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**EARLY STAGE RESOURCE ALLOCATION
IN SPECIALIZED SUPPLIER FIRMS**

By

Alexander Davidson

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

Department of Systems and Computer Engineering

Carleton University

Ottawa, Canada, K1S 5B6

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**EARLY STAGE RESOURCE ALLOCATION
IN SPECIALIZED SUPPLIER FIRMS**

Submitted by

Alexander Davidson

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

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ABSTRACT

This research examines: (i) change in the budget allocations to research and development, and sales and marketing and (ii) the importance of founders' ability to change internal processes and company values during the earliest stage of development of specialized supplier firms. Results of interviews with 10 managers of specialized supplier firms suggest that a high proportion of the company's budget is allocated to R&D initially, that this proportion decreases with time as a result of carrying out activities to prepare for initial sales, and that senior management's ability to transition the company from one that is learning to master a technology to one that can sell product is a highly valuable resource. These results can be used by start-ups to allocate budgets during the early stages of development and to recruit the right top management team.

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1.0 INTRODUCTION

1.1 Objective.

Kazanjian (1984) and Dodge and Robbins (1992) split the first stage of development of a firm (i.e., Conception and Development Stage) into two sub stages: a Pre-start Up Stage, and a Start Up Stage. For the purpose of this research, the Pre-start Up Stage is referred to as Stage A and the Start Up Stage is referred to as Stage B.

During Stage A, the founding members of the firm are typically technology specialists with access to and ability to apply unique technology (Hansen and Bird, 1997). They are placed in a position of having to perform most all traditional business management functions, often with little background or experience in those areas.

Life cycle models propose a sequential set of stages through which firms must pass as they develop. These stages are characterized by a dominant problem and tasks to be overcome by the firm (Kazanjian, 1984). Firms establish and apply resources, processes and values to address the dominant problems and tasks of the particular stage they are in Kazanjian

(1984), Kazanjian and Hayagreeva (1999), Hanks, Watson, Jansen and Chandler (1993), and Christensen (1997). To transition between stages, the firm must reconfigure its resources, processes and values to a form best suited to address the dominant problem and tasks of the next stage. The literature focuses on exploring the dominant tasks of stages of development, but few examine the budgetary allocation of funds to accomplish the different dominant tasks, or the ability of management to transition the firm from one early stage to the next early stage.

The objective of this research is to examine the budget allocations to research and development (R&D) and sales and marketing (S&M) during the first stage of development of Ottawa-based specialized suppliers and how these firms move from one early sub stage to the next.

This research extends the body of knowledge of life cycle models by examining characteristics of the firm that contribute to the new venture firms transition between the two sub stages of the Conception and Development stage.

This research reviews the percent of budget allocated to R&D and S&M functions for the first two sub stages. This financial metric is used as

opposed to head-count measures because it accounts for large funding levels for outsourced design, development and prototyping activity.

The results of this research can be used to plan and budget for appropriate sizes of organizational groups to support accomplishment of the dominant tasks during the initial stages of development (Van de Ven, Hudson and Schroeder, 1984).

This research will be of interest to students and academics looking for a method to study the relative size of different functional groups in the organization of the firm, and also to those studying Strategic Management.

This research will be of interest to founders of specialized suppliers firms who have technical backgrounds. They will benefit from a better understanding of (i) the process knowledge of the budgetary allocations to R&D and S&M deployed by successful predecessor firms, and (ii) the leadership and management ability required to transition the firm from Stage A to Stage B.

1.2 Thesis Organization.

The thesis is organized into six chapters. Chapter 1 is the introduction.

Chapter 2 reviews the literature. Chapter 3 describes the research model. Chapter 4 describes the research method. Chapter 5 provides the results of this research. Chapter 6 provides a discussion of the results, conclusions, limitations of the research and suggestions for future research.

2.0 LITERATURE REVIEW

2.1 Organization

This chapter is organized into six sections. The second section presents life cycle stages as models of development of the firm. The third section presents the need for resources, processes and values of the firm to address the specific tasks of each stage of development. The fourth section presents the need to transition the firm from one configuration of resources, processes, and values in one stage to another configuration more suited to the dominant tasks of the next stage. The fifth section presents the criticality of senior management knowledge and action to the transition of the firm from one stage to the next, and early stage problems characteristic of firms. The last section presents lessons learned from the literature review.

2.2 Life Cycle Models and Stages of Development

Life cycle models propose a sequential set of stages through which firms must pass as they develop, (Kazanjian,1984). Kazanjian (1984) presents a detailed literature review to identify the existence of several life cycle

models. He summarizes previous models by quantity of stage citing five 3-Stage models, three 4-Stage models, and two 5-Stage models. He notes that all models vary slightly in the range and depth of specific activity characteristic to a particular stage.

Dodge and Robbins (1992) studied 364 firms across multiple industries to conduct an empirical investigation of small business development to present a 4-Stage model. They propose that all models assume that regularities occur in organizational development and that if studied can lead to prescriptive protocols. They propose that models assume that 'what management does' propels the firm from one stage into the next, and that firms categorized by stage are representative of all firms in that stage.

However, not all models are applicable to all industries or types of firms, (Churchill and Lewis, 1983). They studied 83 owner/managers of successful small businesses to derive and develop a 5-stage model and argue that previous life cycle models based on size or maturity of the firm are inappropriate for small business. Previous models developed from the study of larger, mature firms do not account for very early stages of firm foundation, and that larger firms are characterized by sales revenue and do not account for other factors such as technology complexity and market

volatility faced by high-tech start-ups. Shuman and Seeger (1986) studied 500 of the smallest and fastest growing US firms to point out that the majority of previous research focused on larger more established firms and what literature there was applied large business models to address smaller rapid growth businesses and did so as if there were little or no difference between the two. They observe major differences to include smaller firms have limited access to internal and external expertise, limited and constrained access to capital, different cost structures, and sizes and types of organizational groups. They point out that the literature on life cycle models rarely explores the size or type of human resources or financial resources to use these models.

Koberg, Sarason and Rosse (1996) confirm that stages of development in high technology firms differ considerably in terms of strategy, organization and management processes. They provide a validated model capable of distinguishing between new venture firms and more established firms.

Churchill and Lewis (1983) define the first stage as the 'Existence' stage where owner/founders perform most all business functions, including technology development, prototyping, marketing, sales, and seeking funding. Kazanjian (1984) is one of the first to propose a Pre-Start-Up stage

as being applicable to all high technology firms. He proposes that firms must go through this stage where the founder(s) must obtain access to and conduct development of unique technology sufficiently to demonstrate the technical viability and application of the technology to defined market opportunity. Kazanjian (1984) reveals that almost all activity is focused on the technical issues during this stage, and the dominant task to be addressed by the firm is the successful construction of a prototype. The sequential nature of life cycle models establishes the demonstration of technology as being a pre-requisite to any other stage. Without this, the firm does not continue to grow. The secondary major problem characteristic of this first stage is seeking financing for the next stage. Kazanjian (1984) identifies the need for different sizes and types of management skills, priorities and organizational groups to address the unique dominate task of each stage. Dodge and Robbins (1992) also describe their first stage as being focused on the selection of technology/product. Hanks et al. (1993) describe the common patterns of their first stage for business tasks is to obtain resources, build a prototype and establish organizational groups capable of addressing the dominant problems of the stage. They describe the structural form as undifferentiated and simple, with power centralized in the founder(s). Koberg, Sarason and Rosse (1996) also describe the first stage as characterized by technology research and development. Hansen

and Bird (1997) survey 18 entrepreneurs with prior experience as business managers. They report that high technology start-ups typically; first gain access to technology, engage in a number of iterative product development and testing processes (e.g., prototyping), then market-test their product, followed by entering their products into designated markets and commencement of operations.

Kazanjian (1984) refers to the second stage as the Start-Up Stage. This stage requires more financial backing and focuses on commercialization of the technology, establishment of supply partnerships, and peripheral technology or product alliances to bring a product to market. He notes the embryonic formation of formal sales and marketing functions to commence pre-sales activities with lead customers. Dodge and Robbins (1992) describe their second sub-stage as gaining customer acceptance or obtaining commercial viability of the product/technology within the limits imposed by available capital. Hanks et al. (1993) describe the second stage common business task patterns as setting up operating systems and capacity expansion. They describe the organization as departmentalized and functional (i.e., comprised of identifiable R&D and S&M groupings of expertise). As with previous studies the first two stages mention little of customer involvement in product definition or other traditional marketing

tasks. Koberg, Sarason and Rosse (1996) describe their second stage, known as Startup, will differ primarily in the structure of the organization, where linked work groups from functional areas operate in a non-formal, decentralized structure to emphasize product research and development.

2.3 Resources, Processes and Values

Bower (1993) conducts a detailed case study to propose that resource allocation is a continuous process and not an event. He examines four projects in a large firm, over a two- year period. Although not focused on smaller, high technology, start-ups firms it lays the foundation for future study of resource allocation where processes form the foundation for future works in strategic human resource management approaches.

Hanks et al. (1993) conduct an empirical cluster analysis of 126 high technology organizations to classify by organizational context and structure. They define organizational context by parameters such as firm size, age, growth rate, and characteristic dominant problems. They define organizational structure by form, formalization of structure, centralization and vertical differentiation. They propose that the “patterns and magnitudes” of organizational context and structure differentiate the firm

from one stage from another. They concur with their citation of Miller and Friesen (1984), to propose that:

Configurations may represent common organizational structures, common scenarios of strategy making in context, and even common developmental or transitional sequences.

This provides the modern definition of stages, as a unique configuration of variables related to resources, processes and values.

Firms establish and apply resources, processes and values to address the dominant problems and tasks of the particular stage they are in Kazanjian (1984), Kazanjian and Hayagreeva (1999), Hanks et al. (1993), Christensen (1997), and Christensen, Anthony and Roth (2004). Christensen (1997), Christensen et al. (2004) and Colbert (2004) highlight the need for firms to consider the capabilities of their firms beyond that of specific individuals to include the firm itself as an entity. They define the firm's capabilities to reside in the resources, processes and values and govern what the firm can and cannot do. They stress the need for the firm to assess these factors as to how each can affect the ability of the firm to change or transition its self.

Resources are defined as including people, technology, equipment, cash, product design, intellectual property, information, brands and relationships with suppliers, partners and customers. Processes include patterns of interaction internally and externally, communication, coordination, decision making employees use to transform inputs into higher valued output products and/or services. Processes are intended to allow the firm to conduct tasks in a predictable, repeatable and efficient manner. Values represent the 'standards by which the employees at every level set priorities that enable them to judge' what is important in their daily work (Christensen, 1997). Values are also reflected in senior management decisions to invest in specific products, services and processes, including allocation of resources. Christensen (1997) observes that during the earliest stage of firm development, capabilities reside primarily in key human resources and that as the firm continues to grow, capabilities begin to reside in processes and values under the influence of owner/founders. Transitioning the firm's capability across stages entails re-allocating resources to best address different tasks, revising established processes and changing employee values. Christensen (1997) highlights the need for firms to create the internal capability to change and transition the firm to address new market opportunities, to respond to external market threats, to revise internal processes and to address dominant tasks. To transition between stages,

the firm must reconfigure its resources, processes and values to a form best suited to address the dominant problem and tasks of the next stage.

Christensen and Bower (1996) combine the thoughts from resource allocation as a process and resource allocation combined with disruptive strategies. They propose that customer power can hinder the entrance of new technologies that are not understood sufficiently to generate customer demand. They also suggest that new technology can assist larger firms to support introduction of new systems or products to overcome their competition by providing newer disruptive technology.

2.4 Transitioning Between Stages to address Dominant Tasks

Kazanjian (1984) presents a model for transitioning through the stages where the firm must apply organizational learning to overcome the dominant problems of the stage through the search for knowledge, the application, testing and retention of knowledge and the institutionalization of that knowledge into organizational processes. Hansen and Bird (1997) are among the first to discuss organizational configuration and to imply the need for re-configuration to address problems of the next stage. Slevin and Covin (1997) address the transition activity between the stages. They recognize

the 'centrality and significance' of time as a resource to efficiently transition the organization existing in one stage to something more appropriate for the next stage. Instead of studying what most other models present (i.e., the appropriate activities to overcome dominant problems), they focus on the ability to transition the organization from one state to another state. Reconfiguration, or transition, of the organizational groups is given deeper focus by Borch, Huse and Senneth (1999) through their empirical study of 400 Swedish small firms. They base their work on the Resource Based View of the firm espoused by Barney (1991). They study the resource base configuration, or organizational groups, and the choice of strategy employed by the small firm to compete. They propose that a coherence exists between resource configuration and the strategy of 'Technological Firms', that of product innovation and growth. Kazanjian (1984), and Kazanjian and Hayagreeva (1999) note the lack of research into how organizational capabilities are created and changed from stage to stage. He performs a longitudinal study across life cycle stages to be one of the first to relate dominant problems to stages through in-depth consideration of size and type of organizational groups. He focuses in on the R&D organizational element, or functional group.

Galbreath and Galvin (2004) conduct a detailed analysis of different types of

resources by assessing each qualitatively against the criteria from the resource based view of the firm (i.e., rare, imitable, valuable, substitutable). They focus on intellectual property assets, organizational assets and reputation assets as intangible resources, and conclude that although potentially valuable resources, one does not necessarily drive performance more than the other. This leaves their overriding quest for which resource(s) drive performance most.

Colbert (2004) presents a study of strategic human resource management as a complex, living systems extension of the resource based view of the firm, to establish an integrated framework incorporating complexity theory for further study and development of theory. This framework allows for the "introduction of complexity principles at the appropriate level of abstraction of a Human Resources (HR) system, and assumes that one is present in the firm under study.

Stages are characterized by a dominant problem and tasks to be overcome by the firm (Kazanjian, 1984). Kazanjian (1984) notes the similarity of all life cycle models being the sequential nature of stages, the presence of a dominant problem to which the firm must apply it self successfully, and the

need for the firm to transition itself from one stage to the next through organizational learning, re-orientation and re-structuring. D'Amboise and Muldowney (1988) examine attempts to develop theory for small businesses by reviewing task environment, the nature of the dominant problem to be overcome by the firm during a stage, and organizational groups within the organization best suited to solve the dominant problem of a particular stage. Dodge and Robbins (1992) echo earlier studies where they propose that stages are characterized by dominant tasks to be performed by the firm.

Many researchers have studied firm development based size, age and growth rate. Few have studied the subject based on budget allocations applied to R&D or S&M activity to accomplish dominant tasks. Less have presented studies to examine differences between the Conception and Development stages.

2.5 Critical Factors Affecting Transition

Churchill and Lewis (1983) propose that a critical factor affecting early success is the owner/founders ability to perform these functions or to obtain appropriate expertise. The owner/founders knowledge and ability to act are found to be critical. Castrogiovanni (1996) study suggests that previous

founder(s) knowledge and success can create disincentives towards early business planning. Castrogiovanni (1996) measures the prevalence of planning during the early stages of development of the top 500 fastest growing firms. He reports that business planning is conducted primarily to establish credibility of the business opportunity with venture capitalists to obtain funding and to provide a roadmap for early design and development activity. They report 51% did not have formal business plans and delve deeper to discover that those founders with previous new venture experience may not need stringent business case documentation, but instead could rely on their reputation to obtain access to key human, physical and financial resources. Castrogiovanni (1996) concludes that insufficient process knowledge and capital are significant causes of firm failure. The major findings of Koberg, Sarason and Rosse (1996) suggest that managers must recognize the need to change from one stage to the next, managers must have the ability to act on the need to change from one stage to the next, and managers must reduce the time to transition their firms from the current state to a state more conducive to addressing the dominant problems of the next stage.

Although development of technology appears as the dominant task during the first stage of development, Bruno, Leidecker and Harder (1987) quantify

the nature of the early stage problems as being 38% attributable to sales and marketing activity, 33% to financial management, 11% to general management and 9% to product development and operations issues. Dutta, Narasimhan and Rajiv (1999) study 92 high-tech firms to provide substantial evidence for the importance of both Sales and Marketing during early stage growth. They find that firms with a strong R&D base can best benefit from a strong marketing orientation. They suggest that a firm might have excellent R&D capability but be unable to convert it into commercially successful products due to poor marketing and sales capability. They describe resources in terms of amount of expenditures on S&M and R&D, and also consider senior management knowledge and ability to act as resources to the firm. In proposing their taxonomies, Koeborg, Sarason and Rosse (1996) note that other definitions in the literature stress the level of human capital investment, which has been measured by the ratio of R&D costs to revenue, as a metric that researchers have failed to identify what those levels may be, and hence avoid the term in development of their taxonomy. George and Zheng (2004) suggest the existence of other non-dominant, yet still critical tasks (e.g., Sales and Marketing) that if not performed to at least some basic level, can result in real problems in subsequent stages, as noted by Terpstra and Olson (1993). Dutta et al. (1999) findings seem applicable to early stage high technology firms, where R&D capability is

characteristically paramount to performing the dominant tasks of early stages (i.e., to develop and demonstrate a viable prototype), and also where previous study has shown that hindsight evaluation of problems contributing to failure were cited by CEOs were primarily due to 'marketing problems', (Terpstra and Olson, 1993).

2.6 Lessons Learned

The following lessons are extracted from the literature review:

- a. Life cycle models are comprised of sequential stages of activity focused on addressing dominant tasks specific to each stage.
- b. A firm's capabilities reside in its resources, processes and values and govern what the firm can and cannot do.
- c. The firm must configure it's self with appropriate resources, processes and values to address the dominant tasks of each stage.
- d. The firm must transition its self from its current configuration to best address the different dominant task of the next stage.

- e. Transition between stages can be accomplished through organizational learning of new processes, re-orientation of internal values and re-structuring of resources.
- f. Life cycle models based on large firms or mature businesses are inappropriate models for new venture, high technology firms. Nascent firms have limited access to human, physical, financial and external resources. High-technology firms operate in much faster markets than traditional, more stable technologies.
- g. Owner/founders process knowledge of development; prototyping, marketing, sales, and obtaining financial backing are important to early stage success of the firm.
- h. Although R&D activity dominates the earliest stage of development, it appears that this activity is well addressed. Additionally, the literature indicates 38% of problems in subsequent stages can be traced back to inadequate S&M activity in the earliest stage Bruno et al. (1987). This implies that although S&M does not dominate the budget allocation, it

is nonetheless very important and possibly critical to future success of the firm.

- i. Specialized Supplier firms' typically first gain access to technology and develop a working prototype. Once technology is demonstrated focus shifts to product and production development and early sales activity.
- j. Experienced entrepreneurs who applied stage of growth business modeling significantly out-performed those who did not.
- k. Managers should recognize the need to change the organizational resources, process and values of the firm to direct appropriate emphasis to the dominant tasks of specific stages.
- l. Managers should have the ability to transition the firm from one configuration optimal for Stage A to another configuration optimal for Stage B.
- m. Firms with a strong R&D base can most benefit from strong S&M input. Marketing capability strongly influences the breadth and applicability of the market of new technology.

3.0 RESEARCH MODEL AND PROPOSITION DEVELOPMENT

This chapter is organized into three sections. The first section describes the research model used in this thesis. Four propositions are developed in the second section. The third section provides a list of the four propositions.

3.1 Research model

Figure 1 illustrates the research model used to examine: (i) change in the budget allocations to research and development, and sales and marketing and (ii) the importance of founders' ability to change internal processes and company values during the earliest stage of development of specialized supplier firms.

A specialized supplier is a firm whose main strategic focus is based on internally developed product innovation as per Pavitt, Robson and Townsend (1989) and George and Zheng (2004). A specialized supplier develops specific technological advantage based on capacity to improve performance of specialized inputs into complex and interdependent production systems. The specialized supplier accesses external production capabilities and systems activities of customers.

Figure 1 Research model of change in the budget allocation, processes and values of specialized suppliers

The research model shown in Figure 1 is consistent with company growth models that describe stages as linked to dominant problems Kazanjian (1988), Koberg, Sarason and Rosse (1996), and Sarason and Tegarden (2001). This research model is also consistent with the capabilities perspective, which holds that the resources (what a firm has), processes (how a firm does its work), and values (what a firm wants to do) collectively define a company's strengths, and weaknesses (Christensen et al., 2004).

Stage A and Stage B are sequential. Each stage is characterized by a set of dominant problems that the firm needs to address in order to grow into the next stage.

Stage A starts with the founders' commitment to develop a technology upon which a business can be built and ends with the production of a workable prototype product. Stage A is a period during which the dominant problems are two: (i) selling the business idea to financial backers, and (ii) the development of a workable prototype product that can be evaluated by potential customers.

Stage A in the model shown in Figure 1 corresponds to the Pre-Start Up stage of the Stage-of-Growth Model described in (Kazanjian, 1988). Structure and formality are nonexistent during this stage, with almost all activity focused on technical issues as defined and directed by the firm's founders. Major organizational problems include initial development, building a proof of principle product, testing and debugging, constructing throwaway prototypes, and constructing prototypes for test and evaluation.

Stage B starts with the production of a prototype product that customers evaluate and ends with a product launch of the first production article. Stage B in the model shown in Figure 1 corresponds to the Start Up stage described by Kazanjian (1988). The firm resembles a product development team responsible for the development and launch of a new product. Stage B is one where the dominant problems are three: (i) learn how to produce

the product beyond the engineering model prototype approach used in the previous stage, (ii) involve key customers to influence product design and learn how to make the product work well in key customers' environments, and (iii) set up production capability to support the launch of the first product.

Figure 1 illustrates that budget allocations, internal processes and company values change over the two stages. An organization must change its form in order to optimally address the dominant problem of a particular stage Kazanjian (1984, 1988), Koberg, Uhlenbruck and Sarason (1996) and Sarason and Tegarden (2001).

The research model shown in Figure 1 posits that the portions of the budget allocated to R&D and S&M change from Stage A to Stage B because the number of different types of dominant tasks increases in Stage B. Whereas R&D activity is expected to completely dominate Stage A, once the technology is demonstrated with a working prototype, the firm needs to focus on customer influencing product development, building a limited production capability, and on selling the product. Hence, customer involvement activities associated with sales and marketing should increase. The research model shown in Figure 1 posits that internal processes

change from Stage A to Stage B because owners/founders start to place organizational structure into the firm through establishment of functional groups led by professional managers. These managers establish internal processes that are new to the firm and supportive of the product development, limited production capability and customer engagement tasks of Stage B.

The research model shown in Figure 1 posits that company values change from Stage A to Stage B because the founders must place new emphasis and value on new tasks to re-direct and re-structure the firm to address a different set of dominant tasks. The firm's employees must agree with these values to guide their day-to-day decision making to efficiently accomplish the task.

3.2 Proposition development

In Stage A, there are two dominant problems, selling the idea and developing a prototypical product. Selling the idea is expected to consume an equal amount of owners/founders time during both Stage A and Stage B, due to the continual need to fund initial growth of the firm. During Stage A, it is expected that a large proportion of the total budget will be spent on R&D

to first develop and prove their technology. In stage B, the company must engage lead customers and incorporate market relevant functions and features into product design and development, develop a limited production capability, convince customers to work with the firm to deploy the new product, and set-up capability to support a first product launch. It is clear that the R&D investment will be significant. It is also clear that a portion of the budget must be allocated to customer engaging, sales and marketing activities. Therefore,

Proposition 1: The proportion of available budget spent on research and development activities is greater in Stage A than in Stage B.

In Stage A, founders market a vision for the product to potential financial backers. The proportion of budget allocated to pre-product sales and marketing activities is small or negligible. In Stage B, there are three dominant problems. In addition to product and process development tasks, the company needs to undertake marketing and sales activities to: (i) identify an attractive target market, (ii) raise customers' awareness of the company's offer, (iii) convince early customers to work with the company to improve the design of the product and incorporate the new product into their business processes, and (iv) get ready for a product launch. This suggests

that the portion of the budget allocated to sales and marketing in Stage B needs to be larger than the portion of the budget that was allocated to sales and marketing in Stage A. Therefore,

Proposition 2: The proportion of available budget spent on sales and marketing activities is greater in Stage B than in Stage A.

Founder's ability to change internal processes from those that address the dominant problems in Stage A to those that address the dominant problems in Stage B is a particularly valuable capability. Internal processes in Stage A are informal and are anchored around the founders' own knowledge about what these processes should be. In Stage B, internal processes are designed to meet the needs of embryonic functional groups (Sarason and Tegarden, 2001). This requires founders and employees to learn new ways in which the specialized supplier will do its work. In order to grow the company from Stage A to Stage B, founders must lead the change in internal processes. They must have the knowledge of what changes in internal processes should be implemented and when. The specialized supplier will be unable to grow without founders making changes to its internal processes. Therefore,

Proposition 3: Ability to change informal internal processes that are anchored around founders' knowledge to internal processes capable of supporting embryonic functional areas is a valuable capability in founders of specialized suppliers.

Culture is a property of a group that determines both individual and collective behaviour, ways of perceiving, thought patterns and values (Schein, 1999). In Stage B, the greater the number of employees who believe that the increased proportion of the budget allocated to sales and marketing contributes to the success of the firm, the better. The greater the number of employees who disagree that sales and marketing is associated with company success, the more difficult for the company to transition out of Stage A. We expect the extent to which employees of successful specialized suppliers agree that the greater financial emphasis on sales and marketing is related to company success will be significant. Therefore,

Proposition 4: For successful specialized suppliers, the proportion of employees who agree that a greater emphasis in sales and marketing is linked to the company's success at Stage B will be high.

3.3 List of propositions

The four propositions developed in this chapter are:

Proposition 1: The proportion of budget spent on research and development activities is greater in Stage A than in Stage B.

Proposition 2: The proportion of budget spent on sales and marketing activities is greater in Stage B than in Stage A.

Proposition 3: Ability to change informal internal processes that are anchored around founders' knowledge to internal processes capable of supporting embryonic functional areas is a valuable capability in founders of specialized suppliers.

Proposition 4: For successful specialized suppliers, the proportion of employees who agree that a greater emphasis in sales and marketing is linked to the company's success at Stage B will be high.

4.0 RESEARCH METHOD

4.1 Unit of Analysis

The unit of analysis is a specialized supplier firm with headquarters located in Ottawa, Ontario which as of June 2004, sold product and was operating for more than two and less than five years.

4.2 Study Period

The study is from 1998 to 2002.

4.3 Sample Selection

The sample was selected using a four-step process. In the first step, the list of 249 firms published by 'Carleton Start-Ups Central' (<http://www.carleton.ca/startupsportal/thestartuplist.php3>) was used as the comprehensive guide to all technology based firms in the Ottawa area. This list was used to search the Communications and Networking and the Optical and Semiconductors sectors to yield a potential source for specialized suppliers relevant to the high-technology community in the Ottawa area.

Each firm in the list had to have a website with company information.

The second step was to identify specialized suppliers that were selling products. The websites of the firms in the list compiled from the first step were examined to determine whether or not the firm was selling product.

To determine if a firm was selling product, the writer examined the news releases on the firm's web site for announcements of product sales. If these announcements suggested that the company was not selling products, the company was eliminated from the sample.

A firm that was selling product was deemed to be a specialized supplier if the main strategic focus is based on internally developed product innovation

To determine if a firm's main strategic focus is based on internally developed product innovation, the writer examined the product information and 'about us' sections of each firm's website.

This second step was designed to select companies that were characterized by a strategy of internally developed product innovation based on a specific technology that provided specialized advantage over competitors, in

accordance with the criteria provided by Pavitt et al. (1989) and George and Zheng (2004).

The third step was to contact the senior member of the Human Resources department for each firm. A brief outline of the research was explained and each was asked if there was a senior employee still with the firm, that was an initial owner or member of the firm's founding senior management team, who could have knowledge of the resource allocation decisions made during the early stages of development of the firm.

The fourth step was to contact the individuals who were members of the top management teams of specialized suppliers during the early stages of their firms and that had direct knowledge of budget allocation decisions. Unstructured interviews were conducted to present the purpose and benefits of the research, and to determine if the participants had the knowledge of resource allocations and if they were willing to provide that information. Non-disclosure agreements were signed where required. An attempt to reduce corporate concerns by using only relativistic data (i.e., percent budget allocated) and not absolute data did not amend initial decisions not to participate.

A questionnaire was sent to participants, by email, requesting the following information:

- a. When was the firm founded?
- b. When was the first engineering prototype successfully demonstrated?
- c. When was the first production article produced?
- d. During the periods between these events, what was the percent of budget allocated to R&D activity?
- e. During the periods between these events, what was the percent of budget allocated to S&M activity?

4.4 Method

This section describes the steps used to collect the data for this research.

4.4.1 Step 1. Budget Allocation Questionnaire

In step 1, the questionnaire shown in Appendix A was sent to the people who had agreed to participate in the research study. This first questionnaire was named Budget Allocation Questionnaire. The questionnaire was sent

via email addresses obtained from initial interviews. Each was phoned to establish a consistent understanding of the questions and terminology.

4.4.2. Step 2. Consolidation of Results Obtained from Budget Allocation Questionnaire

The responses received to the questions d and e, from paragraph 4.3 were plotted on a one-dimensional scale to show the extent to which responses agreed with one another, referred to as consolidated results for the first questionnaire.

Each participant was sent via email the information and asked to consider the overall results. Each participant was then contacted by phone. Each was asked to comment and provide their opinion as to their overall agreement or disagreement with the results. Each was asked if the resource allocations indicated were necessary in order to transition the firm from Stage A to Stage B, to identify the events that led to the need to reallocate resources, and how this was accomplished.

4.4.3 Step 3. Transition Questionnaire

A second questionnaire was sent to the respondents of the first Budget Allocation Questionnaire. The second questionnaire was named the Transition Questionnaire and is provided in Appendix B.

The second questionnaire examined the issues raised by the responses to Step 2 of the Budget Allocation Questionnaire. The questionnaire was sent via email to all participants to the first questionnaire. Each participant was called to ensure consistent interpretation of the questions.

4.4.4 Step 4. Consolidation of Results Obtained from Transition Questionnaire

The responses received to the questions were plotted on a one-dimensional scale to show the extent to which responses agreed with one another, referred to as consolidated results for the Transition Questionnaire.

Each participant was sent via email the information and asked to consider the overall results. Each participant was then contacted by phone. Each was asked to comment and provide their opinion as to their overall

agreement or disagreement with the results.

4.5 Questionnaires

Two questionnaires were used to collect the data: Budget Allocation Questionnaire and Transition Questionnaire.

4.5.1 Budget Allocation Questionnaire

The Budget Allocation Questionnaire is shown in Appendix A. It was organized into two major sections. The first section requests participants to indicate the dates of key milestones defining the beginning and end of each life cycle stage. The second section is presented along side the first section with a scale to indicate the percent of budget allocated to the durations (stages) between these events.

The questionnaire included the parameters of 'percent allocated budget' and 'stages of development'. The 'percent allocated budget' is defined as the total amount of funds, expressed in percent, made available to either R&D or S&M during a specific stage. The stages were identified as durations between the dates indicated for each event.

Of the total budget available to the firm during each stage, participants were asked to approximate, on a linear scale, the percentage that was allocated to R&D and to S&M. The demonstration of an engineering prototype is used as a definitive marker to delineate the end of Stage A and beginning of Stage B, as indicated by Kazanjian (1984).

4.5.2 Transition Questionnaire

The Transition Questionnaire is shown in Appendix B. The objective of this questionnaire was to assess the competitive advantage conferred on the firm by senior managements ability to transition the firm from Stage A to Stage B.

The questionnaire was organized into three major sections. The first section was designed to assess the advantage provided by senior management process knowledge of the 'need to reallocate resources' once a prototype was constructed and successfully demonstrated. The structure of the first section is based on the evaluation criteria from the resource-based view model of the firm presented by Barney (1991) and recently validated by Barney, Wright and Ketchen Jr. (2001). The factors of value, rareness, imitability and substitutability are assessed to indicate if a

characteristic confers sustained competitive advantage to the firm. These four criteria were assessed on a Likert scale of 1 through 7, indicating strong disagreement or strong agreement. This approach follows on from that used by Galbreath and Galvin (2004), and provides deeper resolution from their scale of 1 through 4. Firms were contacted after emailing out the questionnaire to ensure consistent interpretation of the criteria.

The second section of the questionnaire was designed to assess the advantage provided by senior managements ability to effectively reallocate resources once a prototype was constructed and successfully demonstrated. The structure of the second section is also based on the evaluation criteria from the resource-based view of the firm model

The third section of the questionnaire was designed to assess the overall effect of reallocating resources once a prototype was constructed and successfully demonstrated to the present day success of the firm. We use this as an overall indicator of senior management's ability to appropriately reconfigure the resources, processes and values of the firm from Stage A to Stage B.

4.6 Data Analysis

This section describes how the data was analyzed.

Propositions 1 and 2 were tested using the Mann-Whiney U test. The Mann Whiney U test is an alternative to the independent-samples t test. Given the small sample in this research, it is of no interest to test whether or not the variances at stages A and B were the same. The interest is solely to determine if budget allocations in one stage are greater than those of the other stage.

If the mean rank difference is significant at $p < .10$, it will be concluded that the percentage budget allocation for one stage is greater than that of the other stage.

For Proposition 1: The proportion of available budget spent on research and development activities is greater in Stage A than in Stage B, we will determine the proposition to be supported if the mean rank of budget allocated to R&D in stage A is significantly higher than that of stage B with $p < 0.10$.

For Proposition 2: The proportion of available budget spent on sales and marketing activities is greater in Stage B than in Stage A, we will determine the proposition to be supported if the mean rank of budget allocated to S&M in stage B is significantly higher than that of stage A with $p < 0.10$.

For Proposition 3: Ability to change informal internal processes, we will determine the proposition to be supported if more than 75% of participants strongly agree with all criteria measured (i.e., value, sustainability, imitability, and rare).

For Proposition 4: For resource reallocation to emphasize increased sales and marketing activity is linked to future success of the firm, we will determine the proposition to be supported if more than 75% of participants strongly agree with all criteria measured.

5.0 RESULTS

5.1 Sample Selection

The sample was selected using a four-step process. In the first step, from the list of 249 firms published by 'Carleton Start-Ups Central' (<http://www.carleton.ca/startupsportal/thestartuplist.php3>), a search was conducted to identify a total of 58 firms from the Communications and Networking sector and 41 firms from the Optical and Semiconductors sector, for a total of 99 firms.

For the second step, the 'news releases' section of the firms web sites were reviewed to look for sales announcements to determine whether or not the firm was actively selling product. The sites were reviewed in the 'about us' and 'products' section to determine if the firm's main focus was on internally developed product innovation. This reduced the sample to 57 firms.

The third step, contact with HR departments to identify suitable participants reduced the potential sample size from 57 to 19 participants.

The first questionnaire was sent out and resulted in 10 returns. The

participants included two Presidents, four Vice Presidents of Marketing, two Chief Technology Officers, and two Vice Presidents of Marketing Communications. The second questionnaire to the same 10 participants resulted in a reduced sample of 8 participants with the loss of two Vice Presidents of Marketing.

5.2 Descriptive Statistics

Table 1 provides the descriptive statistics for the percentages allocated to research and development, and sales and marketing at stages A and B by the ten firms in the sample.

**Table 1 - Descriptive statistics for percentage of budget allocations to R&D
and sales and marketing**

	Minimum	Maximum	Mean	Median	Skewness (Std. error is .687)	Kurtosis (Std. error is 1.334)
Stage A						
R&D (percentage)	65	90	80.5	82.5	-.475	-1.056
Sales & marketing (percentage)	5	25	12.0	10.0	.866	-.567
Stage B						
R&D (percentage)	50	85	70.0	75.0	-.830	-1.074
Sales & marketing (percentage)	10	40	17.5	15.0	1.582	1.893

Figures 2 through 5 provide bar plots showing the responses to questions of percent budget allocated to R&D and to S&M during Stages A and B, respectively, from the Budget Allocation Questionnaire.

Table 1 and Figures 2 and 3 show that during Stage A, the firms in the sample allocated 65% to 90% of their budgets to R&D and 5% to 25% to sales and marketing.

Figure 2 - Responses to the question: What percent budget was allocated to R&D during Stage A?

Figure 3 - Responses to the question: What percent budget was allocated to S&M during Stage A?

Table 1 and Figures 4 and 5 show that during Stage B, the firms in the sample allocated 55% to 85% of their budgets to R&D and 10% to 40% to sales and marketing.

Figure 4 - Responses to question: What percent budget was allocated to R&D during Stage B?

Figure 5 - Responses to question: What percent budget was allocated to S&M during Stage B?

5.3 Mann-Whiney U test comparing budget allocations

Proposition 1 predicts that the percentage of budget spent on research and development activities is greater in Stage A than in Stage B. Table 2 shows the results of using the Mann-Whiney U test to compare the percentage budget allocated to R&D at stages A and B. The results indicate that the mean rank of budget allocated to R&D in stage A is significantly higher than that of stage B with $p < 0.10$.

Table 2 - Mann-Whiney U Test comparing percentage budget allocation to R&D between Stages A and B.

		N	Mean Rank	Sum of Ranks
R&D	Stage A	10	12.80	128.00
	Stage B	10	8.20	82.00
	Total	20		

Test Statistics

	R&D
Mann-Whiney U	27.000
Wilcoxon W	82.000
Z	-1.771
Asymp. Sig. (2-tailed)	.077
Exact Sig. [2*(1-tailed Sig.)]	.089

a Not corrected for ties.

b Grouping Variable: AORB

Proposition 2 predicts that the percentage of budget spent on sales and marketing activities is greater in Stage B than in Stage A. Table 3 shows the results of using the Mann-Whiney U test to compare the percentage budget allocated to sales and marketing at stages A and B. The results indicate that the mean rank of budget allocated to sales and marketing in stage B is not significantly higher than that of stage A with $p < 0.10$.

Table 3 - Mann-Whiney U Test comparing percentage budget allocation to sales and marketing between Stages A and B.

		N	Mean Rank	Sum of Ranks
Sales and marketing	Stage A	10	8.60	86.00
	Stage B	10	12.40	124.00
	Total	20		

Test Statistics

	SM
Mann-Whiney U	31.000
Wilcoxon W	86.000
Z	-1.473
Asymp. Sig. (2-tailed)	.141
Exact Sig. [2*(1-tailed Sig.)]	.165

a Not corrected for ties.

b Grouping Variable: AORB

5.4 Issues raised by respondents of the first questionnaire

After sending the consolidated results of the resource allocation questionnaire to participants, discusses with participants identified consistent themes regarding senior management.

The first issue consistently observed amongst participants was that senior management should have the process knowledge of what resources to allocate, and in what proportions, to address the dominant task of concept development in Stage A, and the product development and customer

engagement activities of Stage B.

The second issue consistently observed amongst participants was that senior management should have the leadership ability to change the informal processes used by the firm in Stage A to the more systemic processes developed by nascent functional groups beginning to form in Stage B, and the resultant reallocation of available funds. Participants consistently mentioned the difficulty with senior technical members of the firm in accepting the reallocation of limited funds to decrease the relative amount of funds available to R&D, especially in light of the recently demonstrated success of the prototype.

A third issue was consistently observed in that current success of the firm was due in part to the reallocation of limited funds to increase sales and marketing activity as a dominant task in Stage B.

A second questionnaire was designed to assess the value of senior management in addressing these issues. The questionnaire was sent to these same participants of the first questionnaire. Only 8 responses were returned, further reducing the sample size.

5.5 Results of Assessment of Senior Management Characteristics

Table 4 provides the descriptive statistics to the responses for the first section of the Transition questionnaire, regarding the senior management's process knowledge of the need to reallocate resources once technology is successfully demonstrated.

Table 4 - Senior management process knowledge in recognizing the need to reallocate resources.

	Min	Max	Mean	Median	Skewness	Kurtosis
Valuable	4	7	6.4	7.0	-1.960	3.937
Rare	2	6	3.5	3.5	0.808	-0.229
Imitable	3	7	5.6	5.5	-0.821	-0.542
Substitutable	4	7	5.6	6.0	-0.105	-1.922

Table 5 provides the descriptive statistics for the responses to the second section of the Transition questionnaire, regarding the senior management's ability to act and effectively reallocate resources once technology is successfully demonstrated.

Table 5 - Management ability to act and reallocate resources.

	Min	Max	Mean	Median	Skewness	Kurtosis
Valuable	4	7	6.5	7.0	-2.339	5.469
Rare	1	7	4.1	4.0	0.125	-0.943
Imitable	3	7	5.6	6.5	-0.646	-1.679
Substitutable	4	7	5.1	5.0	0.623	-1.686

Table 6 provides the descriptive statistics to the responses to the third section of the Transition questionnaire, regarding the contribution of the resource reallocation decisions to success of the startup firm.

Table 6 - Success from Resource Allocation.

Transition Questionnaire - Responses to Success from Resource Reallocation						
	Min	Max	Mean	Median	Skewness	Kurtosis
Success from Resource Allocati	3	7	5.9	7.0	-1.028	-0.690

Table 4 and Figure 6 show that the responses to the question of senior management process knowledge in recognizing the need to reallocate resources was assessed in a range of 4 to 7 on the Likert scale, with a mean of 6.4 and a median 7, indicating 'strong agreement' amongst respondents for the criteria of 'valuable' to the firm.

Figure 6 - Is senior management knowledge of the need to reallocate resources valuable?

From Table 4 and Figures C-1, C-2 and C-3 (included under Appendix C), the remaining criteria of rare, imitable and substitutable show widely distributed results across the Likert scale, indicating no agreement amongst participants for the 3 criteria.

Table 5 and Figure 7 show that the responses to the question of senior management's ability to act and effectively reconfigure the firms resources to a configuration more supportive of the dominant task in Stage B was assessed in a range of 4 to 7 on the Likert scale, with a mean of 6.5 and a

median 7, indicating 'strong agreement' amongst respondents for the criteria of 'valuable' to the firm.

Figure 7 - Is senior management ability to reallocate resources valuable?

From Table 5 and Figures C-4, C-5 and C-6 (included in Appendix C), the remaining criteria of rare, imitable and substitutable show widely distributed results across the Likert scale, indicating no agreement amongst participants for the 3 criteria.

Table 6 and Figure 8 show that the responses to the question of resource reallocation after successful demonstration of technology was assessed in a

range of 3 to 7 on the Likert scale, with a mean of 5.9 and a median 7, indicating 'strong agreement' amongst respondents.

Figure 8 - Did resource reallocation contribute to success of the startup firm?

The consolidated results of the transition questionnaire were returned to participants. Follow-up unstructured interviews by phone calls indicated concurrence with the overall results.

6.0 CONCLUSION

6.1 Discussion of Results

Proposition 1 is supported by the Mann-Whiney U results. The test indicates that the mean rank of budget allocated to R&D in stage A is significantly higher than that of stage B with $p < 0.10$.

Proposition 2 is not supported by the Mann-Whiney U results. The test suggests that the mean rank of budget allocated to sales and marketing in stage B is not significantly higher than that of stage A with $p < 0.10$

Proposition 3 is shown limited support. A review of results from Table 4 and Figure 6, and Table 5 and Figure 10 indicates that 87% of participants strongly agree that senior management process knowledge of the need and ability to change the budgetary allocation to R&D and S&M activity across the two stages is valuable to success of the firm. Figures 11, 12 and 13 indicate that the remaining resource-based view criteria (imitable, rare and sustainable) were widely dispersed on the Likert scale and showed no consistent opinion amongst participants. Hence, according to resource based view theory the characteristics of senior management process

knowledge and ability to act are valuable to the firm, but do not confer a sustainable competitive advantage to the firm.

Proposition 4 is supported. A review of Table 6 and Figure 14 indicates that 84% of participants 'strongly agree' that reallocation of resources between Stage A and Stage B, contributed to early success of the firm.

6.2 Discussion and Considerations

The sample is limited in size. This was a disappointment to the writer. The small sample size was attributed to the research being limited to the Ottawa area, and specifically to the telecommunications and optical sectors. Moreover, few founding members were available and remained with the firm during the later stages of development. Of the founding members still with these firms, few knew of the split between both R&D and S&M budgets and some of those that did were not willing to disclose that information for the research.

Despite the small sample size, the writer believes that this research presents qualitative evidence of the deployment of the limited funding available to startup firms that was used to develop technology and then to

re-allocate the limited funding to focus on developing markets. Technology based startup firms have a high failure rate, and this knowledge can be used as a guide-post for what has worked for firms that have successfully developed into later stages. The results can guide entrepreneurs and capital providers on the efficient deployment of limited funds as to when to slow technological development and when to focus on market development.

This study expands on the work of Hanks et al. (1993) by examining the size of the specific elements of organizational groups, S&M and R&D, during the earliest stages of development. Whereas the literature focuses on exploring the dominant tasks of stages of development, few examine the budgetary allocation of funds to accomplish these dominant tasks, and the ability of the firm to transition the firm from stage to stage.

Bruno et al. (1987) describe early stage problems as being 38% attributable to sales and marketing activity. Dodge and Robbins (1992) reiterate 'marketing problems' as being dominant in their first stage, and are defined as a lack of customer contact, selling, marketing assessment and defining target markets. Their findings seem contradictory to the earlier statements by Kazanjian (1984), Koberg, Sarason and Rosse (1996), and Sarason and Tegarden (2001), that the dominant problem of the earliest stage is to

develop technology and construct a viable prototype. Bruno et al. (1987), and Dodge and Robbins (1992) have measured problems during later stage growth, that were traced back to the lack of adequate S&M emphasis during early stage growth.

In the first stage of development, George and Zheng (2004) find that high technology new ventures tend to focus and concentrate on very narrow elements of technology, providing the firm with 'depth' of technology capability. They identify arrangements of formal and informal alliances with suppliers of complimentary technologies. This characteristic of specialized suppliers can permit the firm to focus on building its core technological capability and still have sufficient funds remaining to address other critical but non-dominant tasks, such as S&M. Trade-offs are needed primarily due to finite and limited funding and the need to allocate a portion of funds to other 'non-dominant' tasks.

Hansen and Bird (1997) critical finding is that experienced entrepreneurs who applied stage of growth modeling to their planning significantly outperformed those that did not. Their research implies that even the knowledgeable, experienced and reputable entrepreneur can benefit from business planning and application of stage of growth models. This result

implies that greater than 49% of entrepreneurs can benefit from early planning today to assist in future implementation of organizational configurations specific to dominant problems of specific stages. These results also seem to be somewhat contrary to observations by Castrogiovanni (1996), where experienced reputable entrepreneurs may not need a detailed business plan to obtain funding or guide dominant problem solving. Hansen and Bird (1997) report that experienced entrepreneurs will tend to have a more managerial orientation towards addressing the dominate problems in stages, then those entrepreneurs who are scientists, technicians and engineers with little previous management experience.

The review of 121 CEO by Terpstra and Olson (1993) places the problems of early stages onto S&M (38%) and financial (31%), and not on the technology. Although Kazanjian (1984,1988) points out, high technology firms' first stage activity is dominated by technology issues, the study by Bruno et al. (1987) also identify similar problems with early stage sales and marketing. However, these latter studies of early stage sales and marketing problems were only identified as being problematic in the later life cycle stages. It may be that with all the attention and expertise given to solving the technology problems during early stages, there is little or insufficient attention given to early stage Sales and Marketing efforts. The literature

indicates that technology issues, though dominant in early stages, appear to be well addressed and not paying sufficient quality of attention to S&M can cause 'problems' for the firm in later stages. This research of firms who have successfully passed through these early stages seems to confirm the need to increase emphasis onto S&M activity through increased resources, and transitioned processes.

As pointed out by Quirin (1971), the initial work by Bower (1993) on resource allocation as a process came from a case study of four separate projects over two years for one large firm. One can question it's applicability to very early stage, small, high-technology firms, to suggest further study may be required to state that resource allocation is a process and not an event at this early stage of development. Also, resource management as a process may be applicable at the individual project level and governed by standard project management practice, but may not be applicable at the level of the firm where strategic considerations may govern and result in event driven resource allocation practice. The results of this work indicate that management did change resource allocation after the successful demonstration of a prototype event.

The results represent the degree of achieved consensus of expert opinion,

and in consideration of the contributing themes from the literature review, are used to propose the following protocol of guidelines for consideration by Senior Management and the Investor community:

1. Start-up firms allocate the vast majority of available funds to R&D, between 40% and 95%, until the developing technology or product is successfully demonstrated. When technology is successfully demonstrated, the proportion of available funding decreases to between 35% and 90%.
2. Start-up firms allocate between 0 and 30% of available funds to S&M during the earliest stage of firm development. When technology is successfully demonstrated, the proportion of available funding increases to between 10% and 50%.
3. Senior Management's process knowledge of the need to shift available funding into S&M after technology is demonstrated appears highly valuable to the firm, but not a sustainable competitive advantage to the firm.
4. Senior Management's ability to act positively to implement this

knowledge appears to be highly valuable, but not a sustainable competitive advantage to the firm.

5. Senior Management's ability to affect the values of the firm so employees place more emphasis on S&M activities in Stage B contributes to success of the firm.

The research is based on results of questionnaires and follow-up interviews to confirm and discuss consolidated results. Two further interviews were conducted to gain further insight into three issues arising from the results.

Our results indicated senior management knowledge and ability to act are highly valuable to the firm, though are not sustained competitive advantage. It may be that this knowledge and ability to act are more readily available to startup firms and thus imitable and not rare to other successful firms.

Our results also show that firms did reallocate resources to invest in formal S&M groups soon after successful demonstration of technology (i.e., the end of Stage A), although not at a significant level. It may be that other means are used to obtain market based product definition and early market interest.

Also, some participants indicated the presence of internal friction amongst senior management as a result of reallocations of the budget to form a formal S&M group, after the successful demonstration of technology.

To further explore the results reported in Chapter 5, two founders out of those who were interviewed previously were asked six new questions. Appendix D presents the interview process and results to examine more closely these three issues. The outcomes of the two new interviews are five insights:

- a. An experienced CEO and a founding team with previous business history contributes to successful development of the prototype and the transition from being technologically centric (Stage A) to being more of a market, sales and product focus (Stage B).
- b. A CEO with previous startup and S&M experience contributes to establishing a formal S&M group with minimal internal friction.
- c. Receiving additional funding soon after the successful demonstration of technology reduces the duration of friction.

- d. Having board members that can supplement the lack of founding member management experience facilitates making the appropriate resource allocations and the development of the firm.
- e. Having investors that are also potential customers contributes to getting the design correct early and postpones the need for a formal, dedicated S&M group immediately after successful technology demonstration. Postponing the investment in the S&M group conserves cash.

6.3 Limitations

The study is limited by sample size. The primary difficulty in obtaining data is establishing contact with knowledgeable, founding senior management members of a firm currently in later development stages, but still have knowledge of early stage resource allocation decisions. Another limitation is the lack of quantifiable data. Operational planning data on budget allocations for such early stage firms was no longer available at the time of the study. The research relies on the memories and estimates of participants as to what ratios of budget allocations existed several years prior to the conduct of the survey. Only firms with founding members still

present within the firm were selected for the research in an attempt to limit this potential shortfall. However, the research does demonstrate consistency of the results across this small sample of experts. Population size may be increased in subsequent studies by focusing on other major technology concentrations, for example in Boston or Silicon Valley.

The expanse of the study is limited by the unwillingness of participants to discuss the characteristics of unsuccessful firms from their previous endeavours. The study could be expanded to include unsuccessful firms where participants are willing to contribute.

The combination of small sample size, the early stage of development of the firm (lack of business systems to collect quantified data), having to rely on self-reporting and memory of participants, and limiting the research to the Ottawa area all combine to limit the general applicability of this research. However, the sample of knowledgeable, founding members, coupled with the high degree of coalescent opinions expressed by these mutually anonymous participants provides a measure of qualitative support for the results. The opinions expressed by the participants should have been evenly distributed had there been no support for the propositions. However, a high degree of coalescent opinion and consistency amongst the

participants is observed.

6.4 Future Research

The literature indicates that later stages attribute problems to lack of earlier stage S&M activity and this research indicates that successful firms have increased the emphasis on S&M through increased resource allocations and senior management transitioning of the processes and values of the firm, once technology is successfully demonstrated. Hence, early stage S&M activity is not the dominant task but is still sufficiently important to receive adequate management emphasis. Future work could investigate the contributions of other business functions that are less dominant tasks during these early stages, such as operations process engineering or corporate management tasks such as obtaining financing to support future stages of development. These activities may not be as dominant as R&D or S&M, but may need to be performed to at least some basic level in Stage A and increased in Stage B. Knowledge of the resource levels of other business functions can reveal a pattern of resource configuration leading to successful development.

Future research may attempt to obtain data from unsuccessful ventures to

contrast this against the results of this study. However, the challenges to overcoming the unwillingness of unsuccessful candidates to disclose reasons for failure may not be socially possible, and may never be subject for empirical study based on quantitative, verifiable data from a firms business system. This may leave future study of such early stages of development to the use of qualitative methods from the social sciences.

Future research may attempt to increase the population size by studying other concentrations of specialized suppliers for example in the Boston or Silicon Valley areas. However, the limitations observed in the study (i.e., lack of verifiable, quantified data coupled with self reporting) are likely to be evident in future work unless more quantitative historical data can be obtained from the business systems of early stage firms.

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APPENDIX A – BUDGET ALLOCATION QUESTIONNAIRE

The following presents the form of the questionnaire used to obtain percent of budget allocated to R&D and S&M during the Stage A and Stage B.

<u>Survey Questions</u>		During These Periods what was the Budget Allocated to R&D and S&M?
1. When was firm founded?	mm/yy	
2. When was first Engineering Prototype demonstrated, or Company acquired or dissolved?	mm/yy	
3. When was First Production Article produced, or Company acquired or dissolved?	mm/yy	
4. When was Financial Break-Even achieved, or Company acquired or dissolved?	mm/yy	
5. When was Initial Public Offering released, or company acquired or dissolved?	mm/yy	

APPENDIX B – TRANSITION QUESTIONNAIRE

The following presents the form of the questionnaire used to obtain raw data to evaluate the competitive advantage provided by senior management in transitioning the firm from Stage A to Stage B.

<p>In moving from Stage A to Stage B: do you believe the ability of senior management to recognize the need to reallocate resources from R&D to S&M, after successful demonstration of technology/product is a characteristic <u>valuable</u> to the success of your firm, rare as a senior management ability relative to other management capabilities, imitable readily by your competition, substitutable by other resource capabilities.</p>	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;"></th> <th style="width: 15%; text-align: center;">Strongly Disagree</th> <th style="width: 15%;"></th> <th style="width: 15%;"></th> <th style="width: 15%;"></th> <th style="width: 15%;"></th> <th style="width: 15%; text-align: center;">Strongly Agree</th> </tr> </thead> <tbody> <tr> <td>Valuable</td> <td style="border: 1px solid black; text-align: center;">1</td> <td style="border: 1px solid black; text-align: center;">2</td> <td style="border: 1px solid black; text-align: center;">3</td> <td style="border: 1px solid black; text-align: center;">4</td> <td style="border: 1px solid black; text-align: center;">5</td> <td style="border: 1px solid black; text-align: center;">6</td> <td style="border: 1px solid black; text-align: center;">7</td> </tr> <tr> <td>Rare</td> <td style="border: 1px solid black; text-align: center;">1</td> <td style="border: 1px solid black; text-align: center;">2</td> <td style="border: 1px solid black; text-align: center;">3</td> <td style="border: 1px solid black; text-align: center;">4</td> <td style="border: 1px solid black; text-align: center;">5</td> <td style="border: 1px solid black; text-align: center;">6</td> <td style="border: 1px solid black; text-align: center;">7</td> </tr> <tr> <td>Imitable</td> <td style="border: 1px solid black; text-align: center;">1</td> <td style="border: 1px solid black; text-align: center;">2</td> <td style="border: 1px solid black; text-align: center;">3</td> <td style="border: 1px solid black; text-align: center;">4</td> <td style="border: 1px solid black; text-align: center;">5</td> <td style="border: 1px solid black; text-align: center;">6</td> <td style="border: 1px solid black; text-align: center;">7</td> </tr> <tr> <td>Substitutable</td> <td style="border: 1px solid black; text-align: center;">1</td> <td style="border: 1px solid black; text-align: center;">2</td> <td style="border: 1px solid black; text-align: center;">3</td> <td style="border: 1px solid black; text-align: center;">4</td> <td style="border: 1px solid black; text-align: center;">5</td> <td style="border: 1px solid black; text-align: center;">6</td> <td style="border: 1px solid black; text-align: center;">7</td> </tr> </tbody> </table>		Strongly Disagree					Strongly Agree	Valuable	1	2	3	4	5	6	7	Rare	1	2	3	4	5	6	7	Imitable	1	2	3	4	5	6	7	Substitutable	1	2	3	4	5	6	7
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APPENDIX C – ADDITIONAL FIGURES

The following figures are included for completeness of presentation of results provided under Chapter 5.

Figure C-1. Is senior management knowledge of the need to reallocate resources rare?

Figure C-2. Is senior management knowledge of the need to reallocate resources imitable?

Figure C-3. Is senior management knowledge of the need to reallocate resources substitutable?

Figure C-4. Is senior management ability to reallocate resources rare?

Figure C-5. Is senior management ability to reallocate resources imitable?

Figure C-6. Is senior management ability to reallocate resources substitutable?

APPENDIX D – INSIGHTS FROM TWO ADDITIONAL INTERVIEWS

To further explore the results reported in Chapter 5, two founders out of those who were interviewed previously were asked six new questions. The outcomes of the two new interviews are the insights reported in sections D.3.3 and D.4.3 provided below.

D.1 Selecting the two founders to interview

The founders who had been interviewed to obtain the results reported in Chapter 5 were classified into two groups:

1. Founders of communications and networking firms
2. Founders of optics and semiconductor firms.

One founder was randomly selected from each group.

D.2 Questions asked

The founders selected were interviewed over the phone during the month of May 2005. The two founders selected were asked six questions:

1. Did the founding members have previous start-up or business management experience?
2. Did members of the Board have previous start-up experience, or provide access to such experience?
3. After Stage A, were professional managers and staff hired to establish a formalized S&M group?
4. When were professional managers hired to establish a formal S&M group?
5. Did reallocation of resources to the S&M function encounter any senior management resistance or internal friction?
6. Did internal friction slow down the hiring of professional managers to establish a formal S&M group?

Questions 1 and 2 seek to understand whether knowledge and ability to act were resident with the founding members or Board members. Questions 3 and 4 examine the nature and timing of the investment in S&M related resources. Questions 5 and 6 examine the internal resistance to resource allocation changes.

D.3 Communications Networking Firm

D.3.1 Context

This firm designs, manufactures and sells optical networking equipment for carriers and large enterprises. The firm has developed technology partnerships with key suppliers and channel partnerships with system integrators. Six investment groups, including three that are specific to communications technology investments, have provided capital to the firm. The product reduces carrier's capital costs.

D.3.2 Answers to the six questions

This firm had founding members with previous start-up and business management experience. The CEO had previous startup experience as a CEO of a small networking firm, and experience as a VP S&M in another networking firm. Additionally, the CEO, CTO, CFO and VP of Business Development had all worked together for the same large network equipment firm prior to starting the new firm.

This firm established a complete senior management team before having a prototype to demonstrate to potential customers. The VP Business Development performed all customer requirements interfacing during Stage A.

Prototyping required large investment in technology development, product development and process development, throughout Stage A. Approximately \$5 million was raised to cover the first year of development activity (i.e., to the end of Stage A). Once the prototype was successfully demonstrated to their lead customers, budget and headcount increased in the S&M group.

Friction did arise internally as R&D wanted to retain key technology specialists, product developers, and process and test staff and funding was limited. However, this friction was not severe enough to adversely affect the intended schedule for staffing a formal Sales and Marketing group.

The CEO was once a VP of Sales and Marketing and this may have contributed to the level of support provided to establish a formal S&M group. Additionally, one month after successful demonstration of the prototype, the firm added other investors. This contributed to the retention of key R&D designers, process and test personnel, while increasing the proportions of

funding available to S&M and to Operations production and test. They raised approximately \$20 million to establish their Stage B activities.

D.3.3 Insights gained

Three insights were gained from interviewing the founder of the networking communications firm. First, the combination of an experienced CEO and a founding team with previous business history contributes to successful development of the prototype and the transition from being technologically centric (Stage A) to being more of a market, sales and product focus (Stage B).

Second, a CEO with previous startup and S&M experience contributes to establishing a formal S&M group with minimal internal friction.

Third, receiving additional funding soon after the successful demonstration of technology reduces the duration of friction.

D.4 Optical Components Firm

D.4.1 Context

This 'fabless' semiconductor company designs, develops and supplies packaged integrated circuits for high-speed enterprise data networking products. The firm develops valued added integration of peripheral functions onto the die or into a module complying with industry communication standards. The present CEO and CTO are the initial founders of the firm. Of the seven different investors, two are large firms that use the technology in their system level products.

D.4.2 Answers to the six questions

The CEO and the CTO did not have experience establishing start-ups and had not worked together prior to starting the company. Both had senior management experience in large firms. The CEO was a previous CFO with a large firm, and the CTO was previously a senior member of a semiconductor R&D laboratory at a large prominent firm.

Throughout Stage A and Stage B, members of the Board guided the CEO and CTO through early stages of the firm.

The firm engaged a professional VP of Sales late in Stage B. The VP Sales was responsible for establishing a formal S&M group. This group was established right before the firm announced that the first production items were being made available for customer evaluation.

There was no friction in the firm with the introduction of the VP of Sales.

The viability of the technology was demonstrated approximately two years after the creation of the firm. The firm then moved directly into outsourced production in order to demonstrate their ability to supply product in volume. This was the main focus for this firm during Stage B.

The firm hired a VP of Sales very late in Stage B and was still successful in transitioning from Stage A to Stage B and successfully completing Stage B. This firm had no previous senior management startup experience but was provided access to management support by board members. As this firm has successfully passed through Stages A and B, and is actively selling product, having a board that can provide access to startup management

expertise may help overcome the need for founding members to have this management experience.

The firm had secured over \$30 million dollars after successfully demonstrating their production capability (i.e., the end of Stage B). Two new large institutional banks were added to the investors list, along with other unidentified private investors. This funding was identified for further commercialization activity and to increase the size of the recently formed S&M group.

The board members who were also potential customers seemed to provide the components firm with customer requirements throughout Stage A, by providing access to system level integration, functionality and performance requirements, as well as to key R&D and production staff. By having investors that were potential customers, the components firm seemed to forgo the need to engage the market formally at the end of Stage A by investing in a formal S&M group.

The components firm did not experience notable internal friction at the end of Stage A. The influence of the investing customers may have helped to lessen the immediate need for identifying specific target customer

requirements during Stage B, and reduce the need to reallocate proportions of funding to establish a formal S&M group.

D.4.3 Insights gained

Two insights were gained from the interview with the founder of the optical components firm. First, having board members that can supplement the lack of founding member management experience facilitates making the appropriate resource allocations and the development of the firm.

Second, having investors that are also potential customers contributes to getting the design correct early and postpones the need for a formal, dedicated S&M group immediately after successful technology demonstration. Postponing the investment in the S&M group conserves cash.