North America, it is assumed to be operating in global market and opportunity is assumed to be a global opportunity. Tables 12 and 13 present the regression results when the number of new products was the dependent variable and the sample was divided into startups that address global and non-global markets.

Table 12. Results of OLS regression with number of new products as the dependent variable and total number of partners and time to VC funding as the potential explanatory variables: Global sample

(Sample size = 54)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	2.246	.241		9.319	.000	.230	8.912(***)	.000
Total number of partners	.067	.016	.492(***)	4.078	.000			
Time to VC funding (SQRT)	-.077	.074	-.124	-1.028	.309			

* p < 0.10

** p < 0.05

*** p < 0.01

Table 13. Results of OLS regression with number of new products as the dependent variable and total number of partners and time to VC funding as the potential explanatory variables: Non-global sample

(Sample size = 39)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	1.964	.147		13.319	.000	.405	13.927(***)	.000
Total number of partners	.070	.016	.566(***)	4.520	.000			
Time to VC funding (SQRT)	-.118	.046	-.321(**)	-2.563	.015			

* p < 0.10

** p < 0.05

*** p < 0.01

Tables 12 and 13 are replication of table 8 with ‘global’ as a control variable.

Examination of tables 12 and 13 reveals that results of table 8 hold true with the exception that time to VC funding does not remain significant at $p < 0.10$ for global sample. Therefore, total number of partners remains the only significant determinant of performance measured as the number of new products introduced by a startup, irrespective of a global or a non-global opportunity.

Tables 14 and 15 present the regression results when the amount of venture capital was the dependent variable and the sample was divided into startups that address global and non-global markets respectively. Tables 14 and 15 are replication of table 11 with ‘global’ as a control variable.

Table 14. Results of OLS regression with amount of venture capital as the dependent variable and time to VC funding and market experience of TMT as the potential explanatory variables: Global sample

(Sample size = 54)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	5.137	1.186		4.333	.000	.299	12.278(***)	.000
Time to VC funding (SQRT)	-.926	.251	-.425(***)	-3.692	.001			
Market experience of TMT	.029	.009	.379(***)	3.298	.002			

* p < 0.10

** p < 0.05

*** p < 0.01

Table 15. Results of OLS regression with amount of venture capital as the dependent variable and time to VC funding and market experience of TMT as the potential explanatory variables: Non-global sample

(Sample size = 39)

Explanatory variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	3.961	1.412		2.806	.008	.317	9.835(***)	.000
Time to VC funding (SQRT)	-.653	.240	-.369(**)	-2.723	.010			
Market experience of TMT	.038	.012	.415(***)	3.067	.004			

* p < 0.10

** p < 0.05

*** p < 0.01

Examination of table 14 and 15 reveals that results of table 11 hold true irrespective of the startup targeting a global or non-global market. Therefore, time to VC funding and market experience of TMT remain significant determinants of performance measured as the amount of venture capital raised by a startup, irrespective of a global or a non-global opportunity.

5.6 Summary of the results organized by hypothesis

Table 16 summarizes the hypothesis results obtained in section 5.4. A hypothesis was supported when:

- (i). the variable being examined entered the stepwise regression
- (ii). the variable being examined was included in the OLS regression model with the highest 'adjusted R square' value. This step was only required when the number of new products was the dependent variable.
- (iii). the regression coefficient for the variable being examined was significant at $p < 0.10$ and was in the same direction as expected.

A hypothesis was not supported when the criteria above was not met.

Table 16. Summary of test results organized by hypothesis

Hypothesis	Decision based on test results	Rationale
Hypothesis 1a. Market experience of TMT is positively associated with the number of new products introduced by a startup.	Not supported	Market experience of TMT was not included in the OLS regression model which produced the highest value of adj. R square.
Hypothesis 1b. Market experience of TMT is positively associated with the amount of venture capital raised by a startup.	Supported	Regression coefficient for market experience of TMT was significant at $p < 0.10$ in stepwise analysis, and was in the expected direction.

Hypothesis 2a. Time to VC funding is negatively associated with the number of new products introduced by a startup.	Supported	Regression coefficient for time to VC funding was significant at $p < 0.10$, in the expected direction, and it was included in OLS regression model which produced the highest value of adj. R square.
Hypothesis 2b. Time to VC funding is negatively associated with the amount of venture capital raised by a startup.	Supported	Regression coefficient for time to VC funding was significant at $p < 0.10$ in stepwise analysis, and was in the expected direction.
Hypothesis 3a. Total number of partners acknowledged by a startup is positively associated with the number of new products introduced by the startup.	Supported	Regression coefficient for total number of partners was significant at $p < 0.10$, in the expected direction, and it was included in OLS regression model which produced the highest value of adj. R square.
Hypothesis 3b. Total number of partners acknowledged by a startup is positively associated with the amount of venture capital raised by the startup.	Not supported	Total number of partners did not enter the stepwise regression analysis.

Hypothesis 4a. Partner heterogeneity is positively associated with the number of new products introduced by a startup.	Not supported	Partner heterogeneity was not included in the OLS regression model which produced the highest value of adj. R square.
Hypothesis 4b. Partner heterogeneity is positively associated with the amount of venture capital raised by a startup.	Not supported	Partner heterogeneity did not enter the stepwise regression analysis.
Hypothesis 5. The number of venture capital firms that invest in a startup is negatively associated with the number of new products introduced by the startup.	Not supported	Number of venture capital firms did not enter the stepwise regression analysis.

6. DISCUSSION OF RESULTS

The objective of this thesis was to examine how a startup's capability platform affects its performance. The specific elements of a startup's capability platform that were examined include: market experience of TMT, time to VC funding, total number of partners acknowledged by the startup, partner heterogeneity and the number of venture capital firms that invested in the startup. The research examined how these elements affected the two dimensions of performance i.e. the number of new products the startup introduced and the amount of venture capital the startup raised in the first three years of its operations. Following sections provide discussion of results obtained in chapter 5.

6.1 Privileged assets and the two dimensions of performance

The first hypothesis tested the relationship between the market experience of TMT and the two dimensions of performance. The results supported the hypothesis that the market experience of TMT is positively associated with the amount of venture capital raised by the startup.

There is some support for hypothesis 1a, i.e. market experience of TMT is positively associated with the number of new products introduced by a startup. The Pearson correlation coefficient for market experience of TMT and the number of new products introduced by a startup is 0.546 and it is significant at $p < 0.01$. Market experience of TMT also met the criterion for inclusion in the stepwise regression. However, market experience of TMT was not a major contributor to explaining the variance in the number of new products because value of 'adjusted R square' produced by OLS regression model

2, using market experience of TMT and time to VC funding as explanatory variables, was not the highest.

The results supported hypothesis 1b, i.e. market experience of TMT is positively associated with the amount of venture capital raised by the startup. The results are consistent with the findings of Shane and Stuart (2002). According to Shane and Stuart (2002), the founders and TMT members of startups vary in their ability to obtain the support of resource holders, and that this variance affects the startup's performance. Startups with founding teams that have experience in the target market are more likely to acquire repeated rounds of external funding for their ventures. More experience in the market also results in having pre-established reputations and relationships with venture investors that increase the dollar amount of VC money raised by the startup.

6.2 Capital availability and the two dimensions of performance

Hypothesis 2 tested the relationship between time to VC funding and the two dimensions of performance. As shown in table 16, both hypotheses 2a and 2b were supported. Shorter time to VC funding permits a startup to introduce more new products in first three years of operations. The results are consistent with the findings in the literature. Capital availability increases the organizational slack or liquidity position of a firm and according to Ferrier (2001); companies with high levels of liquidity have the ability to execute a greater number of actions. Earlier capital availability permits a firm to experiment with strategic innovation, investments in development, and sales or support and thus commercialize more products in the market. It also allows startups to prove

potential attractiveness of the opportunity and show growth in number of sales and new customers wins during early years.

The results of hypotheses 2a and 2b support the findings that initial resources stocks have enduring effects on organizational performance (Baron et al., 1996). The results also support the findings of Eisenhardt and Schoonhoven (1990). Eisenhardt and Schoonhoven (1990) in their study on U.S. semiconductor firms provided evidence that the effects of initial conditions exhibited positive feedback behavior and were amplified, not diminished, with time.

6.3 Special relationships and the two dimensions of performance

Total number of Partners, partner heterogeneity and performance

Hypothesis 3 tested the relationship between the total number partners acknowledged by a startup and the two dimensions of performance. As shown in table 16, hypothesis 3a is supported. Total number of partners acknowledged by a startup is the major contributor to explaining the variance in the number of new products introduced by the startup.

This finding supports findings in the literature by Ahuja (2000), Angel (2002), and Baum et al. (2000). The number of partnerships a firm maintains can affect its innovative output positively by providing three substantive benefits: knowledge sharing, complementarities, and scale (Ahuja, 2000). Firms engage in external partnerships to harness both the resources of the partner firms and those of the network of firms as a whole (Angel, 2002).

The results are also consistent with the findings of Eisenhardt and Schoonhoven (1996), i.e. alliances can often improve the market power of a firm, either because the alliance partner is a customer for the product or because the distribution channels and buying power of the partners can be combined.

Distribution agreements with local and worldwide resellers, value added resellers (VARs), and distributors increase startups' markets reach. The new customers in different geographical and organizational settings would have unique requirements, which motivate additional features and enhancements to be added on top of the basic version of the product.

There is some support for hypothesis 3b, i.e. total number of partners acknowledged by a startup is positively associated with the amount of venture capital raised by the startup. The Pearson correlation coefficient for total number of partners and the amount of venture capital is 0.167 significant at $p < 0.10$. However, the total number of partners did not enter the stepwise regression when the amount of venture capital was the dependent variable. A possible explanation for contradictory result for hypothesis 3b is described below, while explaining the results for hypothesis 4b.

Hypothesis 4 tested the relationship between partner heterogeneity and the two dimensions of performance. There is some support for hypothesis 4a, i.e. partner heterogeneity is positively associated with the number of new products introduced by a startup. Pearson correlation coefficient for partner heterogeneity and number of new

products is 0.473 significant at $p < 0.10$. Partner heterogeneity also met the criterion for inclusion in the stepwise regression. However, partner heterogeneity was not a major contributor to explaining the variance in the number of new products because value of 'adjusted R square' produced by OLS regression model 3, using partner heterogeneity and time to VC funding as explanatory variables, was not the highest. There was no support for hypothesis 4b, i.e. partner heterogeneity is positively associated with the amount of venture capital.

The results of hypotheses 4a and 4b are contradictory with the literature. Burt (1992) suggested that growth in the number of alliances of a firm increases potential partner redundancy: alliances are redundant to the extent that they provide access to the same information or complementary capabilities. Consequently, increasing the number of alliances without considering partner heterogeneity can create inefficient configurations that return less diverse information and capabilities for greater cost than a smaller non-redundant set (Baum et al., 2000). The results of this research suggest that it is important for startups to establish more partners during their early years than to concentrate on heterogeneity.

The total number of partners and partner heterogeneity (hypotheses 3b and 4b) were not found to be determinants of the amount of venture capital raised by the startup. One possible explanation is that there are other factors that contribute more to attract the venture capital than having more partners with diverse configuration. These factors may

include value proposition for users based on the technology, growth in number of sales, and growth in number of new customers wins.

Number of venture capital firms and the number of new products

Hypothesis 5 tested the relationship between number of venture capital firms that invested in the startup and the number of products that were introduced by the startup.

Hypothesis 5 predicted that the number of venture capital firms that invest in the startup is negatively associated with the number of new products. The results do not support this hypothesis. The Pearson correlation coefficient for the number of venture capital firms and the number of new products is 0.232 significant at $p < 0.05$. The result was significant in the opposite direction than the one hypothesized. The hypothesis was based on the rationale that the greater the number of venture capital firms results in increased TMT diversity. Increased TMT diversity experiences high interpersonal conflicts that have a negative impact on the agreement-seeking behaviors (Knight et al., 1999). According to the rationale for this hypothesis, the increased TMT diversity and larger size of advisory board would result in spending more time on resolving the internal conflicts than expediting the organizational processes which, in turn, retards the process of new product introduction.

An explanation for contradictory result is that the VC financing is carried out only after an agreement, made between VC and the startup about the future strategic direction.

Therefore, the presence of VC representatives in TMT and advisory board would result in less interpersonal conflicts given that an agreement is already in place. The second

potential explanation is that startups do not make direct agreements with each of the venture capital firms involved in different financing rounds. Each round is led by a lead VC who syndicates investments to both their peers and less experienced capital providers (Lerner, 1994).

Effect of having global or non-global opportunity

Examination of tables 12 through 15 reveals that results summarized in table 16 remain valid with the exception of hypothesis 2a. Time to VC funding does not remain significant at $p < 0.10$ when the number of new products is the dependent variable and startup targets a global opportunity.

The results suggest that the time to VC funding affects the performance of non-global startups and does not remain significant when startups target global opportunity. This result is consistent with the finding that market scope affects the relationship between commercialization strategy and competitive aggressiveness of technology startups (Sajjad, 2004). In his study on 60 technology startups, Sajjad (2004) found that global startups are more aggressive than non-global startups and VC financing is positively associated with action diversity and is not related to action volume for global startups.

7. CONCLUSIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

This chapter has three sections. The first section describes the conclusions drawn from this research and provides the implications for founders of technology startups, venture investors, and the organizations responsible for regional development. The second section identifies the limitations of this research. Finally, the third section provides suggestions for future research in the nascent area of startup commercialization.

7.1 Conclusions

During their early years, startups do not possess the necessary complementary resources required to commercialize new products. However, by configuring effective relationships, startups can access resources that normally require years of operating experience to accumulate. The results of this research suggest that having a greater number of partners enable startups to introduce more new products in the market.

Market experience of TMT members is an important intangible asset for generating sustained competitive advantage. The results of this research suggest that the market experience of TMT members provides startups the ability to raise larger amount of venture capital.

The results show that time to VC funding is negatively correlated with the two dimensions of performance. This result suggests that startups that manage to obtain VC funding early, perform better. Their innovation rate is better and initial resources stocks

may have enduring effects on organizational performance, perhaps evincing a positive feedback dynamic in the resource accumulation process in which initial advantages amplify over time.

Specifically, this research makes following recommendations to the founders of technology startups:

- Establish a large number of technology, strategic and channel partners in the industry; do not innovate in isolation
- Setup a top management team comprised of members that are experienced in the market that the startup targets
- Acquire financial capital early after the startup's formation.

These insights can be used by the organizations responsible for regional development to design programs that support the growth and success of technology startups in the region. The successful startups, in turn, would create new jobs, generate new wealth for society and lower the rate of startups' death.

This study also provides insights to capital providers such as venture capital firms.

Venture capital firms may prioritize their investments in the startups whose TMT members have greater level of experience with the addressable market than the startups whose TMT members are relatively inexperienced in the addressable market. Likewise, venture capital firms may prioritize their investments in the startups that are not

innovating in isolation, but are establishing technology, strategic, and channel partners to innovate and commercialize their innovations.

7.2 Limitations

The research is not without limitations. The first limitation is that while measuring the market experience of TMT members, the study did not differentiate the level of previous job title, prior experience of founding new startups, or the history of working with prominent entrepreneurial firms.

Second, the research only studied technology startups that develop products including Internet/IP, network security, photonics, semiconductor, software, and wireless.

Therefore, the results cannot be generalized to non-technological startups due to different market trends and life cycle variations. Furthermore, the study used data from North American technology startups to test the hypotheses. As a result, validity of the results to other country settings is questionable and awaits further research in other kinds of settings.

Third, the duration of study period was limited to first three years of startups' operations due to unavailability of data for longer periods on publicly available resources. The results would have shown a better understanding of the performance determinants provided the study period was longer than three years. As an example, consider the scatter plot C3 of number of new products with the total number of partners as shown in Appendix C. According to scatter plot, the number of new products introduced by a

startup has linear relationship with the total number of partners for the first three years but most probably this relationship would not stay linear over time. According to Burt (1992), growth in the number of a firm's alliances increases potential partner redundancy and alliances can be redundant to the extent that they provide access to the same information or complementary capabilities. Increasing the number of alliances without considering partner diversity can create inefficient configurations that return less diverse information and capabilities for greater cost than a smaller non-redundant set (Baum et al., 2000). The results of this research depict a linear relationship between these two variables for the first three years but the relationship is unknown afterwards due to limitation of data availability.

7.3 Suggestions for future research

There are four suggestions for future research. First, future research may consider the effect of other characteristics of TMT on the performance of technology startups. The other characteristics that may be considered include: previous experience in high-level jobs, previous experience of founding new startups, and history of working with prominent entrepreneurial firms. Entrepreneurial prominence reduces the perceived uncertainty of a new venture (Burton, Sorensen, and Beckman, 2001). According to Burton et al. (2001), among firms pursuing an innovation strategy, employer prominence has the positive and statistically significant effect on the odds of securing external financing at startup. Future research may consider the effect of employer prominence on the number of new product introduction and the amount of venture capital raised by a startup.

Second, future research may consider the effect of elements of capability platform on the performance over time. Specifically; the effect of total number of partners, market experience of TMT, and partner heterogeneity is expected to reveal interesting findings over time that may be different than the relationships depicted in Appendix C.

Third, future researchers can conduct case based research for theory building using outlying data points highlighted in Appendix C and D. According to Carlile and Christensen (2005), anomalies are valuable in theory building because the discovery of an anomaly is enabling a step in identifying and improving the categorization scheme in a body of theory, which is the key to being able to apply the theory with predictable results. Specifically, future researchers can consider seven cases where technology startups introduced products at exceptionally higher rates as depicted in scatter plots C1 through C4; and the seven cases where startups raised exceptionally larger amounts of venture capital as shown in scatter plots C6 through C8 in Appendix C. Moreover, three outlying data points, that did not fit the regression model of table 8, as shown in box plot D3 in Appendix D can also be considered for future research. There may be more information carried out by these outlying data points than the ones that fit the mode well and understanding the outliers or anomalies is generally the key to discover new categorization scheme.

Fourth, this research examined only the validity of regression results based on the opportunity the startup targeted was a global or non-global. The results suggest that shorter time to VC funding only affects the performance of non-global startups. Future

researchers can replicate this study, dividing the sample based on global and non-global opportunity and explore the difference between the results. The interesting findings will add to what is known by academics in the nascent area of startup commercialization.

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Appendix A. Definitions of new and significantly improved products

The definitions and examples of new and significantly improved products provided here are drawn from the OECD's (1997) 'Oslo Manual'. This manual provides guidelines for collecting and interpreting technological innovation data.

New Product

For the purpose of this research, a new product refers to a completely new or significantly improved product.

Completely new product

A completely new product is a product whose technological characteristics or intended uses differ significantly from those of previously produced products. Such innovations can involve radically new technologies, can be based on combining existing technologies in new uses, or can be derived from the use of new knowledge.

Examples:

The first microprocessors and video cassette recorders were examples of completely new products of the first kind, using radically new technologies. The first portable cassette player, which combined existing tape and mini-headphone techniques, was a technologically new product of the second type, combining existing technologies in a new use. In each case the overall product had not existed before.

Significantly improved product

A significantly improved product is an existing product whose performance has been significantly enhanced or upgraded. A simple product may be improved (in terms of better performance or lower cost) through use of higher-performance components or materials, or a complex product which consists of a number of integrated technical sub-systems may be improved by partial changes to one of the sub-systems.

Examples:

The substitution of plastics for metals in kitchen equipment or furniture is an example of the use of higher performance components. The introduction of ABS braking or other sub-system improvements in cars is an example of partial changes to one of a number of integrated technical sub-systems. The introduction of 802.11a/b/g compatible products is an example of enhancements made over 802.11 basic wireless LAN specifications.

Similarly, a technology product after having an up-gradation made on top of its basic version to adopt new standards announced by IEEE or other standard bodies is considered as a significantly improved product.

Appendix B. List of the companies in the sample

	Company name	Website	Date founded
1.	Acme packet	www.acmepacket.com	Aug, 2000
2.	Aeluros	www.aeluros.com	Jun, 2001
3.	Airmagnet	www.airmagnet.com	Jul, 2001
4.	Alloptic Inc.	www.alloptic.com	Jun, 1999
5.	Alopa Networks	www.alopa.com	Sep, 1999
6.	Ample communications	www.amplecomm.com	Sep, 2000
7.	Arbor networks	www.arbornetworks.com	Aug, 2000
8.	Astute networks	www.astutenetworks.com	Apr, 2000
9.	Atreus systems	www.atreus-systems.com	Jul, 1999
10.	Atrica	www.atrica.com	Feb, 2000
11.	Authenticate	www.authenticate.com	Sep, 1999
12.	Axerra	www.axerra.com	Nov, 2000
13.	Bay packets	www.baypackets.com	Feb, 2000
14.	BigBear networks	www.bigbearnetworks.com	Jun, 2000
15.	Brix networks	www.brixnetworks.com	Jul, 1999
16.	Captus	www.captusnetworks.com	May, 2000
17.	Cedar point communication	www.cedarpointcom.com	Jun, 2000
18.	Centrata Inc.	www.centrata.com	Dec, 2001
19.	Cenzic	www.cenzic.com	Jun, 2000
20.	Circadiant	www.circadiant.com	Aug, 2000
21.	Colubris	www.colubris.com	Nov, 1999
22.	Convedia corp.	www.convedia.com	Feb, 2000
23.	Corrent	www.corrent.com	Dec, 2000
24.	Crossbeam systems	www.crossbeamsystems.com	Mar, 2000
25.	Cyoptics	www.cyoptics.com	Mar, 1999
26.	Danger Inc.	www.danger.com	Jan, 2000
27.	DragonWave Inc.	www.dragonwaveinc.com	Jul, 2000
28.	Ecrio	www.ecrio.com	Dec, 1998
29.	Egenera	www.egenera.com	Mar, 2000

30.	Ember corporation	www.embercorp.com	July, 2001
31.	Ethertronics	www.ethertronics.com	May, 2000
32.	FineGround	www.fineground.com	Feb, 2001
33.	Force10 networks	www.force10networks.com	Dec, 1999
34.	Galazar networks	www.galazar.com	Jan, 2001
35.	General bandwidth	www.genband.com	Jul, 1999
36.	Ingrian networks	www.ingrian.com	Jan, 2000
37.	Inkra networks	www.inkra.com	May, 2000
38.	InterSAN	www.intersan.net	Jan, 2000
39.	IP unity	www.ipunity.com	Dec, 1999
40.	Jedai broadband networks	www.jedai.com	May, 2000
41.	Kavado	www.kavado.com	Feb, 2000
42.	Knownow	www.knownow.com	Apr, 2000
43.	Kodeos communications	www.kodeos.com	Jan, 2001
44.	Kontiki	www.kontiki.com	Aug, 2001
45.	Laurel networks	www.laurelnetworks.com	Oct, 1999
46.	Lumeta	www.lumeta.com	Dec, 2000
47.	Maranti	ww.marantinetworks.com	Dec, 2000
48.	Maxxan	www.maxxan.com	May, 2001
49.	Megisto systems	www.megisto.com	May, 2000
50.	Mellanox technologies	www.mellanox.com	Mar, 1999
51.	Meriton networks(Edgeflow)	www.meriton.com	Sep, 2000
52.	Metratech	www.metratech.com	Jun, 1998
53.	Mintera	www.mintera.com	Oct, 2000
54.	Nakina systems	www.nakinasystems.com	Oct, 2001
55.	Natural convergence	www.naturalconvergence.com	Apr, 2001
56.	Navini networks	www.navini.com	Jan, 2000
57.	Netrake	www.netrake.com	Jan, 2000
58.	nLight photonocis	www.nlightphotonics.com	Jul, 2000
59.	Optium	www.optiumcorp.com	Oct, 2000
60.	Overture networks	www.overturenetworks.com	Sep, 2000
61.	Polaris networks	www.polarisnetworks.com	Jun, 2000
62.	Panasas	www.panasas.com	Sep, 2000

63.	PanGo networks	www.pangonetworks.com	Oct, 1999
64.	Peribit	www.peribit.com	May, 2000
65.	Postini	www.postini.com	Oct, 1999
66.	Quake technologies	www.quaketech.com	Apr, 2000
67.	Qualys	www.qualys.com	Oct, 1999
68.	Redline communications	www.redlinecommunications.com	Nov, 1999
69.	Redline networks	www.redlinenetworks.com	Mar, 2000
70.	Santur	www.santurcorp.com	Nov, 2000
71.	Seaway networks	www.seawaynetworks.com	Mar, 2001
72.	SentitO	www.sentito.com	Dec, 2000
73.	S2io (Now Neterion)	www.s2io.com	Nov, 2001
74.	Seven	www.seven.com	Jun, 2000
75.	Sheer networks	www.sheernetworks.com	Sep, 1999
76.	SiberCore technologies	www.sibercore.com	Aug, 1998
77.	SiliconBandwidth	www.siliconbandwidth.com	Aug, 1999
78.	SolarFlare	www.solarflare.com	Jul, 2001
79.	Sotera networks (Vormetric)	www.vormetric.com	Jan, 2001
80.	Sourcefire	www.sourcefire.com	Jan, 2001
81.	Stratum8 (new name:Teros)	www.teros.com	Apr, 2000
82.	SyChip	www.sychip.com	Mar, 2001
83.	Teknovus	www.teknovus.com	Jan, 2002
84.	Teraburst	www.teraburst.com	Jan, 2000
85.	Topio	www.topio.com	Jan, 2001
86.	Topspin	www.topspin.com	Apr, 2000
87.	Trapeze networks	www.trapezenetworks.com	Feb, 2002
88.	Tropic networks	www.tropicnetworks.com	May, 2000
89.	Turin networks	www.turinnetworks.com	Oct, 1999
90.	White Rock networks	www.whiterocknetworks.com	Nov, 1999
91.	Xelerated	www.xelerated.com	Aug, 2000
92.	Zeevo	www.zeevo.com	Nov, 1999
93.	Ziptronix	www.ziptronix.com	Oct, 2000

Appendix C. Scatter plots of dependent variables with independent variables

C 1. Scatter plot of number of new products with market experience of TMT

C 2. Scatter plot of number of new products with time to VC funding

C 3. Scatter plot of number of new products with total number of partners

C 4. Scatter plot of number of new products with partner heterogeneity

C 5. Scatter plot of number of new products with number of venture capital firms

C 6. Scatter plot of amount of venture capital with market experience of TMT

C 7. Scatter plot of amount of venture capital with time to VC funding

C 8. Scatter plot of amount of venture capital with total number of partners

C 9. Scatter plot of amount of venture capital with partner heterogeneity

Appendix D. Studentized deleted residual analysis for regression model of table 8

Dependent variable: Number of new products (SQRT)

Independent variables: Total number of partners; time to VC funding (SQRT)

D 1. Studentized deleted residual Stem-and-Leaf plot

D 2. Normal Q-Q plot of studentized deleted residual

D 3. Box plot of residuals

D 4. Scatter plot of predicted and observed values

Appendix E. Studentized deleted residual analysis for regression model of table 11

Dependent variable: Amount of venture capital (SQRT)

Independent variables: Market experience of TMT; time to VC funding (SQRT)

E 1. Studentized deleted residual Stem-and-Leaf plot

E 2. Normal Q-Q plot of studentized deleted residual

E 3. Box plot of residuals

E 4. Scatter plot of predicted and observed values