THE RELATIONSHIP BETWEEN CAPABILITY PLATFORM AND PERFORMANCE FOR SOFTWARE STARTUPS

by

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ABSTRACT

This research examines how the capability platform of a software startup affects its performance. A model that relates privileged assets, special relationships and capital availability with software startup performance is developed and then tested using data from 43 software startups. A startup's performance was measured in four ways. The results of this thesis suggest that: (i) the number of publicly traded companies for which members of the top management team have worked is positively associated with the amount of venture capital raised by a startup, (ii) the number of venture capital firms that invest in a startup is positively associated with the amount of venture capital raised by a startup, (iii) the number of venture capital firms that invest in a startup is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup, and (iv) the number of venture capital firms that invest in a startup is positively associated with the average amount of venture capital money raised per round by a startup. The results of this research also suggest that the measure of a software startup's performance is difficult and that much needs to be discovered about the factors that contribute to a startup's performance.

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1 INTRODUCTION

1.1 Objective

The objective of this research is to examine the relationship between a software startup's capability platform and its performance. A capability platform is comprised of privileged assets, capital availability and special relationships (Baghai, Coley, and White, 2000).

This research builds on Ahmad (2005) and contributes to the growing literature that examines the relationship between a startup's capability platform and performance (Baghai et al., 2000; Lee et al., 2001; Shane, 2000; Shane & Stuart, 2002 and Teece, 1986).

The specific elements of a software startup's capability platform that were examined in this research include three dimensions pertaining to privileged assets, one dimension pertaining to capital availability, and one dimension pertaining to special relationships. The privileged assets dimensions include: (i) number of publicly traded companies for which members of the top management team (TMT) have worked, (ii) number of non-publicly traded companies for which members of the TMT have worked, and (iii) number of companies that were founded by members of the TMT.

The TMT is comprised of the CEO and executives responsible for finance, sales, engineering, manufacturing, and marketing who report to the CEO (Eisenhardt and Schoonhoven, 1996).

Time to venture capital funding (Hellmann and Puri, 2000) is the capital availability dimension. The number of venture capital firms that invest in a startup is the special relationship dimension.

A startup's performance is measured using four dimensions. The number of new products a startup introduces and the amount of venture capital the startup raises during the first three years of operations are used to measure performance. These were the two company performance measures used by Ahmad (2005). The number of new venture capital firms that started funding the startup in later rounds of financing as a ratio of the total number of venture capital firms that funded the startup is used as the third dimension of startup performance[1] (Lerner, 1994). The average amount of venture capital money the startup raised per each round is used as the fourth dimension of performance (Davila, Foster, and Gupta, 2003).

[1]For example, Nakina Systems received venture capital funds through three rounds of finance. VenGrowth was the only venture capital firm for the 1st round of finance. MM Venture Partners funded the 2nd round of finance. EDC, MMV Financial Inc., VenGrowth, and VIMAC funded Nakina Systems in the 3rd round.

Four venture capital firms funded Nakina Systems in later rounds for the first time. In total, five venture capital firms funded Nakina Systems. The ratio for Nakina Systems is 4/5.

1.2 Relevance

This research is relevant for at least three reasons. First, the results of this research support the following: i) measuring the performance of a software startup as well as the finding the relationship between capability and performance are difficult tasks, ii) the number of publicly traded companies for which members of the TMT have worked is positively associated with the amount of venture capital raised by a startup, iii) the number of venture capital firms that invest in a startup is positively associated with the performance of a software startup. Knowledge of these findings will be of relevance to founders and executives of software startups. It will help them select the right members for the TMT, and better understand the effect of receiving funds from multiple venture capital firms on the company performance.

Second, this research will be relevant to organizations responsible for regional development (Ahmad, 2005), consultants (e.g., growth accelerators) and federal government agencies as it sheds light on factors that make software startups grow. Regional development organizations, consultants and government agencies may be able to use the results of this research to design programs that help startup companies improve their performance. This leads to more jobs and greater job security.

Third, this research will be of interest to researchers working in the area of software startup performance. It examines two new performance dimensions of startups. Measuring the performance of a startup is a difficult task for both conceptual and data availability reasons.

1.3 Contributions

This research makes at least three contributions. First, this study examines an important subject that has not been thoroughly examined in the literature. The relationship between startups' capabilities and performance is important because it helps founders and investors build those capabilities that increase a software startup's value.

Second, the literature is replete with discussions of what are appropriate measures of performance that are applicable to startups. It is an important debate because, to heed the pleas for the development of causal models of new venture performance, it must be agreed on as to what are and are not valid and reliable ways to assess the performance of a startup (Lange, 2001). The fact that there still is debate in the literature concerning performance measures for startups makes it more difficult for researchers exploring the relationship between startup capabilities and startup performance. This research contributes to the academic literature by exploring four ways to measure the performance of software startups.

Third, professional investors favor software over other technology startups (Machover, 1994 and Crowne, 2002). Approximately 70% of venture capital invested in IT was invested in Internet and software companies in the last few years (Lange, 2001). Roberts (1990), states that software startups require far less initial capital than other technology startups. This distinguishes software startups from other technology startups. Therefore there is a need for studies focusing specifically on software startups.

Table 1 illustrates the differences between this research and that completed by Ahmad (2005). The first difference is that the sample used in this research is comprised of software startups exclusively while the sample used by Ahmad (2005) was comprised of technology startups belonging to six different industrial sectors.

The second difference is that this research examines three dimensions of privileged assets while Ahmad (2005) only examined one, market experience of TMT. Ahmad's results did not support the existence of a relationship between market experiences of TMT and company performance. For this reason, this research examines alternate dimensions of privileged assets.

Ahmad (2005) reported a positive relationship between the number of venture capital firms that funded the startup and company performance. This research benefits from that done by Ahmad (2005). Thus, the third difference between Ahmad's research and this research is that unlike Ahmed (2005), a positive relationship between the number of venture capital firms and performance is expected to exist.

The fourth difference is that this research examines four dimensions of performance instead of two. There are two reasons for using four dimensions instead of two. The first reason is to validate Ahmad's results. The second reason is to introduce new measures of performance.

Table 1: Differences between (Ahmad 2005)'s and this research

	Ahmad (2005)	Ghobros (2005)
Sample	93 technology startups in six industrial sectors.	43 software startups.
Privileged assets dimension(s)	Market experience of TMT	(i) Number of publicly traded companies for which members of the TMT have worked (ii) Number of non-publicly traded companies for which members of the TMT have worked (iii) Number of companies that were founded by members of the TMT
Special relationships hypothesis	The number of venture capital firms that invest in a startup is negatively associated with the number of new products introduced by the startup	The number of venture capital firms that invest in a startup is positively associated with startup performance
Performance measures	(i) Number of new products introduced by the startup (ii) The amount of venture capital raised by a startup	(i) Number of new products introduced by the startup (ii) The amount of venture capital raised by a startup (iii) The ratio of the number of venture capital firms that funded the startup for the first time in later round to the total number of venture capital firms that funded the startup, the startup valuation (iv) Average amount of venture capital money it raises per round.

This thesis is organized into seven chapters. Chapter 2 provides the literature review. Chapter 3 develops the research model and the hypotheses to be tested. The research method is described in chapter 4. Chapter 5 includes the results. Chapter 6 provides a discussion of the results. Chapter 7 provides the conclusions, limitations and suggestions for further research.

2 LITERATURE REVIEW

The literature review is organized into six sections. The first section reviews the literature of the software industry. Sections two to four review the factors affecting software startup performance which are privileged assets, special relationships and capital availability. The literature review on innovation performance is covered in section five. Section six provides the lessons learned from the literature review.

2.1 The software startup industry

The software industry is characterized by growth, innovative activity, and competition (Mann, 2005). Software product companies are of interest to entrepreneurs and investors (Crowne, 2002). Some argue that innovation in software and related industries has driven much of the innovation in other industries in recent decades (Mann, 2005). Federal government statistics suggest that it is one of the few technology sectors that consistently show a large trade surplus (Mann, 2005). More importantly, software has become the driving force behind productivity gains in numerous manufacturing as well as service industries (Rao, 1994). It is also the source of many marketing innovations in such diverse industries as telecommunications, banking and airlines (Rao, 1994).

In domains outside of software technology, Return on Investment (ROI) is well defined and calculated by established formulas. Attempts to calculate software technology ROI, however, have generally failed (Brown and Wallnau, 1996). Smagalla (2004) noted that,

for software startups, it is not the size of the budget but how it is used that determines success or failure.

In general, measuring the performance of new business startups is difficult. Performance measures for startups must differ from traditional measures of performance. In mature businesses, performance is generally a matter of profitability over time. New businesses do not have a profit history and are not usually expected to show much profit during their early years (Van de Ven, 1984).

When it comes to measuring performance for small software companies in particular, the question of the need for processes to measure capabilities arises. Even though processes can offer advantages to small companies, in the case of the software start-up where no history of software development exists, using the correct practices can be the difference between survival and demise (Merz 2001).

The uniqueness of software startups' when it comes to measuring performance was highlighted in an ongoing research by Coleman (2005). Coleman (2005) noted that specific performance measures have not been clearly established in the field of software startups.

2.2 Capability platform in the software startup industry

All software companies start with an entrepreneur and a vision. They perceive a market opportunity and assume they exploit technology to satisfy it. They need to assemble the

key employees around them with the necessary skills, and then start to build the product (Crowne, 2002). Having the right top management team (TMT) with the appropriate experience is therefore considered an important component of the capability platform of the company. This privileged asset will play an important role in defining the startup's future.

Capital availability also plays a crucial role in determining the capability of a company, first because capital is indispensable for the development of products and second because it will allow the recruitment of a competent management team. Lack of cash tempts the company to rely on clever but inexperienced people. This may lead to failure in meeting product delivery schedules or meeting customers' requirements once the product is delivered (Crowne, 2002).

Special relationships, or networking, are equally important when it comes to capability platform of a company. The superior network of contacts with established companies not only provides an advantage when it comes to capturing business, but is also a crucial aspect of the value proposition of startups, since it provides access to thousands of potential customers, suppliers, and potential partners early in the life of a company (Mooney, 2002).

TMT past experience as a dimension of the capability platform

The majority of software companies are small, under 50 people (Cusumano and Yoffie 1998). These companies play a crucial role in the industry because of their

innovativeness, popularization of new technologies, keeping established firms on their toes, job creation and promotion of growth (Wheelen and Hunger, 2002). However, up to one half of small companies founded in any one year are not in business five years later and the TMT is considered a major factor here (Wheelen and Hunger, 2002).

According to Gardner (2005), firm performance is at least partially a function of the value of its human and social capital. The founders' background and their human and social capital affect the success of a start-up (Lee, Lee, and Pennings, 2001). Startup success and company stage of development are positively related to a broad set of skills and expertise exhibited by the entrepreneur. This is due to that fact that, in small businesses, the entrepreneur must often act as the central brain and agent (Van de Ven, 1984).

Cooper and Bruno (1977) found that it is advantageous for members of TMT in technology startup to have prior experience in large companies. While others mentioned that prior experience in startups or prior experience founding startup is what counts. For example, when it comes to startup founding experience, Crowne (2002) states that individuals who have survived in the company from the early days develop a wide range of skills on an ad-hoc basis. If these individuals are experienced and become team leaders as development grows, then they will tend to develop the necessary skills in new recruits.

According to Castrogiovanni (1996), founder knowledge enhances the likelihood of business survival since it facilitates proper alignment of the business concept with customer preferences and other market conditions.

Capital availability as a dimension of the capability platform

Venture capital financing is widely believed to be influential for new innovative companies (Hellman and Puri, 2000). Entrepreneurs often develop products and ideas that require substantial resources, particularly during the formative stages of a new company's life cycle. Since most entrepreneurs lack sufficient funds to finance these projects themselves, they must seek outside financing. Venture capital firms finance these high-risk, potentially high-reward projects (Mooney, 2002).

Hellmann and Puri (2000) provided empirical evidence that venture capital financing is related to product market strategies and startups' outcomes. Venture capital is also associated with a significant reduction in time to bring product to market.

Hui (2004) related ties to and via venture capitalists to startup survival and commercial success. Specifically, he mentioned that venture capital-backed startups have larger sales and are less likely to fail.

Special relationships as a dimension of the capability platform

Network structure has been shown to have an effect on firm level outcomes such as innovation (Ahuja 2000), alliances (Gulati 1995) and growth (Powell et al., 1996).

The role of network relationships has been particularly associated with the internationalization of small firms (Coviello and Munro, 1997; and Dimitratos, Johnson, Slow and Young, 2003), which seems entirely consistent with the characteristics of such firms (Prashantham and Berry, 2004) who are renowned for their networking abilities (Jones, 1999). While their small size (resource-poverty) warrants extensive networking with other firms possessing complementary resources (Gnyawali and Madhavan, 2001), their knowledge-intensity calls for a constant focus on innovation, which in turn is often greatly facilitated by collaborative network relationships (Baum, Calabrese and Silverman, 2000).

Smith (1999) noted that prior to an initial public offering, after which the company can access public capital markets; the entrepreneur relies heavily on the network of contacts provided by the venture capitalist.

Hsu (2005) has highlighted the importance of establishing ties with venture capitalists as an important precursor of superior venture performance. The same observation was made by Hui (2004); more direct ties to venture capitalists and more indirect ties via venture capitalists gave startups lower failure likelihood and higher sales revenues.

2.3 Measures of performance

Input indicators (e.g. R&D expenditures), output indicators (patent counts, patent citations, or counts of new product announcements), and multiple (or composite) indicators for an advantage indicator are used to measure company performance (Hagedoorn and Cloodt, 2003).

Capital raised as a measure of performance

Experienced venture capitalists primarily syndicate first-round investments. In later rounds, established venture capitalists syndicate investments to both their peers and to less experienced capital providers. Venture capitalists generally prefer later stage investments in growing enterprises (Roberts, 1990). Potential investors estimate a sharp decline in their risk of loss of investment, depending upon the stage at which they invested in the company, from 66% at the seed (or early) stage down to 20% at the exit stage. When experienced venture capitalists invest for the first time in later rounds, the firm is usually doing well (i.e., its valuation has increased since the prior venture round) Lerner (1994).

In addition to capital, venture capital firms usually provide access to their accumulated experience and expertise, networks and reputation. As indicated by Timmons (1999), classic venture capitalists work as coaches and partners with entrepreneurs and innovators at a very early stage to help shape and accelerate the development of a company. The proposition that venture capitalists add value is consistently supported in the literature. Therefore, the presence or absence of an investment by experienced venture

capitalists for the first time in later rounds may be used as a measurement of innovation performance.

Additionally, Gompers and Lerner (2000) show that returns on non venture-backed Initial Public Offerings (IPOs) are significantly below those of venture-backed IPOs and below relevant benchmarks when returns are weighted equally.

Corporate investment in VC-backed startups typically comes in later financing rounds, after it becomes clear to potential investors that the startups have real products, customers and revenue (Roberts, 2004).This observation leads to the assumption that the later venture capitalists invest in a startup, the safer the investment is and the better the company is performing. Having increasing numbers of venture capital firms funding a startup in later round translates into better startup performance. Hence, the number of venture capital firms that started funding the startup in later rounds of financing as a ratio of the total number of venture capital firms that funded the startup is an important measure of startup's performance.

Staged financing is the practice of investing only enough money to allow the entrepreneur to progress to the next milestone in the business plan. Before the money runs out, the entrepreneur must begin the process of raising the next round of financing. This type of financing places the investment decision in the hands of the venture capitalist and because the venture capitalist is not required to provide financing at any stage in the process, staged financing allows the venture capitalist to abandon ventures

whose prospects are dim (Smith, 1999). Moreover, refusal by the venture capitalist to continue investing will likely be viewed by other potential investors as a signal that the company is unworthy of capital (Smith, 1999). Based on these facts, one can assume that the higher the average amount of venture capital money raised per each round of finance, the better the startup is performing. Venture capitalists will only continue funding startups that perform well and this will translate into a higher average amount of raised capital per round of finance.

Products introduced to the market as a measure of performance

Successful development of new software products is a key value driver for many startup companies (Crowne, 2002). A company which can show that it has produced one or more successful products in a marketplace, and has the vision, road map and capability to produce more can expect a trade sale at a good valuation (Crowne, 2002). There are significant opportunities for long term profits and growth for a company bringing the right product to the market (Crowne, 2002).

2.4 Lessons learned

This section provides the lessons learned from the literature review.

Uniqueness of the software startup industry

The software startup sector is rapidly growing and represents an attractive investment opportunity. However, the research done on the core capabilities of successful software startups has not yet provided conclusive data regarding the measures of performance that

can be applied across the software startup industry. In the absence of standard performance measures that can be applied specifically to the software industry, startups rely on their own benefit-generating past experiences to project performance outcomes for future endeavors. There is a need to establish more solid guidelines when it comes to measuring software startup performance.

Past experience of the TMT and its impact on performance

Past experience of the TMT plays an important role in startups' development and should be considered one of the privileged assets of the company. Looking at the type of experience of the TMTs (past experience in large companies versus startups or founding experience) could help identify what background will most successfully impact the startup's performance.

Capital availability and its impact on performance

Venture capitalists raise money frequently. To attract investors to their funds, venture capitalists strive to develop a reputation for producing successful companies (Smith, 1999). In order to maintain this reputation, one can assume that well-performing startups will attract more venture capitalists, and at a faster rate, compared to less successful startups. Time to venture capital funding could then be considered one of the components of the capability platform of the software startup.

Special relationships and their impact on performance

Networking is an important contributing element to startups' success. Networking helps expand the pool of resources available for these small enterprises (through relationships with larger firms).

Increased ties to venture capital firms also provide entrepreneurs with access to consultants, investment bankers and lawyers (Mooney, 2002). More ties to larger firms including venture capital firms should influence a software startup's performance. One would therefore expect that there is a positive relationship between the number of venture capital firms that funded the startup and company performance.

Capital raised as a measure of startup performance

Larger initial funding correlates with greater entrepreneurial success (Roberts, 1990). Venture capital firms are more attracted to startups that perform well. The reputation of the alliances partners provide visibility, credibility and access to management talent for the start-up (Mooney, 2002). Venture capital firms which seek a positive reputation will therefore prefer seeing their names associated with successful startups. A startup that is performing well will attract more funding; hence, the amount of capital raised by a startup through venture capital funding is related to better company performance.

A startup that performs well will also attract more investors in later round of finance since investors prefer backing a company where products, clientele and even revenue are established. The larger the number of venture capital firms that started funding the startup

in later rounds of financing is, the better the startup should be performing. This measure can be expressed as the ratio of the number of new venture capital firms investing after the first round to the total number of venture capital firms that funded the startup.

Venture capitalists continue funding startups that perform well, as the startup continues to receive funding with each round; this should translate into a higher average amount of raised capital per round of finance. It would then be logical to assume that the average amount of venture capital money raised per each round of finance is a reflector of the startup performance.

Products introduced to the market as a measure of startup performance

Few product startups are able to transcend their first success and generate a stream of new products (Crowne, 2002). To be able to launch new products, the company must invent new product ideas aligned with its strategic plans and which can be realized from the existing product platform and skills base (Crowne, 2002). The more new products a startup is able to launch on the market the better the company should be performing.

3 RESEARCH MODEL AND HYPOTHESIS DEVELOPMENT

This chapter is organized into three sections. The first section describes the model used in this research. The hypotheses are developed in the second section and listed in the third section.

3.1 Research model

The objective of this research is to examine how five key elements of a startup's capability platform affect the startup's performance. Figure 1 illustrates the model used in this research.

The three constructs of a company's capability platform are shown on the left of the model in Figure 1. A capability platform is comprised of privileged assets, growth-enabling skills, and special relationships. The conceptualization of the capability platform shown in the research model is consistent with Baghai et al. (2000) and the resource-based view (RBV) of the firm (Barney, 1991; Collis and Montgomery, 1995; Baum et al., 2000; Lee et al., 2001; Peteraf, 1993; and Wernerfelt, 1995).

The model includes five key elements of a capability platform, three for the first construct, one element for the second construct and one element for the third. The first three elements of the model pertain to the experience of the members of the startup's top management team and are proxies for privileged assets. Privileged assets are assets that

are hard to replicate and confer competitive advantage on their owners (Baghai et al., 2000). The use of the experience of the members of the top management team as a privileged asset is consistent with Shane (2000), and Nerkar and Roberts (2004).

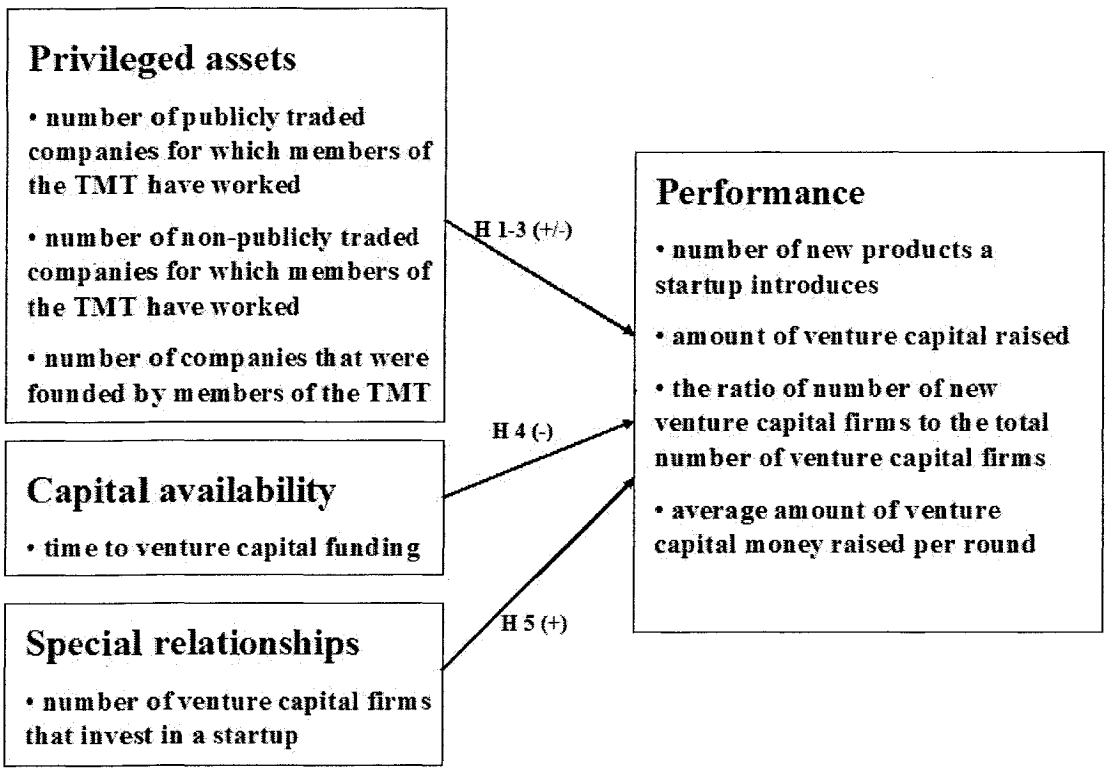
Shane (2000) used prior knowledge of markets, ways to serve markets, and customer problems as dimensions for privileged assets. Nerkar and Roberts (2004) used past technical experience and product-market experience as dimensions for privileged assets.

The three experience-related privileged assets of the model are: (i) number of publicly traded companies for which members of the TMT have worked, (ii) number of non-publicly traded companies for which members of the TMT have worked, and (iii) number of companies that were founded by members of the TMT.

Early capital availability is used as proxy for growth-enabling skills for startups (Shane and Stuart, 2002). Earlier capital availability permits the growth and development of a startup. It affects the introduction of new products and facilitates the manufacturing, sales, and distribution of those products.

This research examines one element of the special relationships construct, the number of venture capital firms that invest in the startup. Startups with greater ties to venture capital firms have greater sales and are less likely to fail (Hui, 2004).

Figure 1: Research model



The model in Figure 1 posits that the five elements of the startup's performance affect the company's performance. Little is known about performance measures that are applicable to startups. In this research, startups' performance is measured using four indicators: (i) number of new products introduced in the market, (ii) the amount of venture capital raised by the startups in the first three years of operations, (iii) the ratio of the number of new venture capital firms that funded the startup for the first time in later round to the total number of venture capital firms that funded the startup, and (iv) the average amount of venture capital money the startup raised per each round.

Four measures of performance are used because there is no agreed upon measures of startups performance, and information on variables typically used to measure performance of large, publicly traded companies (e.g., audited financial statements) is not available for startups.

Hagedoorn and Cloodt (2003), and Tanev (2004) used new product announcements as a performance measure. Thus, use of new product introduction as a performance indicator is consistent with Hagedoorn and Cloodt (2003), and Tanev (2004).

Shane and Stuart (2002) used several variables to study their effect on the rate of IPO. Among all the variables, the cumulative amount of venture capital funding has the greatest effect on the rate of IPO. The use of the cumulative amount of venture capital as a performance indicator is consistent with Shane and Stuart (2002).

When experienced venture capitalists invest for the first time in later rounds, the firm is usually doing well (Lerner 1994). To measure startups' performance, Lerner (1994) used the ratio of the number of new venture capital firms that funded the startup for the first time in later rounds to the total number of venture capital firms that funded the startup The use of this ratio in the model shown in Figure 1 is consistent with Lerner (1994).

Davila, Foster, and Gupta (2003) used the average amount of venture capital money the startup raised per each round to measure the startup performance and valuation. The use of this variable as a measure of performance is consistent with Davila et al. (2003)

3.2 Hypotheses development

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

3.2.1 Privileged assets

Past experience of members of the TMT

Working for publicly traded companies helps employees learn about processes, corporate culture and several other important concepts. Gompers, Lerner and Scharfstein (2004) find empirical support for a model in which startups result primarily from employees who are waiting for the right resources, training and opportunity before striking out on their own.

It takes many years in an industry to build up extensive experience and a network of social contacts with suppliers, buyers, potential partners, and complementary resource holders. Founders' prior knowledge might include information about supplier relationships, sales techniques, or capital equipment requirements (Von Hippel, 1988). Human capital investments, such as training and work experience, result in accumulated skills and knowledge (Becker, 1964). This experience may lead to a better startup management.

TMT members, who have worked for publicly traded firms, are familiar with organizational routines (Klepper, 2001). Some of these routines can be used to better manage startups, which may also be instrumental inputs to new venture performance. Therefore,

Hypothesis 1. Number of publicly traded companies for which members of the TMT have worked is positively associated with a startup's performance.

The complementary hypotheses are:

Hypothesis 1a. Number of publicly traded companies for which members of the TMT have worked is positively associated with the number of new products introduced by a startup.

Hypothesis 1b. Number of publicly traded companies for which members of the TMT have worked is positively associated with the amount of venture capital raised by a startup.

Hypothesis 1c. Number of publicly traded companies for which members of the TMT have worked is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 1d. Number of publicly traded companies for which members of the TMT have worked is positively associated with the average amount of venture capital money raised per round by a startup.

Prior experience in non-publicly traded companies provide a "know how" type of experience. This knowledge leads to a better startup management. TMT with prior experience with non-publicly traded companies are in a better position when they work for a startup since they are more likely to have learned from their prior experience. These management skills may lead to a better performance for startups they work for. Therefore:

Hypothesis 2. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with a startup's performance.

The complementary hypotheses are:

Hypothesis 2a. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the number of new products introduced by a startup.

Hypothesis 2b. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the amount of venture capital raised by a startup.

Hypothesis 2c. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 2d. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the average amount of venture capital money raised per round by a startup.

Entrepreneurs with prior founding experience are in a better position for new venture development since they are more likely to have learned from their prior experience. Prior entrepreneurial founders are those that have typically been in the community the longest championing their venture ideas. They affect time to venture capital funding, and determining venture valuation by venture capitalists. Prior start-up founding experience has measurable performance effects (Hsu 2005). Therefore:

Hypothesis 3. Number of companies that were founded by members of the TMT is positively associated with a startup's performance.

The complementary hypotheses are:

Hypothesis 3a. Number of companies that were founded by members of the TMT is positively associated with the number of new products introduced by a startup.

Hypothesis 3b. Number of companies that were founded by members of the TMT is positively associated with the amount of venture capital raised by a startup.

Hypothesis 3c. Number of companies that were founded by members of the TMT is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 3d. Number of companies that were founded by members of the TMT is positively associated with the average amount of venture capital money raised per round by a startup.

3.2.2 Capital availability

Venture capital financing is related to product market strategies, time to market and outcome of startups (Hellmann and Puri, 2000). Typically, venture capital firms fund companies using a series of financing rounds (Lerner, 1994). For a startup, the first round of venture financing is a significant milestone (Shane and Stuart, 2002). Earlier capital availability permits the growth and development of a startup. It affects the introduction of new products and facilitates the manufacturing, sales, and distribution of those products. The sooner a startup receives venture capital funding the more chances this startup has to innovate, introduce new products, and commercialize these products. Therefore:

Hypothesis 4. Time to venture capital funding is negatively associated with a startup's performance.

The complementary hypotheses are:

Hypothesis 4a. Time to venture capital funding is negatively associated with the number of new products introduced by a startup.

Hypothesis 4b. Time to venture capital funding is negatively associated with the amount of venture capital raised by a startup.

Hypothesis 4c. Time to venture capital funding is negatively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 4d. Time to venture capital funding is negatively associated with the average amount of venture capital money raised per round by a startup.

3.2.3 Special relationships

Network structure has been shown to have an effect on firm level outcomes such as innovation (Ahuja, 2000), alliances (Gulati, 1995) and growth (Powell et al., 1996).

Ties to venture capitalists

Startup's ties to and via venture capitalists are important to startup survival and commercial success. Venture capital- backed startups have larger sales and are less likely to fail (Hui, 2004). Ahmad (2005) reported a positive relationship between the number of venture capital firms that funded the startup and company performance.

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). Venture capital firms provide management related know-how to the startups by having a seat on the board, and providing access to professionals (Gorman and Sahlman, 1989).

In addition to capital, venture capital firms usually provide startups with access to their accumulated experience and expertise, networks and reputation. Classic venture capitalists work as coaches and partners with entrepreneurs and innovators at a very early stage to help shape and accelerate the development of a company (Timmons, 1999).

Startup's reliance on venture capitalists value-added services, such as recruiting senior executive officers, is associated with startup's performance and enhances founders'

bargaining power for venture valuations (Hsu 2005). Therefore, the more venture capital firms invest in a startup, the better the startup's performance will be.

Hypothesis 5. The number of venture capital firms that invest in a startup is positively associated with a startup's performance.

The complementary hypotheses are:

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

Hypothesis 5b. The number of venture capital firms that invest in a startup is positively associated with the amount of venture capital raised by a startup.

Hypothesis 5c. The number of venture capital firms that invest in a startup is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 5d. The number of venture capital firms that invest in a startup is positively associated with the average amount of venture capital money raised per round by a startup.

3.3 List of hypotheses

The following hypotheses are tested in this thesis.

Hypothesis 1. Number of publicly traded companies for which members of the TMT have worked is positively associated with a startup's performance.

Hypothesis 1a. Number of publicly traded companies for which members of the TMT have worked is positively associated with the number of new products introduced by a startup.

Hypothesis 1b. Number of publicly traded companies for which members of the TMT have worked is positively associated with the amount of venture capital raised by a startup.

Hypothesis 1c. Number of publicly traded companies for which members of the TMT have worked is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 1d. Number of publicly traded companies for which members of the TMT have worked is positively associated with the average amount of venture capital money raised per round by a startup.

Hypothesis 2. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with a startup's performance.

Hypothesis 2a. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the number of new products introduced by a startup.

Hypothesis 2b. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the amount of venture capital raised by a startup.

Hypothesis 2c. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 2d. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the average amount of venture capital money raised per round by a startup.

Hypothesis 3. Number of companies that were founded by members of the TMT is positively associated with a startup's performance.

Hypothesis 3a. Number of companies that were founded by members of the TMT is positively associated with the number of new products introduced by a startup.

Hypothesis 3b. Number of companies that were founded by members of the TMT is positively associated with the amount of venture capital raised by a startup.

Hypothesis 3c. Number of companies that were founded by members of the TMT is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 3d. Number of companies that were founded by members of the TMT is positively associated with the average amount of venture capital money raised per round by a startup.

Hypothesis 4. Time to venture capital funding is negatively associated with a startup's performance.

Hypothesis 4a. Time to venture capital funding is negatively associated with the number of new products introduced by a startup.

Hypothesis 4b. Time to venture capital funding is negatively associated with the amount of venture capital raised by a startup.

Hypothesis 4c. Time to venture capital funding is negatively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 4d. Time to venture capital funding is negatively associated with the average amount of venture capital money raised per round by a startup.

Hypothesis 5. The number of venture capital firms that invest in a startup is positively associated with a startup's performance.

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

Hypothesis 5b. The number of venture capital firms that invest in a startup is positively associated with the amount of venture capital raised by a startup.

Hypothesis 5c. The number of venture capital firms that invest in a startup is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.

Hypothesis 5d. The number of venture capital firms that invest in a startup is positively associated with the average amount of venture capital money raised per round by a startup.

4 RESEARCH METHOD

This chapter is divided into six sections. Sections 1 through 3 describe the unit of analysis, the study period, and the sample selection method. Section 4 contains the variables' definitions and their means of measurement. Section 5 describes the data collection. Finally, section 6 explains the steps used to analyze the data.

The research method used to undertake this research is the one used by Ahmad (2005).

4.1 Unit of analysis

The unit of analysis is a software startup that develops products. A startup is defined as a company recently formed, not before 1998 that has not experienced an IPO or acquisition.

4.2 Study period

The study period includes the first three years of a software startup established between January 1998 and January 2002. Thus, for a company established on January 2002, the study period is comprised of January 2002 to January 2005.

Most firm-level studies have not examined the lag effect that may exist between antecedent variables and company performance (Zahra, Jennings and Kuratko, 1999).

A lag of six months was allowed between the elements of a startup's capability platform and the startup's performance in order to properly capture the effect of these capability elements on performance. Thus, for a company established in January 2002, the performance indicators were recorded from June 2002 to June 2005.

This research adopts a lagged dependent variable model in order to test the relationship between firms' capability platform and organizational performance. The effect of independent variables is lagged for six months. The four performance indicators are the lagged dependent variables. For a company established in January 2002, the performance indicators were recorded from January 2002 to June 2005. The lagged dependent variable model would be a more rigorous test of the effects of firm characteristics on firm performance (Mosakovski, 1993).

4.3 Sample selection

The sample is extracted from a list of North American technology startups included in the directory of technology startups maintained by convergedigest.com.

The startups in the directory were listed by their technology sector. The directory included startups from six sectors: optical, silicon, wireless, DSL, voice, and P2P. The software startups were extracted by examining the companies' mission statements and opportunity descriptions.

The following criteria are used to select the sample from the software companies list:

1 Startup was funded by venture capital firms, and was established between January 1998 and January 2002.

2 Startup was not a part of any large organization during the study period.

3 Another company did not acquire the startup during the study period.

4 Startup maintained press releases on its website since the inception phase of the startup or missing data was available on other data sources.

4.4 Variables definitions and measurement scheme

4.4.1 Past experience of TMT

The TMT is comprised of the CEO and the executives responsible for finance, sales, engineering, manufacturing, and marketing that report to the CEO (Eisenhardt and Schoonhoven, 1996).

4.4.1.1 Past experience of TMT with publicly traded companies

Past experience of TMT with publicly traded companies was measured as the number of publicly traded companies for which each member of the TMT had worked at the time of joining the startup.

For example, the TMT of Nakina Systems consists of six members. Four of them have worked for one publicly traded company each. One of them has worked for two publicly

traded companies. And one of them has worked for three publicly traded companies. For Nakina Systems, this variable equals to nine.

4.4.1.2 Past experience of TMT with non-publicly traded companies

Past experience of TMT with non-publicly traded companies was measured as the number of non-publicly traded companies for which each member of the TMT had worked at the time of joining the startup.

For example, the TMT of XY-Mobile Technologies consists of four members. One of them has worked for three private companies. One of them has worked for two private companies. And the other two have for one private company each. For XY-Mobile Technologies, this variable equals to seven.

4.4.1.3 Past experience of TMT as founders of startups

Past experience of TMT as founders of startups was measured as the number of companies that were founded by members of the TMT.

For example, the TMT of Intoto Software consists of six members. One of them has co-founded a startup before Intoto Software. For Intoto Software, this variable equals to one.

4.4.2 Time to venture capital funding

Time to the first venture capital funding was defined as the number of months from the date of startup's creation to the first occurrence of venture capital funding.

For example, Cloakware was established in 1997 and received the first venture capital funding in 2001. For Cloakware, this variable equals to 48.

4.4.3 Number of venture capital firms that invest in a startup

The number of venture capital firms that financed a startup is defined as the total number of venture capital firms that invested in this startup in all of its rounds of financing.

For example, SipQuest has received venture capital funding through thee rounds of finance. In the first round, two venture capital firms funded SipQuest. In the second round, one venture capital firm funded SipQuest. In the third round, two venture capital firms funded SipQuest. If a venture capital firm funded a startup in two rounds it will be counted twice. For SipQuest, this variable equals to five.

4.4.4 Number of new products

This variable is defined as the total number of new products introduced by the startup to the market for the duration of the study.

For example, Kodiak Networks offers five software applications. For, Kodiak Networks, this variable equals to five.

4.4.5 Amount of venture capital

This variable is defined as the total amount, in millions of dollars, raised from venture capital firms in all of the startup's financing rounds.

For example, ObjectWorld has raised eight millions through four rounds of finance. For ObjectWorld, this variable equals to eight.

4.4.6 The ratio of the number of new venture capital firms to the total number of venture capital firms

The ratio of the number of new venture capital firms that started funding the startup in later rounds of financing to the total number of venture capital firms that funded the startup is used in this research as the third dimension of performance.

For example, Natural Convergence is a software startup that has received venture capital funds through four rounds of finance. First round of finance was in 2001. Primaxis Technology Ventures and Purple Angel were the only two venture capital firms for this round of finance. Desjardins Venture Capital Group was the only venture capital firm for the second round of finance in the year 2002. Five venture capital firms funded Natural Convergence in the third round of finance. These five venture capital firms were: BDC Venture Capital, Jefferson Partners, Primaxis Technology Ventures, Purple Angel and VIMAC. Seven venture capital firms funded Natural Convergence in the fourth round of finance. These Seven venture capital firms were: BDC Venture Capital, Desjardins

Venture Capital Group, Jefferson Partners, Primaxis Technology Ventures, Purple Angel, Terence Matthews and VIMAC.

In this example, there are five venture capital firms that funded Natural Convergence in the second, third and fourth rounds of finance for the first time. These five venture capital firms did not participate in the first round of finance. These venture capital firms are: BDC Venture Capital, Desjardins Venture Capital Group, Jefferson Partners, Terence Matthews and VIMAC. In total, seven venture capital firms funded Natural Convergence. The ratio for Natural Convergence is 5/7.

4.4.7 Average amount of venture capital money raised per round

The average amount of venture capital money raised per round was measured by dividing the total amount of venture capital (section 4.4.5) by the total number of financing rounds.

For example, ObjectWorld has raised eight millions through four rounds of finance. For ObjectWorld, this variable equals to two.

4.5 Data collection

Data was collected from: (i) the OCRI database http://www.ottawacapitalnetwork.com, (ii) Thomson Gale, Business & Company Resource Center database at http://www.gale.com, (iii) the Converge Network Digest database at http://www.convergedigest.com/, and (iv) companies' websites, news, and press releases.

Table 2: Measurement of variables

Variable	Measurement	Reference
Past experience of TMT with publicly traded companies	The number of publicly traded companies for which each member of the TMT has worked at the time of joining the startup.	Gompers, Lerner and Scharfstein (2004) Von Hippel (1988) Becker (1964) Klepper (2001) Hsu (2005) Cooper and Bruno (1977)
Past experience of TMT with non-publicly traded companies	The number of non-publicly traded companies for which each member of the TMT has worked at the time of joining the startup.	Hsu (2005)
Past experience of TMT as founders of startups	The number of companies that were founded by members of the TMT.	Van de Ven (1984) Crowne (2002) Castrogiovanni (1996) Hsu (2005)
Time to venture capital funding	The number of months from the date of startup's inception to the first occurrence of venture capital funding.	Hellmann and Puri (2000) Lerner (1994) Shane and Stuart (2002)
Number of venture capital firms	Total number of venture capital firms that invested the startup in different rounds during first three years of operations.	Hui (2004) Gorman and Sahlman (1989) Timmons (1999) Hsu (2005)
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.	Hagedoorn and Cloodt (2003) Crowne (2002)
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.	Roberts (1990) Smith (1999)

The ratio of number of new venture capital firms to the total number of venture capital firms	The ratio of the number of new venture capital firms that started funding the startup in later rounds of financing to the total number of venture capital firms that funded the startup.	Lerner (1994) Roberts (2004) Roberts (1990)
Average amount of venture capital money raised per round	It was measured by dividing the total amount of venture capital by the total number of financing rounds.	Smith (1999)

The OCRI database is used to collect information on venture capital financing for Canadian companies.

The Business & Company Resource Center database is a collection of press releases containing information related to products, and funds raised by companies from different industry sectors.

The press releases and news articles available at the companies' websites were used as the main source of data collection.

Convergedigest.com contains, under the 'startup' section, archived news releases and searchable records back to 1996 including funding history by date and amount.

4.6 Data analysis

The SPSS software was used to analyze the data. A bar graph showing the startups by the year they were founded was created.

As for data analysis, the following evaluations were conducted. First, the descriptive statistics for all the variables used in this research were calculated (e.g., mean number of new products introduced, mean number of amount of venture capital, etc.). Normal distribution of variables was 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.

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

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

Final step consisted in regressing the performance variables against the elements of capability platform using stepwise regression. The performance variables were used as the dependent variables in the stepwise regression.

5 RESULTS

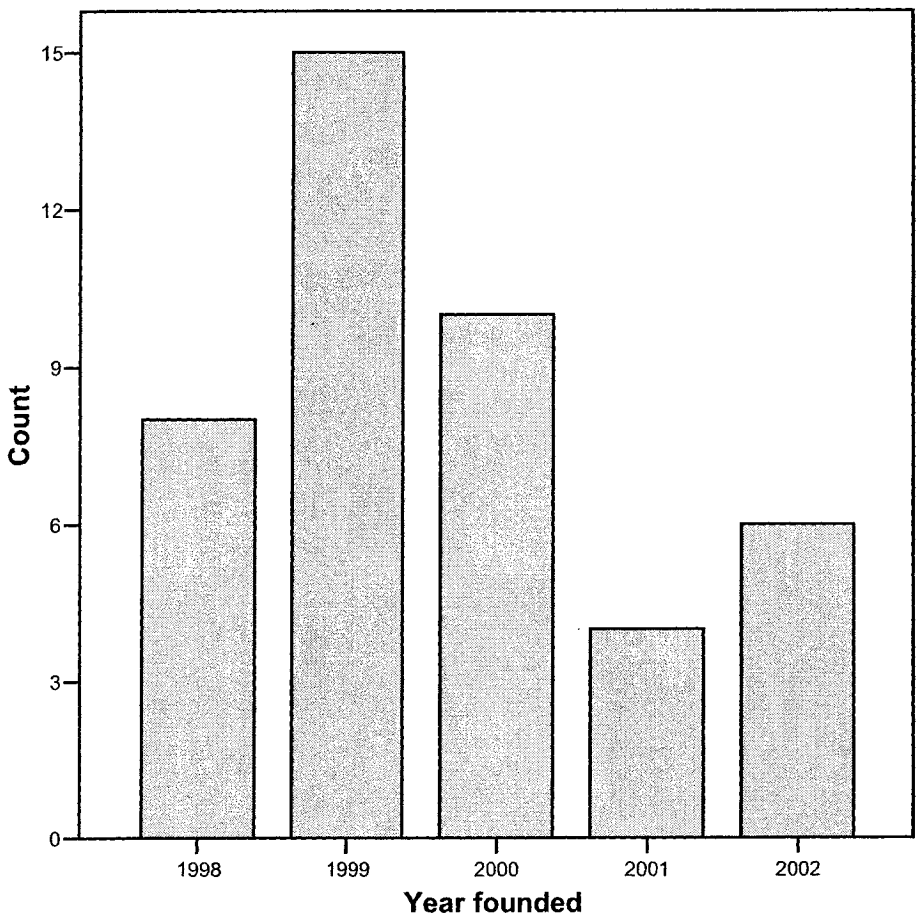
The following chapter contains five sections. The sample is described in the first section. The descriptive statistics are presented in the second. The third section provides the results obtained after the Pearson correlation coefficients were conducted on the variables. The fourth section provides the results obtained while testing hypotheses using regression analyses. Finally, the results are summarized in the sixth section.

5.1 Sample

The sample consisted of 43 software startups founded between January 1998 and December 2002. Appendix A provides a list of the companies in the sample, their websites and the year of founding.

Figure 2 provides a bar graph of the software startups in the sample by the year the startups were founded. The majority of the companies in the sample were founded in 1998, 1999, 2000 and 2002. In this sample, only 4 startups were founded in 2001. Nearly half of the sample (n=23; 53%) was established before the year 2000 while the rest of the companies were established in the year 2000 (peak of the industry meltdown) and up.

Figure 2: Startups in the sample categorized by year founded.



5.2 Descriptive statistics

Table 3 provides the descriptive statistics for the 9 variables used in the research. The skewness and kurtosis were computed for each of the variables in order to assess normality of their distributions.

If the value of the skewness was within 2 standard errors of skewness (ses) or less (regardless of sign) the variable was considered to be normally distributed. In addition to

the skewness, the kurtosis value had to range between -2 and +2 in order for the variable to be normally distributed.

Out of the nine variables examined, five were normally distributed (Table 3): the number of publicly traded companies, the number of non-publicly traded companies, the number of venture capital firms, the ratio of the number of new venture capital firms to the total number of venture capital firms and the average amount of venture capital raised per round of finance.

Table 3: Descriptive statistics (sample size = 43)

Variable	Min	Max	Mean	Std. D.	Skewness (*)	Kurtosis (**)	Normally distributed
No of publicly traded companies	1	19	9.21	4.507	.282	-.232	Yes
No of non-publicly traded companies	0	23	8.35	5.964	.677	-.032	Yes
No of startups founded	0	6	1.53	1.470	1.061	.962	No
Time to venture capital funding	1	44	14.09	10.160	1.427	1.569	No
Number of venture capital firms	1	14	5.88	3.209	.673	-.212	Yes
Number of new products	1	19	4.19	3.431	2.300	7.546	No
Amount of venture capital	1	150	36.58	32.783	1.691	3.216	No
The ratio of number of new venture capital firms to the total number of venture capital	.0	.9	.507	.2923	-.534	-.873	Yes

firms							
Average amount of venture capital	1.2	30.0	12.432	7.5363	.509	-.022	Yes

* Std. Error 0.361
** Std. Error 0.709

Variables that did not assume a normal distribution (number of startups founded, time to venture capital funding, number of new products and amount of venture capital) were transformed using the square root method (SQRT) in attempt to normalize their distribution. The normally distributed variables were left unchanged. The results of the transformation are presented in Table 4.

Table 4: Descriptive statistics with SQRT transformations (sample size = 43)

Variable	Min	Max	Mean	Std. D.	Skewness (*)	Kurtosis (**)	Normally distributed
Past experience of TMT with publicly traded companies	1	19	9.21	4.507	.282	-.232	Yes
Past experience of TMT with non-publicly traded companies	0	23	8.35	5.964	.677	-.032	Yes
Past experience of TMT as founders of startups (SQRT)	0	2.45	1.0091	.72725	-.179	-.988	Yes
Time to venture capital funding	1.00	6.63	3.5378	1.2708	.608	.354	Yes

(SQRT)							
Number of venture capital firms	1	14	5.88	3.209	.673	-.212	Yes
Number of new products (SQRT)	1.00	4.36	1.9119	.73702	.983	1.662	Yes
Amount of venture capital (SQRT)	1.10	12.25	5.4880	2.5711	.531	.259	Yes
The ratio of number of new venture capital firms to the total number of venture capital firms	.0	.9	.507	.2923	-.534	-.873	Yes
Average amount of venture capital money raised per round	1.2	30.0	12.432	7.5363	.509	-.022	Yes

* Std. Error 0.361
** Std. Error 0.709

5.3 Pearson Correlations

Capability platform

Table 5 presents the correlation coefficients for the set of variables describing the capability platform. In normally distributed samples, the degree to which the variables are related is best described by the Pearson correlation. The value of the Pearson correlation ranges from +1 to -1. The closer the correlation is to +1, the more it approaches a perfect positive linear relationship between the variables.

Table 5: Pearson correlation coefficients for elements of capability platform (sample size = 43)

	Past experience of TMT with publicly traded companies	Past experience of TMT with non-publicly traded companies	Past experience of TMT as founders of startups (SQRT)	Time to venture capital funding (SQRT)	Number of venture capital firms
Past experience of TMT with publicly traded companies	1 .				
Past experience of TMT with non-publicly traded companies	.395(***) .009	1 .			
Past experience of TMT as founders of startups (SQRT)	.036 .817	.056 .721	1 .		
Time to venture capital funding (SQRT)	-.322(**) .035	-.275 .074	.249 .108	1 .	
Number of venture capital firms	.364(**) .016	.351(**) .021	-.055 .726	-.282 .067	1 .

*** Correlation is significant at the 0.01 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).
* Correlation is significant at the 0.10 level (2-tailed).

As observed in Table 5, the following relationship was found when the significance was set a $p < 0.01$ (2-tailed test):

- Past experience of TMT with non-publicly traded companies is positively related to the past experience of TMT with publicly traded companies.

When the significance was set a $p < 0.05$ (2-tailed test), the following relationships were found:

- Time to venture capital funding is negatively related to the past experience of TMT with publicly traded companies.
- The number of venture capital firms is positively related to the past experience of TMT with publicly traded companies.
- The number of venture capital firms is positively related to the past experience of TMT with non-publicly traded companies.

No relationships were observed at $p < 0.10$.

Measures of performance

The four measures of performance were also examined using the Pearson correlation test; the results are described in Table 6.

Table 6: Pearson correlation coefficients for the four dimensions of performance (sample size = 43)

	Number of new products (SQRT)	Amount of venture capital (SQRT)	The ratio of number of new venture capital firms to the total number of venture capital firms	Average amount per round
Number of new products (SQRT)	1 .			
Amount of venture capital (SQRT)	.272 .078	1 .		
The ratio of number of new venture capital firms to the total number of venture capital firms	.219 .158	.579(***) .000	1 .	
Average amount of venture capital money raised per round	.160 .307	.910(***) .000	.337(**) .027	1 .

*** Correlation is significant at the 0.01 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).
* Correlation is significant at the 0.10 level (2-tailed).

As observed in Table 6, the following relationships were found when the significance was set a $p < 0.01$ (2-tailed test):

- The ratio of the number of new venture capital firms to the total number of venture capital firms is positively related to the amount of venture capital raised.
- The average amount of venture capital money raised per round is positively related to the amount of venture capital raised.

When the significance was set a $p < 0.05$ (2-tailed test), the following relationship was found:

- The average amount of venture capital money raised per round is positively related to the ratio of the number of new venture capital firms to the total number of venture capital firms.

No relationships were observed at $p < 0.10$.

Elements of the capability platform and the four dimensions of performance

Table 7 presents the Pearson correlation coefficients of the five elements of capability platform and the four measures of performance.

Table 7: Pearson correlation coefficients for elements of capability platform and four dimensions of performance (sample size = 43)

	Number of new products (SQRT)	Amount of venture capital (SQRT)	The ratio of number of new venture capital firms to the total number of venture capital firms	Average amount per round
Past experience of TMT with publicly traded companies	.142 .363	.531(***) .000	.436(***) .003	.431(***) .004
Past experience of TMT with non-publicly traded companies	.246 .112	.406(***) .007	.323(**) .034	.341(**) .025

Past experience of TMT as founders of startups (SQRT)	.236 .128	-.181 .246	-.052 .741	-.243 .117
Time to venture capital funding (SQRT)	-.050 .751	-.387(**) .010	-.388(**) .010	-.310(**) .043
Number of venture capital firms	.229 .139	.748(***) .000	.687(***) .000	.580(***) .000

*** Correlation is significant at the 0.01 level (2-tailed).
** Correlation is significant at the 0.05 level (2-tailed).
* Correlation is significant at the 0.10 level (2-tailed).

The following relationships were observed at $p < 0.01$:

- The past experience of TMT with publicly traded companies is positively related to the amount of venture capital raised.
- The past experience of TMT with publicly traded companies is positively related to the ratio of the number of new venture capital firms to the total number of venture capital firms.
- The past experience of TMT with publicly traded companies is positively related to the average amount of capital per round.
- The past experience of TMT with non-publicly traded companies is positively related to the amount of venture capital raised.
- The number of venture capital firms is positively related to the amount of venture capital raised.
- The number of venture capital firms is positively related to the ratio of the number of new venture capital firms to the total number of venture capital firms.

- The number of venture capital firms is positively related to the average amount of capital per round

The following relationships were observed at $p < 0.05$:

- The past experience of TMT with non-publicly traded companies is positively related to the ratio of the number of new venture capital firms to the total number of venture capital firms.
- The past experience of TMT with non-publicly traded companies is positively related to the average amount of capital per round.
- The time to venture capital funding is negatively related to the amount of venture capital raised.
- The time to venture capital funding is negatively related to the ratio of the number of new venture capital firms to the total number of venture capital firms.
- The time to venture capital funding is negatively related to the average amount of capital per round.

No relationships were observed at $p < 0.10$.

Correlations seen at $p < 0.01$ in relationship to the hypotheses of the study

Hypothesis 1 stipulates that the number of publicly traded companies for which members of the TMT have worked is positively associated with a startup's performance. The above observations are in accordance to hypothesis 1 when it comes to: the amount of venture

capital raised by a startup (hypothesis 1b), the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup (hypothesis 1c), the average amount of venture capital money raised per round by a startup (hypothesis 1d).

Hypothesis 2 stipulates that the number of non-publicly traded companies for which members of the TMT have worked is positively associated with a startup's performance. The above observations are in accordance to hypothesis 2 when it comes to the amount of venture capital raised by a startup (hypothesis 2b).

Hypothesis 5 stipulates that the number of venture capital firms that invest in a startup is positively associated with a startup's performance. The above observations are in accordance to hypothesis 5 when it comes to: the amount of venture capital raised by a startup (hypothesis 5b), the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup (hypothesis 5c) and the average amount of venture capital money raised per round by a startup (hypothesis 5d).

Correlations seen at $p < 0.05$ in relationship to the hypotheses of the study

Hypothesis 2 stipulates that the number of non-publicly traded companies for which members of the TMT have worked is positively associated with a startup's performance. The above observations are in accordance to hypothesis 2 when it comes to: the ratio of the number of new venture capital firms to the total number of venture capital firms that

funded this startup (hypothesis 2c) and the average amount of venture capital money raised per round by a startup (hypothesis 2d).

Hypothesis 4 stipulates that time to venture capital funding is negatively associated with a startup's performance. The above observations are in accordance to hypothesis 4 when it comes to: the amount of venture capital raised by a startup (hypothesis 4b), the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup (hypothesis 4c) and the average amount of venture capital money raised per round by a startup (hypothesis 4d).

Hypotheses not verified by the Pearson correlations

None of the hypotheses below were verified by the above Pearson correlations at a statistically significant level:

- Hypothesis 1a (the number of publicly traded companies for which members of the TMT have worked is positively associated with the number of new products introduced by a startup).
- Hypothesis 2a (the number of non-publicly traded companies for which members of the TMT have worked is positively associated with the number of new products introduced by a startup).
- Hypothesis 4a (the time to venture capital funding is negatively associated with the number of new products introduced by a startup).
- Hypothesis 5a (the number of venture capital firms that invest in a startup is positively associated with the number of new products introduced by a startup).

Therefore, the number of new products introduced by a software startup does not seem to correlate well with any of the elements of the capability platform. It should be noted, however, that the correlation between the number of products and the elements of the capability platform did approach significance at $p < 0.1$ for past experience of TMT with non-publicly traded companies ($p = 0.112$), past experience of TMT as founders of startups ($p = 0.128$) and the number of venture capital firms ($p = 0.139$).

Hypothesis 3 (the number of companies that were founded by members of the TMT is positively associated with a startup's performance) was not verified at all by the Pearson correlations. Therefore, the past experience of the TMT as founders does not seem to correlate well with a startup's performance. The correlation between the past experience of TMT as founders of startups and the number of new products introduced by a startup did however approach significance at $p < 0.1$ ($p = 0.128$).

Unexpected negative correlations were seen with regards to the past experience of TMT as founders and the amount of venture capital raised ($r = -0.181$; $p = 0.246$), the ratio of the number of new venture capital firms to the total number of venture capital firms ($r = -0.052$; $p = 0.741$) and the average amount of capital per round ($r = -0.243$; $p = 0.117$). These correlations, although both small and non-significant for all 3 measures of performance, were negative. This raises the possibility, a question perhaps for future research, that the past experience of the TMT as founders negatively influences performance.

5.4 Stepwise regression

In order to further examine the relationship between the four performance measures and the elements of the capability platform, stepwise regression was computed.

Number of new products as the dependent variable

As expected from the observations made with the Pearson correlations, none of the capability platform elements entered the stepwise regression with the number of products as the dependent variable.

Amount of venture capital as the dependent variable

Past experience of TMT with publicly traded companies and the number of venture capital firms were the independent variables that entered the stepwise regression when the amount of venture capital was the dependent variable. Table 8 presents the results of this stepwise regression.

Table 8: Stepwise regression with amount of venture capital as the dependent variable and five elements of capability platform as the potential explanatory variable (sample size = 43)

Explanatory variables included	Unstand. Coef. [1]		Stand. Coef.[2]	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	.906	.625		1.449	.155			.000

Past experience of TMT with publicly traded companies	.513	.082	.640 (***)	6.258	.000	.619	35.1	
Number of venture capital firms	.170	.058	.298 (***)	2.912	.006			

[1] Unstandardized Coefficients.
[2] Standardized Coefficients.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

The ratio of the number of new venture capital firms to the total number of venture capital firms as the dependent variable

The number of venture capital firms was the only independent variable that entered the stepwise regression when the ratio of the number of new venture capital firms to the total number of venture capital firms was the dependent variable. Table 9 presents the results of this stepwise regression.

Table 9: Stepwise regression with the ratio of the number of new venture capital firms to the total number of venture capital firms as the dependent variable and five elements of capability platform as the potential explanatory variable (sample size = 43)

Explanatory variables included	Unstand. Coef. [1]		Stand. Coef.[2]	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	.138	.069		1.999	.052			.000

Number of venture capital firms	.063	.010	.687 (***)	6.062	.000	.460	36.7	

[1] Unstandardized Coefficients.
[2] Standardized Coefficients.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

The average amount of venture capital money raised per round as the dependent variable

The number of venture capital firms was the only independent variable that entered the stepwise regression when the average amount of venture capital money raised per round was the dependent variable. Table 10 presents the results of this stepwise regression.

Table 10: Stepwise regression with the average amount of venture capital money raised per round as the dependent variable and five elements of capability platform as the potential explanatory variable (sample size = 43)

Explanatory variables included	Unstand. Coef. [1]		Stand. Coef.[2]	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	4.422	1.998		2.213	.032	.320	20.7	.000
Number of venture capital firms	1.361	.299	.580 (***)	4.554	.000			

[1] Unstandardized Coefficients.
[2] Standardized Coefficients.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

5.5 Summary of the results applied to each hypothesis

Table 11 presents an overview of the hypothesis results as seen in section 5.4. A hypothesis was supported when:

- The capability platform element was correlated to the one of the performance measures, at a statistically significant level, in the Pearson correlation.
- The variable being examined entered the stepwise regression.
- The regression coefficient for the variable being examined was significant at $p < 0.1$ and was in the same direction as expected.

Table 11: Results organized by hypothesis

Hypothesis	Result	Explanation
Hypothesis 1. Number of publicly traded companies for which members of the TMT have worked is positively associated with software startup performance.	Partially supported (1b supported)	Number of publicly traded companies for which members of the TMT have worked entered the stepwise regression only with the amount of venture capital raised by a startup and was significant at $p < 0.1$.
Hypothesis 2. Number of non-publicly traded companies for which members of the TMT have worked is positively associated with the number of new products introduced by a startup.	Not supported	Number of non-publicly traded companies for which members of the TMT have worked did not enter the stepwise regression for any of the performance measures.
Hypothesis 3. Number of companies that were founded by members of the TMT is positively associated with the number of new products introduced by a startup.	Not supported	Number of companies that were founded by members of the TMT did not enter the stepwise regression for any of the performance measures.
Hypothesis 4. Time to venture capital funding is negatively associated with the number of new products introduced by a startup.	Not supported	Time to venture capital funding did not enter the stepwise regression for any of the performance measures.
Hypothesis 5a. The number of venture capital firms that invest in a startup is positively associated with	Not supported	The number of venture capital firms that invest in a startup did not enter the stepwise regression for number

the number of new products introduced by a startup.		of new products.
Hypothesis 5b. The number of venture capital firms that invest in a startup is positively associated with the amount of venture capital raised by a startup.	Supported	The number of venture capital firms that invest in a startup entered the stepwise regression with the amount of venture capital raised by a startup and was significant at $p < 0.1$.
Hypothesis 5c. The number of venture capital firms that invest in a startup is positively associated with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup.	Supported	The number of venture capital firms that invest in a startup entered the stepwise regression with the ratio of the number of new venture capital firms to the total number of venture capital firms that funded this startup and was significant at $p < 0.1$.
Hypothesis 5d. The number of venture capital firms that invest in a startup is positively associated with the average amount of venture capital money raised per round by a startup.	Supported	The number of venture capital firms that invest in a startup entered the stepwise regression with the average amount of venture capital money raised per round by a startup and was significant at $p < 0.1$.

6 DISCUSSION OF RESULTS

The objective of this thesis was to examine the relationship between the capability platform and the performance of software startups. This chapter is organized into five sections. Section 6.1 discusses the results for the relationship between capability platform and number of new products. The results for the relationship between privileged assets and the dimensions of performance are discussed in section 6.2. Section 6.3 discusses the results obtained for the relationship between capital availability and the dimensions of performance. Section 6.4 discusses the results found for the association between special relationships and the dimensions of performance. Finally, section 6.5 discusses issues with the research model.

6.1 Capability platform and number of new products

Ahmad (2005) examined the relationship between elements of the capability platform and the number of new products. Ahmad's sample contained startups from six industrial sectors. There is no study in the literature that focused on the relationship between the capability platform and the number of new products in software startups exclusively.

Ahmad (2005) found the following: i) Capital availability is positively associated with the number of new products introduced by a startup, and ii) Special relationships are positively associated with the number of new products introduced by the startup.

The results of this research did not support a positive relationship between the capability platform elements (privileged assets, capital availability, and special relationships) and

the number of products introduced by software startups. There are two reasons that may explain the results obtained in this research. First, the number of products may not be the best indicator of software startups' performance (Crowne, 2002).

The second reason for the failure to find a positive relationship between elements of the capability platform and the number of new products introduced by a software startup may be the difficulty of measuring the number of software products. Unlike other technology startups, a software startup could have a large number of products that are not "real products" and the issue arises when the product originates as a custom solution. The product becomes then "an extreme version of software reuse" which could cost a company up to seven times as much as their one-use counterparts due to the additional design, maintenance and documentation required (Crowne, 2002).

6.2 Privileged assets and the dimensions of performance

Hypotheses 1, 2 and 3 examined the relationship between privileged assets (past experience of TMT) and the four dimensions of performance. Only one significant relationship was found out of 12 that were tested. The results of this research suggest that there is a positive relationship between number of publicly traded companies for which members of the TMT have worked and the amount of venture capital raised by a startup.

The results of this research do not support the assertion that the number of non-publicly traded companies for which members of the TMT have worked and the number of companies that were founded by the TMT are associated with a startup's performance.

The information on the past experience of the TMT was gathered from the data available publicly on each of the TMT members. The best information made available discloses the past experiences that look more impressive and more appealing to the reader. This information may emphasize their experience with major public companies with an established reputation. It may omit mentioning founding experiences or experiences with small private firms that failed. Thus, the construct of the research model was not measured properly with the data available.

6.3 Capital availability and the dimensions of performance

Hypothesis 4 stipulated that time to venture capital funding was negatively associated with a startup's performance. The results do not support the expected relationship between time to venture capital funding and the amount of venture capital raised.

Unlike what was specified in this research's model, it may have been better to use time to venture capital raised as a dependant variable. This may explain the poor results obtained.

6.4 Special relationships and the dimensions of performance

Hypothesis 5 tested the relationship between the number of venture capital firms that invested in the startup and the four dimensions of performance. The results suggest that

the number of venture capital firms that invested in a software startup is positively correlated with the amount of venture capital raised, the ratio of the number of new venture capital firms to the total number of venture capital firms and the average amount of venture capital raised per round. As discussed in section 6.1, the number of venture capital firms that invest in a startup was not positively associated with the number of new products introduced by a startup.

The number of venture capital firms that invest in a successful startup is expected to increase with each round of finance and this would entail an increase in the amount of venture capital raised, the ratio of venture capital firms that invest in later rounds and the average amount of capital raised per round.

The research results support the findings of Gorman and Sahlman (1989), which noted that the strength of a company was related to its ties to venture capital firms. A higher number of venture capital firms having invested in a startup is therefore expected to influence its performance positively. Also, it is consistent with Hsu (2005). Startup's reliance on venture capitalists value-added services, such as recruiting senior executive officers, is associated with startup's performance and enhances founders' bargaining power for venture valuations (Hsu 2005).

6.5 Research model

The results of this study were not what they were expected. There are a number of potential reasons that could explain this outcome.

First, the study was designed based on a model that had not been previously used in the literature. The model was not based on theory. Moreover, the model may have been specified improperly because one of the variables that was defined as an independent variable may have been a dependent variable (e.g., time to venture capital funding).

Second, some of the variables used in the model could have been measured in more appropriate ways. The TMT past experience should have been defined in a broader way. For example the variable could have been measured as the total number of companies for which members of the TMT have worked. Other variables could have been the number of years of experience which members of the TMT have or the job titles that the members of TMT held in their past experience.

Third, this study was innovative in the sense that it focused on assessing the performance of software startups exclusively. Because this topic had not been previously examined in the literature, the model used was based on the studies that measured the performance of non-software startups or all categories of technology startups combined. However, it was clearly demonstrated from the literature review and as the results of the study unfolded, that the performance of software startups should be measured in a different way than non-software startups. Therefore, the research model that this study was based on may not have been an optimal choice for the evaluation of the impact of capability platform on the performance of software startups. Other suggested performance measures that could be

used in future researches are: (i) the number of customers using the software product, (ii) the outcome of the startup, and (iii) time to VC funding.

7 CONCLUSIONS, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

This chapter has three sections. Section one describes the conclusions drawn from this research and outlines 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.

7.1 Conclusions

There is a need for more studies on the relationship between a software startup's capability and its performance. These studies require better research models and better measures of startup's performance.

The results of this thesis suggest that the past experience in public firms of the members of the TMT positively influence the performance of a software startup. TMT members with experience in public firms tend to affect positively the amount of venture capital raised by the software startup.

The results also suggest that special relationships affect a startup's performance. The number of venture capital firms was selected as a proxy for special relationships. The results suggest that the number of venture capital firms that invest in a software startup is highly correlated with the amount of venture capital raised, the ratio of the number of

new venture capital firms to the total number of venture capital firms and the average amount of venture capital raised per round.

None of the measures of a startup's capability examined in this study was found to be associated with the number of new products introduced, a measure of startup's performance. Unlike other technology sectors where the number of new products is one of the recognized metrics used to assess company performance, it is possible that in the case of software startups, company performance means things other than number of new products introduced.

This research focuses on software startups, a sector which despite its importance, has not been thoroughly examined. Research in this area is becoming more important as the software industry continues to grow and attracts more investors and entrepreneurs.

The hypotheses examined and the results obtained offer a base on which other researchers can build to examine the relationships between capability and performance for software startups.

This research may also help entrepreneurs in the software startup sector focus their strategies and establish their goals in a better way, e.g. whether the goal should be the introduction of multiple software products or whether it would be better to focus on one low-risk successful product.

7.2 Limitations

The first limitation observed in this research is that, while measuring the past experience of TMT members, the study did not differentiate the levels of previous job titles when a member of the TMT was working for a publicly traded company or a non-publicly traded company.

Another limitation is that the educational background was not assessed when looking at the TMT history. This is especially interesting in the software area where technical experience may play a role in the management and accomplishment of products that are relevant to the consumer.

The third limitation is that this study focused on the North American software startups established in the years 1998 to 2002 only. These were difficult years in the capital markets. Moreover, it is difficult to generalize the results to software stratups in regions other than North America.

7.3 Suggestions for future research

Four suggestions for future research are described. First, future research may consider examining the adequacy of using number of new products launched by a software company and time to venture funding as measures of startup performance.

Second, future research may be conducted using the case-based method for the purpose of theory building. The research model used in this research was not based on theory.

Case studies can be used to develop a solid theoretical framework useful for the study of the relationship between capability and performance of software startups.

Third, this study introduced two new performance measures that were never examined in the past: (i) the ratio of new venture capital firm to the total number of venture capital firms and (ii) the average amount of venture capital money raised per round. These two parameters need to be further explored with other dimensions of capability platform and with larger global samples from the software sector.

Fourth, similar studies may be conducted on software startups clustered by geography. This would enable researchers to compare the capability-performance relationship across different geographical areas.

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Appendix A: List of the companies in the sample

	Company name	Website	Year founded
1	Acme Packet	www.acmepacket.com	2000
2	Airmagnet	www.airmagnet.com	2001
3	Aruba Networks	www.arubanetworks.com	2002
4	Astute Networks	www.astutenetworks.com	2000
5	Atreus Systems	www.atreus-systems.com	1998
6	Authentica	www.authentica.com	1998
7	Band Speed	www.bandspeed.com	1998
8	Brix Networks	www.brixnetworks.com	1999
9	Cold North Wind	www.coldnorthwind.com	1999
10	Danger	www.danger.com	2000
11	Ecrio	www.ecrio.com	1998
12	Eeye	www.eeye.com	1998
13	General Bandwidth	www.genband.com	1999
14	Got Corporation	www.gotcorp.com	1999
15	HelloSoft	www.hellosoft.com	1999
16	IP Unity	www.ip-unity.com	1999
17	Klocwork	www.klocwork.com	2001
18	Kontiki	www.kontiki.com	2000
19	Level Platforms	www.levelplatforms.com	1999
20	Maximum Throughput	www.max-t.com	1998
21	MetraTech	www.metratech.com	1998
22	MontaVista Software	www.mvista.com	1999
23	Nakina Systems	www.nakinasystems.com	2001
24	Natural Convergence	www.naturalconvergence.com	2001
25	Navini	www.navini.com	2000
26	Netrake	www.netrake.com	2000
27	Newstep Networks	www.newstepnetworks.com	2002
28	Nextone	www.nextone.com	1998
29	Op40	www.op40.com	1999
30	Orative	www.orative.com	2002
31	Pactolus	www.pactolus.com	1999
32	Pango Networks	www.pangonetworks.com	1999
33	Precidia	www.precidia.com	1999
34	Seven	www.seven.com	2000
35	Sip Quest	www.sipquest.com	2002
36	SiteBrand	www.sitebrand.com	2000
37	Symbium	www.symbium.com	2002
38	Tomoye	www.tomoye.com	2000
39	Traq	www.traq.com	1999
40	Trendium	www.trendium.com	1999
41	Trigence	www.trigence.com	2002
42	United Devices	www.ud.com	1999
43	Voyence	www.voyence.com	2000