**LAUNCH AGGRESSIVENESS AND PRODUCT PERFORMANCE: THE CASE
OF NEW TELECOMMUNICATIONS PRODUCTS**

by

Ying Liu

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in partial fulfillment of the requirements for the degree of
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Department of Systems and Computer Engineering

Carleton University

Ottawa, Canada, K1S 5B6

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ABSTRACT

The objective of this research is to develop and test a model that relates the aggressiveness with which new industrial products are launched with early sales performance and describes how launch aggressiveness is influenced by company-level factors. The model integrates the competitive aggressiveness and new product introduction literatures. Using data on activities undertaken by telecommunications equipment suppliers when introducing 46 new industrial products between January 1997 and January 2002, seven sets of hypotheses anchored around the research model were tested. The results show that top management team tenure heterogeneity affects product launch aggressiveness, launch volume increases number of early sales, and launch aggressiveness does not affect time-to-first sale.

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Carleton University

Ottawa, Canada, K1S 5B6

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1 INTRODUCTION

The objective of this thesis is to develop and test a model that relates product launch aggressiveness with early sales performance and explains how launch aggressiveness is influenced by company-level factors. Product launch aggressiveness refers to the volume, diversity and duration of the actions carried out by a company when introducing a new product. We surmise that the greater a product's launch aggressiveness, the greater the number of early sales and the shorter the time-to-first sale.

Actions associated with a new product launch include trade show participation (Guiltinan, 1999; Hultink et al., 2000), product demonstrations (Guiltinan, 1999), distribution channel arrangements (Guiltinan, 1999; Hultink et al., 2000; Di Benedetto, 1999), soliciting and acting on customer feedback (Di Benedetto, 1999; Sheth, 1987; Senese 2002), and undertaking product trials (Sheth, 1987; Senese, 2002).

Companies aggressively compete with their rivals to increase their market share (Lumpkin & Dess, 1996; Miller, 1993). Market share refers to a brand's share of the total sales of all products within the product category in which the brand competes. Market share is determined by dividing a brand's sales volume by the total category sales volume. To increase market share, a company needs to launch new products (Seneca, 2002). The frequency of new product introduction has increased dramatically and the percentage of companies' profits generated by new products is high. Recent studies show that among

the best performing innovative companies, 49% of sales are derived from the new products launched within the last 5 years (Di Benedetto, 1999).

The research undertaken in this thesis is relevant because product launch actions introduce the new product to the market for the first time. While the undertaking of these launch actions is expensive and risky, they are key to product success and the company's ability to compete (Tomkovich & Miller, 2000).

The thesis makes three contributions. First, it provides a structure to relate product launch aggressiveness with product sales performance. It identifies the actions related to a product launch that affect the early sales of new products and the company-level factors that constrain and enable these actions.

The second contribution that this study makes is that it provides empirical support, using product level data, that:

- launch volume increases the number of early product sales
- TMT tenure heterogeneity increases launch volume and duration
- three TMT heterogeneities affects launch aggressiveness distinctively

The third contribution this research makes is that it provides a way to measure product launch aggressiveness using online data provided by companies. Most empirical studies on product launch rely on data captured using questionnaires.

The thesis is organized into eight sections. Section 1 is the introduction. Section 2 reviews the academic literature and the insights learned from it. Section 3 develops the research model and develops the hypotheses anchored around it. Section 4 describes the research method. It includes the criteria for sample selection, data collection, and data analysis. Section 5 and 6 provide the results using sample of 46 and 26 respectively. In Section 7, we discuss and summarize the results. Section 8 presents the conclusions, the limitations of the research, and the suggestions for future research.

2 LITERATURE REVIEW

The literature review section is comprised of four parts. The first part focuses on the competitive dynamics literature that examines how company-level factors affect a company's competitive aggressiveness, and how a company's competitive aggressiveness affects its performance.

The second part of this section focuses on the new product introduction and commercialization literature that identifies the factors that contribute to product launch success.

The third part of this section examines the literature on Web based competitive intelligence.

Finally, the fourth section identifies the lessons learned from reviewing the literature.

2.1 Competitive dynamics

A “competitive action” is a key concept in the competitive dynamics literature. Competitive actions are “externally directed, specific, and observable competitive moves initiated by a company to enhance its competitive position” (Ferrier, 1999; 2001, Smith et al., 1992; Young et al., 1996).

2.1.1 Competitive aggressiveness and company performance

Researchers who contribute to the competitive dynamics literature have established that the aggressiveness of a company's competitive actions positively affect their performance relative to other companies. The frequency and characteristics of specific competitive actions within a period of time affect company performance (Ferrier et al., 1999; Smith et al., 1992; Young, et al., 1996). Companies that undertake a greater number of competitive actions and a broader action repertoire experience better profitability and market performance (Deephouse, 1999; Ferrier et al., 1999; Miller & Chen, 1994, 1996).

Ferrier (2001) uses four dimensions to describe a company's competitive aggressiveness: attack volume, attack duration, attack complexity, and attack unpredictability. Results based on a sample of 224 observations in 16 different industries over a seven-year period suggest that the aggressiveness of a company's competitive actions affect its relative performance.

Chen, Smith and Grimm (1992) use the characteristics of the initial competitive action to predict competitive responses. They find that competitive impact, attack intensity, implementation requirements and action types, influence the number of competitors' responses and response lags. Bettis and Weeks (1987) found that companies that respond quickly to rivals' new product introductions have better stock market returns when compared to those that do not.

2.1.2 Company-level factors and competitive aggressiveness

Researchers have identified a set of company-level factors that constrain and enable competitive aggressiveness. These company-level factors include: top management team (TMT) heterogeneity, liquidity, past performance and company size.

Ferrier (2001) found that heterogeneity in TMT's education, function and tenure affects competitive aggressiveness. Hambrick, Cho, and Chen (1995) conclude that TMT heterogeneity "may have potential benefits and drawbacks to the company's competitive behaviors." They found that both function and education heterogeneities can significantly reduce action execution speed, however tenure heterogeneities do not. They also concluded that a top management team with high function and education heterogeneities generate greater overall magnitude of competitive actions. Bunderson and Sutcliffe (2002) found that dominant function heterogeneity (the extent to which team members differ in the functional areas within which they have spent the greater part of their careers) and intrapersonal functional heterogeneity (the aggregate functional breadth of team members) affect information sharing and unit performance in different ways. They found that intrapersonal functional heterogeneity is positively associated with information sharing and unit performance, whereas dominant function heterogeneity is negatively related to information sharing.

Researchers have also found that a company with high liquidity has more resources to undertake a greater number of actions with higher diversity (Ferrier, 2001; Young et al.,

1996). Ginsberg (1988) concluded that liquidity could create pressure for competitive aggressiveness and change.

Poor performance motivates companies to challenge their operating models and compete more aggressively (Barr et al., 1992; Ferrier, 2001; Lant et al., 1992). Good past performance increases the reliance on existing company routines and hinders strategic changes (Miller, 1993; Miller & Chen, 1994). A company with good past performance is more likely to compete predictably in the marketplace.

Company size is considered to be one of most important factors that affect company performance, strategy (Hofer, 1975; Smith et al., 1989), innovation (Acs & Audretsch, 1988; Hitt et al., 1991) and competitive behaviors (Chen & Hambrick, 1995). Hambrick, Cho, and Chen (1995) found that a small company is more likely to have higher propensity for action, faster action speed, as well as lower action visibility than a large company does. To compete more aggressively than their larger rivals, small companies undertake a greater number of complex competitive actions (Hitt, et al., 1991; Woo, 1987; Chen & Hambrick, 1995). In addition, industry leaders are more likely to experience market share erosion when they have less competitive aggressiveness than their market challengers (Ferrier, 1999).

2.2 New product launch

The new product launch literature can be organized into three streams. The first stream is focused on strategic and tactical activities that affect new product launch. Strategic activities are concerned with product and market issues, such as product innovativeness, target market, target costumers, and market position (Guiltinan, 1999; Di Benedetto, 1999). Researchers have shown that marketing research, sales force, distribution, promotion, R&D and engineering, as well as high diverse teams contributed to the success of new product launch (Di Benedetto, 1999; Guiltinan, 1999; Hultink & Atuahene-Gima, 2000).

Tactical activities refer to marketing mix decisions (i.e., decisions that affect product, distribution, promotion and price). Tactical decisions include the various types of communication and distribution activities such as introductory pricing, branding and timing announcements which are undertaken to enhance new product launch (Guiltinan, 1999; Di Benedetto, 1999). Researchers have found that advertising, technical support, excellent launch timing, and a strong support management program positively affect the success of a new product launch (Hultink & Atuahene-Gima, 2000; Di Benedetto, 1999; Guiltinan, 1999).

The second stream of the product launch literature focuses on the relationship between resources and capabilities on the one hand and new product introduction on the other. Researchers have found that an adequate sales force (Moriarty & Kosnik, 1989; Di

Benedetto, 1999), marketing skills and resources (Calantone & Di Benedetto, 1988; Calantone et al., 1996; Cooper, 1979, 1983; Song & Parry, 1997) are necessary for companies to proficiently carry out marketing activities specific to a new product launch. Di Benedetto (1999) found that information-gathering capabilities comprised of marketing testing, customer feedback, and advertising testing play an important role in making a launch successful.

Several studies suggest that the launch of consumer products differs from the launch of industrial products. For example, the practice of using agents or brokers as market channels for consumer products tends to lead to poor early sales of industrial products (Hultink, et al., 2000). In terms of new product forecasting, consumer companies have shorter forecast time horizons and rely less on the sales force than industrial companies do (Kahn, 2002).

The third stream of the product launch literature is focused on rivals' reactions to new product introductions. Debruyne (2002) reveals that product newness, marketing effort, targeting strategy, the market growth, and previous experience of innovation success can influence rivals' competitive reactions. Hultink and Langerak (2002) find that different launch decisions generate different market signals, and perceived signal of hostility and commitment increase strength and speed of rivals' response. Since competitive reactions to a new product launch may seriously harm the performance of a new product (Bowman, 1995; Debruyne et al., 2002; Heil, 1993), the capability to predict the reactions of rivals is critical (Hultink & Langerak, 2002).

2.3 Web-based CI

Competitive intelligence (CI) is the process of collecting, analyzing and acting on public information sources to learn about competitors and the competitive environment (Dutka, 1999). Dutka classifies CI activities into three major categories: data collection and storage, data analysis and information interpretation, and dissemination of intelligence. Vella and McGonagle (1987) point out that CI can provide specific information and concise analysis to help companies make better decision. The function of CI is to assist companies not only to react to events quickly but also to create events (Salmon, 1999).

The Internet serves both as a source of information that assists top management's decision-making processes and as an efficient way to share and disseminate information (Graef, 1995). Vibert (2000) provides examples of how theoretical frameworks and knowledge of specific Web sites or information portal content can be integrated to support competent analytical efforts to resolve important business concerns. He concludes that Web-based CI can help CI professionals, analysts, and other users to improve their ability to reason.

2.4 Lessons learned

This section provides five insights learned from reviewing the literature.

2.4.1 Product launch is key to the success of new products

Researchers have suggested that a strong product launch greatly increases the chances of new product success (Calantone & Di Benedetto, 1988; Calantone et al., 1996; Cooper & Kleinschmidt, 1987, 1995). However, little is known about which actions undertaken during the product launch contribute to increase the early sales of new products.

2.4.2 Aggressive companies perform better

A company's competitive aggressiveness and its performance in the market are related. Researchers have found that the more aggressively a company competes in the marketplace, the better its performance is (Ferrier, 1999, 2001; Young et al., 1996).

2.4.3 Company-level factors affect companies' competitive behaviours

Four company-level factors have been found to influence companies' competitive behaviours: company size (Chen & Hambrick, 1995; Hambrick, 1996; Smith et al., 1994), TMT heterogeneity (Bunderson & Sutcliffe, 2002; Ferrier, 2001; Hambrick et al., 1996), liquidity (Ferrier, 2001; Ginsberg, 1988; Young et al., 1996), and past performance (Barr et al., 1992; Ferrier, 2001; Lant et al., 1992).

2.4.4 Different measures are used to assess product performance

Griffin and Page (1996) identified 75 ways to measure the success of a new product. Customer satisfaction, market share, and sales are frequently used dimensions to measure a new product's performance. Brown and Eisenhardt (1995) distinguish between efficiency measures of product success such as time to market and development cost and effectiveness measures such as market share.

The stage at which product success is assessed can influence the perceptions of success. For instance, if measured by one or two years after product introduction, Kodak's instant picture can be defined as a product success. However, if the product performance is tested over a longer term, the product resulted in financial losses due to the infringement on Polaroid's patents (Griffin & Page, 1996).

Funk (2003) assesses the performance of an innovative telecommunications product by focusing on two years after its introduction.

2.4.5 The Web is a valuable source of information on new product launch activities

Companies use the web to obtain and provide information (Vibert, 2000). The Web provides companies with a valuable means to disseminate information on new product introductions to the public (Izsak, 2000). News releases in the companies' websites are updated faster than information included in databases typically used to do research. Companies are accountable for the information posted in their websites, they are not accountable for information about them made available by third part company database suppliers.

3 RESEARCH MODEL AND HYPOTHESIS DEVELOPMENT

3.1 Research model

The objective of this thesis is to develop and test a model that captures how product launch aggressiveness influences product performance and how company-level factors influence launch aggressiveness.

Figure 1 illustrates a two-part model that accounts for the antecedents and consequences of a new product launch. The model describes how company-level factors enable and constrain product launch aggressiveness and how product launch aggressiveness influences early sales performance. An aggressive product launch is related to better early sales results. The company-level factors studied in this research include the company's top management team heterogeneity, liquidity, past performance, and company size.

Top management team heterogeneity has three variants: TMT education heterogeneity, TMT function heterogeneity and TMT tenure heterogeneity.

Figure 1: Research model

The model shown in Figure 1 build on previous studies that conceptualize a company's strategy as comprised of competitive actions. It is based on the following premises:

- Actions comprise the basic building blocks of a product launch
- Aggressive product launch is related to early sales performance
- The dimensions of product launch include: volume, diversity, and duration

In the literature, product characteristics are found to have impacts on the product's early sales, for example, products from different industries, industrial products and consumer products, radical products and incremental products. My research model excludes product characteristics, even though product characteristics are very important for three reasons:

- The sample only includes new industrial products
- All products are coming from telecommunications industry
- All products used in the sample can be categorized into incremental products in terms of product newness

A launch action is defined as an externally directed, specific and observable move initiated by a company to support the launch of a new product. This definition is derived from the definition of competitive actions used by Ferrier et al. (1999), Smith et al. (1992), and Young et al. (1996).

For the purpose of this thesis, launch volume is defined as the total number of actions that support a product launch within the first two years after its introduction to the market. Product launches where companies undertake large numbers of actions are more aggressive.

Launch diversity is defined as the extent to which a product launch is comprised of actions of many different types. New product launches consisting of many action types are more aggressive.

Launch duration is defined as the time elapsed from the start to the end of a sequence of uninterrupted action events. If the interval of two launch actions is more than one month, we consider these two actions as being discontinuous. Product launches that sustain actions over longer, uninterrupted periods of time are more aggressive.

3.2 Hypotheses

Top management team heterogeneity

A diverse top management team is one where its members have different educational, functional, and industrial backgrounds. Past research suggests that top management team heterogeneity is associated with greater awareness of the context and competitive challenge (Hambrick et al., 1996). A diverse top management team is more likely to have relationships with a broader set of vendors and customer types than a homogeneous team. A diverse top management team is able to establish a greater number of strategic relationships with vendors, convince a greater number of customers and analysts to make favorable public comments about the new product, and undertake a greater number of product trials and demos. Accordingly, we predict that top management team education heterogeneity, function heterogeneity and tenure heterogeneity increases number and duration of actions undertaken to support the product launch. Therefore,

Hypothesis 1a

Education heterogeneity is positively related to launch volume.

Hypothesis 1c

Education heterogeneity is positively related to launch duration.

Hypothesis 1d

Function heterogeneity is positively related to launch volume.

Hypothesis 1f

Function heterogeneity is positively related to launch duration.

Hypothesis 1g

Tenure heterogeneity is positively related to launch volume.

Hypothesis 1i

Tenure heterogeneity is positively related to launch duration.

Due to its members' diverse cognitive and experiential backgrounds, a diverse top management team has greater ability to generate a broader mix of actions to support new product introduction. By contrast, members of a homogeneous top management team share a limited cognitive map and a consistent dominant logic (Hambrick, et al., 1996) that constrains their ability to undertake a wide set of action types in support of product

launch. We predict that top management education, function and tenure heterogeneity increase the action diversity that supports the product launch. Therefore,

Hypothesis 1b

Education heterogeneity is positively related to launch diversity.

Hypothesis 1e

Function heterogeneity is positively related to launch diversity.

Hypothesis 1h

Tenure heterogeneity is positively related to launch diversity.

Liquidity

A new product launch can be an expensive undertaking. A company with high liquidity has more resources to undertake a greater number of actions of different types over a longer period of time (Ferrier, 2001; Young et al., 1996). Low levels of liquidity, however, restrict the company's capabilities to undertake a large number of actions and a broad range of action types over long periods of time. Accordingly, we predict that high levels of liquidity will increase the number, diversity and duration of the actions undertaken as part of a product launch. Therefore,

Hypothesis 2a

High liquidity is positively related to launch volume.

Hypothesis 2b

High liquidity is positively related to launch diversity.

Hypothesis 2c

High liquidity is positively related to launch duration.

Past performance

Good past performance increases the reliance on existing company routines and hinders strategic changes. The company with a good past performance is more likely to compete predictably in the marketplace (Miller, 1993; Miller & Chen, 1994). Poor performance motivates companies to challenge their operating models and compete more aggressively (Barr et al., 1992; Lant et al., 1992). We surmise that companies with good performance will place a smaller effort on new product introductions than companies with poor performance. Accordingly, we predict that good performance decreases the number, diversity and duration of actions that support product launch. Therefore,

Hypothesis 3a

Good past performance is negatively related to launch volume.

Hypothesis 3b

Good past performance is negatively related to launch diversity.

Hypothesis 3c

Good past performance is negatively related to launch duration.

Company size

Large companies have more industrial experience, public brand recognition, market power, and economies of scale than small companies do (Hambrick et al., 1982; Woo & Cooper, 1981, 1982). Large companies have more resources to carry out competitive actions. To compete more aggressively than their larger rivals, small companies undertake a greater number of and more complex competitive actions (Hitt, Hoskesson, & Harrison, 1991; Woo, 1987; Chen & Hambrick, 1995). However, for product launch activities, no studies are found in the literature. In the thesis, we make assumption that small companies initiate more launch actions of different types in order to compete with large rivals.

Hypothesis 4a

Company size is negatively related to launch volume.

Hypothesis 4b

Company size is negatively related to launch diversity.

Hypothesis 4c

Company size is negatively related to launch duration.

Launch volume

Companies that undertake more actions than their rivals will perform better (Ferrier, 2001; Young et al., 1996). Thus, we predict that companies that undertake a greater number of actions to support product launch increase their sales performance. Therefore,

Hypothesis 5a

Launch volume will increase the number of early sales.

Hypothesis 5b

Launch volume will decrease the time-to-first sale.

Launch diversity

Prior research suggests that companies that are able to carry out a range of competitive actions perform better (Ferrier, 2001; Kirzner, 1973; Schumpeter, 1950). Accordingly, we predict that companies that undertake actions of different types to support the launch of a new product will close more sales faster. Therefore,

Hypothesis 6a

Launch diversity will increase the number of early sales.

Hypothesis 6b

Launch diversity will reduce the time-to-first sale.

Launch duration

Companies that attack their rivals by undertaking many actions over a longer period perform better than those that do not (Ferrier, 2001). Accordingly, we posit that launch duration increases sales performance. Therefore,

Hypothesis 7a

Launch duration will increase the number of early sales.

Hypothesis 7b

Launch duration will reduce the time-to-first sale.

4 RESEARCH METHOD

4.1 Unit of Analysis

The unit of analysis is the set of activities undertaken to support the launch of a new industrial product by a public company that supplies telecommunications equipment.

4.2 Time period

The time period of the study is from January 1997 to January 2004.

4.3 Sample selection

Three steps were followed to select the sample. The publicly traded suppliers of telecommunications equipment are identified first. In the second step, the new industrial products introduced by publicly traded suppliers of telecommunications equipment from January 1997 to January 2002 were identified. In the third step, the products for which information on the activities undertaken to support their launch were available online were identified.

Figure 2 illustrates the three steps used to select the sample for this research.

Figure 2: Steps of the sample selection procedure

Identify publicly traded suppliers that introduced new products

A list of new products and their suppliers was compiled from the information that appeared in the New Product section of the monthly publications of the Telecommunications Magazine (North Americas) published from January 2000 to December 2002. Telecommunications Magazine is an online magazine that can be accessed through <http://www.telecommagazine.com>.

Telecommunications Magazine aims to fulfill the information needs of service providers. Print subscribers' titles range from C-Level management to IT management to technology management.

The suppliers that were not telecommunications equipment suppliers or were not traded in the New York Stock Exchange (NYSE), National Association of Securities

Dealers Automatic Quotation System (NASDAQ), or Toronto Stock Exchange (TSE) were eliminated from the list obtained from Telecommunications Magazine. This was done to ensure that company level information that was specific to the telecommunications industry could be obtained. It is difficult, sometimes impossible, to obtain accurate information from companies not listed in the NYSE, NASDAQ, or TSE.

Companies for which there was no sufficient online information are eliminated in order to ensure data accessibility and the newsworthiness of news releases. There are two types of companies without sufficient online information to support our research:

- Only provide news releases online after 2002
- No sufficient launch activities information provided in the news releases, such as no customer deployment information

New products that were also excluded from the sample were those introduced by companies that had gone bankrupt or were acquired.

Identify new industrial products

The sample used in thesis only includes new industrial products from telecommunications industry. Thus, the list of new products issued by publicly traded suppliers of telecommunications equipment from January 1997 to January 2002 was examined to identify industrial products.

A new product was considered to be an industrial product if the description of the product in the supplier's new product announcement indicated that the new product addressed one or more the following target markets: service providers, Internet Service Providers (ISP), branch offices and start-ups, cable operators, wireless operators, network designers, IP service and communication providers, independent carriers, Competitive Local Exchange Carrier (CLECs), Interexchange Carriers (IXCs) and Incumbent Local Exchange Carriers (ILECs), Small to Medium sized Business (SMB) market, enterprise customers and government customers.

Identify products for which online data was available

For each product, we identify all news releases about the actions that supported the product launch and its sales from the supplier's website. These news releases had to be published within the first two years after the date of product launch. New products for which no online information could be found were excluded from the sample.

The sample used in this research was comprised of new industrial products introduced by suppliers of telecommunications equipment for which news releases on product sales and actions to support product launch were available online.

4.4 Types of actions undertaken to support product launch

An action undertaken by a company to support a product launch was denoted a launch action. Each launch action was described in a press release issued by the company and was associated with a new product.

Actions not reported in company news releases were assumed not to represent a significant, newsworthy deviation from the company's common routines (Ferrier, 1999; Young et al., 1996) and were not examined.

Based on the keywords that appear in the news releases, launch actions of industrial telecommunication products were summarized into the sixteen categories identified by Izsak (2000). Table 1 provides the 16 types of product launch actions frequently found in news releases (Izsak, 2000).

Table 1. Launch action type

Type	Description
1. New product announcement	First ever mention of the product.
2. Product awards & certificate	Information that mentions an award or a certificate the product has received or the placement the product has received in an award category.
3. Tradeshow	Information noting the product will be shown at a trade show.
4. Demo	Information indicating the product will be in a demo.

Type	Description
5. Named Only	The product is named without any detail given to its functionality.
6. Innovation	Information noting new features or new technology integrated into the product. Innovation must be an upgrade to the existing product and does not create a new platform.
7. Interoperability	Information noting interoperability testing between the product and some other vendor's equipment.
8. Partnership	Information regarding investment in the products development in the form of IP or money that will aid in advancing the product. Can also be in the form of joint marketing agreements or strategic vendor relationships on the product
9. Analyst comments	Comments from industry analysts that mention the product specifically. Also includes comment from VC firms.
10. Integration	Information indicating that a new product (a different product family) can integrated with the existing product
11. Customer: Comments	Also include comments from the customer with respect to the product
12. Customer: Testing	Information indicating that the customer performed testing on the product.
13. Other Testing	Information indicating that someone other than the customer performed testing on the product
14. Beta Availability	Information noting the product availability for beta use. Must use the word beta in the release.
15. Customer Availability	Information noting the date when the product will be available for customer use or shipping.
16. Sale force or support enhancement for the product	Information noting that the company will expand the product target market, open new product support center, or enhance the sale force for the product.

4.5 Variable measurement

Top management heterogeneity

A company's TMT was defined as being comprised of individuals who held positions at and above senior vice president.

To calculate TMT education heterogeneity, we used Blau's (1977) index of heterogeneity across six different degree categories: business, science, liberal arts, engineering, law, and other. High scores suggest that the TMT is educationally diverse.

Blau's index was also used to calculate function heterogeneity. The categories for functional background used in this research were: engineering/R&D, finance/accounting, legal, human resources management, manufacturing, logistics, purchasing, public relations, and general management. High scores indicate that the TMT had diverse functional backgrounds.

TMT education and function heterogeneity was calculated as:

$$H = 1 - \sum_{i=1}^a P_i^2$$

where H is the heterogeneity measure and P is the proportion of top management team members in each of "a" functional background category listed above.

To calculate tenure heterogeneity, we used a coefficient of variation defined as the standard deviation divided by the mean for the team's years of experience in the company (Ferrier 2001). High scores indicate that the TMT is diverse with respect to its experience in the telecommunications industry.

Liquidity

Liquidity is measured as the ratio of current assets less inventory to current liabilities. This is the way that Ferrier (2001) and Smith et al. (1992) measured liquidity. They defined liquidity as the buffer of actual or potential resources that may or may not be currently in use.

Past performance

Past performance is measured as company's return on assets in the past year. It is calculated as the ratio of net income to total assets (Ferrier, 2001).

Company size

Company size is measured as the number of employees reported in the company's annual report that corresponded to the date of new product introduction (Smith et al., 1994; Wasti & Liker, 1999).

Launch volume

Launch volume is measured as the number of actions of the product launch within the first two years.

Figure 3 illustrates the period of time within which launch actions are counted. The date of new product availability is the day of the company's news release indicating that a new product has been introduced.

Figure 3. Launch period

Launch diversity

Launch diversity, D, is calculated using the following formula:

$$D = 1 - \sum_{i=1}^{16} P_i^2$$

where P is the proportion of news releases in each of the 16 launch action types.

Launch duration

We define the duration of a launch action sequence as the days elapsed from the beginning to the end of a sequence of uninterrupted launch action events. If the interval of two launch actions is more than one month, we consider these two actions as being

discontinuous. Accordingly, the launch duration is calculated as the average duration of all uninterrupted launch action sequences within first two years.

Figure 4. Concept of launch duration

A new product launch

Figure 4 illustrates the concept of launch duration. Assume A, B, C, D, E, and F represent different categories of launch actions. Figure 4 depicts a new product launch, which is comprised of two sequences of launch actions. Since t_2 is 40 days, which is longer than one month, action F and C are discontinuous. The duration of the first action sequence is 61 days. This sequence starts with the start of launch action event A and comprises a sequence of six action events: C, D, E, B, and F. 40 days later the second launch action sequence starts. The second sequence starts with the start of launch action event C and lasts 35 days. Therefore, the launch duration is the average of the launch sequence one and launch sequence two. The duration for the example in Figure 4 is 48 days or $(61 + 35)/2$.

Time-to-first sale

Time-to-first sale is measured as the number of days between the date of product availability and the date of the news release indicating the first product sale or customer deployment (Izsak, 2000).

Sales

Sales were measured as the number of sales announced in the company's news releases during the first two years after the product availability date.

4.6 Data collection

For each product in the sample, data was collected to calculate 11 variables. These included six company-level variables (TMT education heterogeneity, TMT function heterogeneity, TMT tenure heterogeneity, liquidity, past performance, and company size); three launch aggressiveness variables (launch volume, launch diversity, and launch duration) and two product performance variables (number of sales in the first two years, and time-to-first sale).

Company level variables

Data to calculate company level variables were collected from the companies' 10K reports filed with the Security and Exchange Commission (SEC) and the companies websites. Company information included:

- Top management members' education, function and industry tenure background

- Annual return on assets
- Current assets, inventory and current liabilities
- Number of company employees

Launch aggressiveness variables

For each product, online news releases were used to collect data on:

- The date of new product announcement
- Actions that supported the introduction of the product during the first two years after the date of product announcement

The number of actions for each of the 16 categories identified in Table 1 were calculated from the data obtained online.

Product performance variables

For each product, online news releases were used to collect data on:

- The date of the first sale
- The number of sales announced in the company's news releases within the first two years after the date of new product announcement

4.7 Data analysis

Descriptive statistics

Descriptive statistics for the 11 variables were calculated. Whether or not a variable's distribution was normal was assessed based on its skewness and kurtosis statistics. Skewness and kurtosis are statistics that characterize the symmetry and shape of a variable's distribution.

Normal distributions produce a skewness statistic of zero. As the skewness statistic departs from zero, a positive value indicates the possibility of a positively skewed distribution (that is, with scores bunched up on the low end of the score scale) or a negative value indicates the possibility of a negatively skewed distribution (that is, with scores bunched up on the high end of the scale). Values of two standard errors of skewness or more (regardless of sign) are probably skewed to a significant degree (Brown, 1996). Thus, we expect a variable that is normally distributed to have a skewness statistic that is less than twice its standard error.

Normal distributions produce a kurtosis statistic of zero. As the kurtosis statistic departs from zero, a positive value indicates the possibility of a leptokurtic distribution (that is, too tall). A negative value indicates the possibility of a platykurtic distribution (that is, too flat). Values of two standard errors of kurtosis or more (regardless of sign) probably differ from a normal distribution to a significant degree (Brown, 1996). Thus, we expect a variable that is normally distributed to have a kurtosis statistic in the -2 to $+2$

range.

Correlation tests

If the variables are not normally distributed, Spearman's rank order correlation tests will be used to measure the strength of the association between two variables. If variables are normally distributed, Pearson correlations will be used.

The Spearman correlation coefficient is a nonparametric alternative to the Pearson correlation coefficient that does not require the assumption of normality to use it. The Spearman correlation coefficient is the Pearson correlation coefficient when the data for each variable are replaced by ranks. It measures the linear relationship between the two sets of ranks (Norusis, 2002).

For each association between two variables the following null Hypothesis was used,

Ho: There is no association between the rank pairs.

When interested in testing whether or not there is an association between two variables, a two-tailed test of the following alternative hypothesis was used,

Ha: There is an association between the rank pairs.

A significance level of $P < 0.10$ was used to reject Ho. I distinguished between $P < 0.01$, $P < 0.05$ and $P < 0.10$ in all the tables.

Stepwise regressions

Each launch dimension was regressed against the company-level factors using the stepwise procedure. The results were used for two purposes. First, the results of the stepwise regressions were used to test hypotheses 1 to 4. Second, the results were used to specify structural equation models used to test hypotheses 1 to 7.

Structural equation modeling

Structural Equation Modeling (SEM) is an extension of the general linear model that enables a researcher to test a set of regression equations simultaneously. SEM software permits examination of more complex relationships and models than the general linear model (Benter & Chou, 1987; Hoyle, 1995; Information Technology Services, 2001).

Each model consists of a set of relationships among the measured variables. These relationships are then expressed as restrictions on the total set of possible relationships. The most attractive feature of SEM is that it provides a unifying framework under which numerous linear models may be fit using flexible, powerful software (Information Technology Services, 2001).

The company-level factors that entered as explanatory variables in the stepwise regressions were considered to the independent or exogenous variables. They were assumed to be measured without error. The three components of launch aggressiveness

and the two market performance variables are modeled as mediating or dependent variables.

SEM requires a reasonable sample size. A good rule of thumb is 15 cases per measured variable. Thus, to include all 11 variables in one model requires a sample size of 165 new products. If the sample size is smaller, the number of variables that can be included in one model can be determined dividing sample size by 15.

Almost always data is not normally distributed. When data are not normally distributed, larger samples are required. It is difficult to make absolute recommendations as to what sample sizes are required when data are skewed or kurtotic. The general recommendation is to obtain more data whenever possible (Information Technology Services, 2001).

The Chi square is used to test the overall fit of the model. If the probability value (P) of the Chi-square is below .05, the model will be rejected. A $P < 0.05$ indicates that the model does not fit the data.

Because the chi-square test of absolute model fit is sensitive to sample size and non-normality in the underlying distribution of the variables, two other descriptive fit statistics will be used to assess the overall fit of a model to the data: the Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA). Hu and Bentler (1999) recommend RMSEA values below .06 and Tucker-Lewis Index values of .95 or higher.

In this study, a model is rejected if the P of the Chi-square test of absolute model fit is below 0.05, the TLI index is lower than 0.95, and the RMSEA is lower than 0.06.

Once a good model that fits the data is identified, the hypotheses will be tested using the P of the regression estimates. A $P < 0.05$ indicates that the relationship between the dependent and independent variable is significant.

5 RESULTS WITH SAMPLE OF 46

The results were obtained using two samples. The first sample includes 46 new industrial products introduced by 15 suppliers of telecommunications equipment between January 1997 and January 2002. This sample included 11 instances of multiple products being introduced by one company in one year. Concerns about independence of the observations in the sample, lead the researcher to draw a second sample. The second sample included only one new product per company per year. The size of the second sample was 26.

Section 5 provides the results using the first sample denoted the $N = 46$ sample. Chapter 6 provides the results of the second sample denoted the $N = 26$ sample.

5.1 The $N = 46$ Sample

This section reports the results for the $N = 46$ sample. This sample includes 46 new industrial products introduced by 15 suppliers of telecommunications equipment with common shares traded in the NYSE, NASDAQ, or TSE. Products were introduced between January 1997 and January 2002. Appendix 1 provides a list that includes the 46 new industrial products in the sample. Appendix 2 provides the list of the 15 companies that introduced these 46 products. Appendix 3 provides the number of new products introduced by the 15 companies for each of the six years in the study.

A total of 85 companies were identified in the New Product section of the 36 issues of Telecommunications Online (Americas) published from January 2000 to January 2002. Only 15 companies met the selection criteria.

A total of 250 products introduced by these 85 companies were examined. Of the 250 industrial products introduced from January 1997 to January 2002, only 46 met the sample criteria. Table 2 provides a breakdown of the reasons why new products were excluded from the sample.

Table 2. Reasons for excluding new products from the sample

Reason for Exclusion	Step when excluded	Number of Companies	Number of Products
Not a telecommunications equipment supplier	1	3	6
Not a public company	1	34	36
Public company not listed in the NYSE, NASDAQ or TSE	1	1	1
Company went bankrupt after introducing the product	1	13	13
Company was acquired after introducing the product	1	16	17
No online information was available	1	3	5
No sufficient online news releases was available	3		126

Reason for Exclusion	Step when excluded	Number of Companies	Number of Products
		70	204

5.2 Descriptive statistics

Table 3 provides descriptive statistics for the 11 variables in the research model shown in Figure 1.

The last column in Table 3 shows that function heterogeneity, tenure heterogeneity, and time-to-first sale are normally distributed. For each of these three variables, the skewness statistics was less than twice its standard error and the kurtosis statistic was within the -2 to $+2$ range. The other eight variables included in the model shown in Figure1 are not normally distributed.

Table 3. Descriptive statistics

(N = 46)

	Min	Max	Mean	Std.	Skewness Std. Error=.35	Kurtosis Std. Error=.69	Normally distributed
TMT education heterogeneity	0.22	0.72	0.57	0.03	-0.81	0.89	No
TMT function heterogeneity	0.44	0.84	0.65	0.07	-0.25	-0.70	Yes
TMT tenure heterogeneity	0.29	1.41	0.75	0.30	0.44	-.902	Yes

	Min	Max	Mean	Std.	Skewness Std. Error=.35	Kurtosis Std. Error=.69	Normally distributed
Past performance	-2.28	2.23	0.19	0.93	0.87	1.55	No
Liquidity	0.46	20.68	3.68	3.36	3.14	14.13	No
Company size	204	41000	3686.83	10112.85	2.50	6.29	No
Launch volume	2	21	7.67	3.82	1.17	2.43	No
Launch diversity	0.44	0.88	0.72	0.10	-1.33	1.47	No
Launch duration	1.00	141.00	43.80	26.17	1.57	4.20	No
Number of sales	1	15	4.39	3.75	1.47	1.46	No
Time-to-first sale	0	642	211.39	156.74	0.61	-0.49	Yes

5.3 Spearman Correlations

Company-level factors

Table 4 shows Spearman correlations among the six company-level factors.

Table 4. Spearman correlations among company-level factors

(N = 46)

Variables	Spearman's correlation	TMT education heterogeneity	TMT function heterogeneity	TMT tenure heterogeneity	Past performance	Liquidity	Company size
TMT education heterogeneity	Correlation Coefficient Sig. (2-tailed)	1.00					
TMT function heterogeneity	Correlation Coefficient Sig. (2-tailed)	.210 .161	1.00				
TMT tenure heterogeneity	Correlation Coefficient Sig. (2-tailed)	-.032 .832	-.363** .013	1.00			
Past performance	Correlation Coefficient Sig. (2-tailed)	.465*** .001	.413*** .004	-.347** .018	1.00		
Liquidity	Correlation Coefficient Sig. (2-tailed)	-.260* .081	.258* .083	-.158 .295	-.133 .379	1.00	
Company size	Correlation Coefficient Sig. (2-tailed)	.356** .015	.204 .173	-.292** .049	.593*** .000	-.620*** .000	1.00

*** Correlation is significant at the .01 level (2-tailed).

** Correlation is significant at the .05 level (2-tailed).

* Correlation is significant at the .10 level (2-tailed).

Two tailed tests of the alternative hypothesis at $P < 0.10$ show the following associations:

- Past performance is associated with TMT education heterogeneity
- Past performance is associated with TMT function heterogeneity
- Company size is associated with Liquidity
- Past performance is associated with TMT tenure heterogeneity

- TMT tenure heterogeneity is associated with TMT function heterogeneity
- Company size is associated with TMT function heterogeneity
- Company size is associated with TMT tenure heterogeneity
- Liquidity is associated with TMT education heterogeneity
- Liquidity is associated with TMT function heterogeneity

Components of Product Launch Aggressiveness

Table 5 provides Spearman correlations among the three components of product launch aggressiveness. Two tailed tests of the alternative hypothesis at $P < 0.10$ show the following associations:

- Launch volume is associated with Launch duration
- Launch volume is associated with Launch diversity

Table 5. Spearman correlations among three components of product launch aggressiveness

(N=46)

Variables	Spearman's correlation	Launch volume	Launch diversity	Launch duration
Launch volume	Correlation Coefficient Sig. (2-tailed)	1.000		
Launch diversity	Correlation Coefficient Sig. (2-tailed)	.675*** .000		
Launch duration	Correlation Coefficient Sig. (2-tailed)	.398*** .006	.241 .107	1.000

*** Correlation is significant at the .01 level (2-tailed).

** Correlation is significant at the .05 level (2-tailed).

* Correlation is significant at the .10 level (2-tailed).

5.4 Spearman rank order correlation tests

5.4.1 Company-level factors and launch aggressiveness dimensions

Table 6 shows the Spearman correlation coefficients between the six company level factors and the three components of product launch aggressiveness.

Table 6. Spearman correlations among company-level factors and components of product launch aggressiveness

(N=46)

	Spearman's	Launch volume	Launch diversity	Launch duration
TMT education heterogeneity	Correlation Coefficient Sig. (1-tailed)	.024 .438	-.048 .377	-.108 .238

	Spearman's	Launch volume	Launch diversity	Launch duration
TMT function heterogeneity	Correlation Coefficient Sig. (1-tailed)	-.175 .122	-.081 .297	-.182 .113
TMT tenure heterogeneity	Correlation Coefficient Sig. (1-tailed)	.391*** .004	.116 .220	.343** .010
Liquidity	Correlation Coefficient Sig. (1-tailed)	.052 .365	.300** .021	-.140 .176
Past performance	Correlation Coefficient Sig. (1-tailed)	-.138 .181	-.128 .198	-.254** .045
Company size	Correlation Coefficient Sig. (1-tailed)	-.102 .250	-.286** .027	-.042 .392

*** Correlation is significant at the .01 level (1-tailed).

** Correlation is significant at the .05 level (1-tailed).

* Correlation is significant at the .10 level (1-tailed).

One tailed tests of the alternative hypothesis at $P < 0.10$ show the following association:

- TMT tenure heterogeneity is positively associated with Launch volume
- TMT tenure heterogeneity is positively associated with Launch duration
- Liquidity is positively associated with Launch diversity
- Past performance is negatively related to Launch duration
- Company size is negatively related to Launch diversity

5.4.2 Launch aggressiveness and product performance

Table 7 provides the Spearman correlation coefficients between the three components of product launch aggressiveness and the two measures of the product's performance in the market.

Table 7. Spearman correlations between components of product launch aggressiveness and measures of product performance

(N=46)

	Spearman's correlation	Number of sales	Time-to-first sale
Launch volume	Correlation Coefficient Sig. (1-tailed)	.484*** .000	-.215* .076
Launch diversity	Correlation Coefficient Sig. (1-tailed)	.358*** .007	-.079 .301
Launch duration	Correlation Coefficient Sig. (1-tailed)	.385*** .004	-.143 .171

*** Correlation is significant at the .01 level (1-tailed).

** Correlation is significant at the .05 level (1-tailed).

* Correlation is significant at the .10 level (1-tailed).

One tailed tests of the alternative hypothesis at $P < 0.10$ show the following associations:

- Launch volume is positively associated with Number of sales
- Launch diversity is positively associated with Number of sales
- Launch duration is positively associated with Number of sales
- Launch volume is negatively associated with time-to-first sale

5.5 Stepwise regressions

5.5.1 Launch aggressiveness dimensions

Each of the three dimensions of launch aggressiveness was regressed against the company-level factors using stepwise regressions. Table 8a provides the results of the stepwise regression with Launch volume as the dependent variable. TMT tenure heterogeneity was the only variable that was entered by the stepwise procedure. The standardized coefficient for TMT heterogeneity is .423 and it is significant at $p < .01$.

Table 8a. Stepwise regression with Launch volume as the dependent variable and company-level factors as the potential explanatory variables

(N = 46)

Explanatory Variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	3.666	1.394		2.631	0.012	0.160	9.580	0.003***
Tenure Heterogeneity	5.367	1.734	0.423	3.095	0.003***			

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

Table 8b provides the stepwise regression results of Launch diversity as the dependent variable. Launch liquidity is the only variable entered by the stepwise procedure. The Adjusted R^2 of 0.041 is very low. The F statistic is significant only at $P = .095$.

**Table 8b. Stepwise regression with Launch diversity as the dependent variable
and company-level factors as the potential explanatory variables**

(N = 46)

Explanatory Variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	0.696	0.022		32.213	0.000	.041	2.920	0.095*
Liquidity	0.007	0.004	0.249	1.708	0.095*			

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

Table 8c provides the results of regressing Launch duration against the dimensions of launch aggressiveness. TMT tenure heterogeneity is the variable entered. The Adjusted R^2 is very low, only 0.049 and the F is significant at $P = 0.076$.

Table 8c. Stepwise regression with Launch duration as the dependent variable and company-level factors as the potential explanatory variables

(N = 46)

Explanatory Variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	26.620	10.164		2.619	0.012	.049	3.310	0.076
Tenure heterogeneity	23.014	12.645	0.265	1.820	0.076*			

* p < 0.10

** p < 0.05

*** p < 0.01

5.5.2 Performance measures

Each of the two measures of product performance variables was regressed against the four launch aggressiveness dimensions using the stepwise regression procedure. Table 9a and 9b show the results of the stepwise regression analyses.

Table 9a shows that launch volume is the only variable by the stepwise procedure entered in the regression with Number of sales as the dependent variable. The standardized regression coefficient is .603 and it is significant at $p < 0.01$.

Table 9a. Stepwise regression with Number of sales as the dependent variable and dimensions of launch aggressiveness as the potential explanatory variables

(N = 46)

Explanatory Variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	-0.157	1.010		-0.155	0.877	0.350	25.2	0.00***
Volume	0.593	0.118	0.603	5.020	0.00***			

* p < 0.10

** p < 0.05

*** p < 0.01

Table 9b shows that Launch volume was entered by the stepwise procedure in the regression with time-to-first sale as the dependent variable. The standardized coefficients for Launch volume was -.270 and it was significant at $p < .10$.

Table 9b. Stepwise regression with Time-to-first sale as the dependent variable and dimensions of launch aggressiveness as the potential explanatory variables

(N = 46)

Explanatory Variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	296.517	50.957		5.819	0.000	0.052	3.47	0.069*
Volume	-11.093	5.958	-0.270	-1.862	0.069*			

* p < 0.10

** p < 0.05

*** p < 0.01

5.6 Structural equation models

For each of the two product performance measures (number of sales and time to first sale), models that can be specified using the AMOS software were identified. Each model included:

- a performance measure as the dependent variable
- company-level factors as exogenous variables
- three dimensions of product launch aggressiveness as endogenous variables
- specifications for the correlations among the endogenous factors
- specification that an unknown exogenous factor affected an endogenous variable

A model met the criteria of goodness of fit if its:

- Probability level was greater than 0.05
- Tucker-Lewis Indices (TLI) was 0.95 or higher
- Root Mean Square Errors of Approximations (RMSEA) was 0.06 or less

5.6.1 Number of sales

Model 1

The results of the stepwise regressions shown in Tables 8a, 8b and 8c indicate that TMT tenure heterogeneity explains the variances in Launch volume and Launch duration and that Liquidity explains the variance in Launch diversity. Therefore, I specified the following paths for Model 1:

TMT tenure heterogeneity → Launch volume

TMT tenure heterogeneity → Launch duration

Liquidity → Launch diversity

The relationship between launch aggressiveness and product performance was defined as:

Launch volume → Number of sales

Launch diversity → Number of sales

Launch duration → Number of sales

From Table 4 we know that TMT tenure heterogeneity and Liquidity are not correlated. Thus, I did not specify a correlation link between these two variables.

From Table 5 we know that Launch volume is correlated with Launch diversity and Launch duration. Thus, I specified the respective correlations amongst these three variables.

Table 10a shows the results of applying AMOS to model 1 specified above. Model 1 meets the criteria for goodness of fit defined for this research. The probability level is greater than .05, the TLI is greater than .95 and the RMSEA is less than .06.

Table 10a. Results of using AMOS to obtain regression estimates for Model 1:

number of sales

(N = 46)

Model 1	Paths	Regression	p
		estimate	
Chi-square = 5.854	TMT tenure heterogeneity → Launch volume	0.441	0.000***
Degrees of freedom = 7	TMT tenure heterogeneity → Launch duration	0.265	0.066*
Probability level = 0.557	Liquidity → Launch diversity	0.232	0.046**
TLI = 1.050	Launch volume → Number of sales	0.553	0.000***
RMSEA = 0.000	Launch diversity → Number of sales	0.013	0.927
Squared multiple correlations	Launch duration → Number of sales	0.156	0.200
Number of sales = 0.371			
Launch volume = 0.194			
Launch diversity = 0.054			
Launch duration = 0.070			

* p < 0.10

** p < 0.05

*** p < 0.01

Model 2

While model 1 fits the data well, I was concerned that it had too many variables. To reduce the number of variables, I deleted the link that had the highest P in model 1 and defined model 2. This eliminated Launch diversity and Liquidity from the model.

Model 2 was defined as follows:

TMT tenure heterogeneity → Launch volume

TMT tenure heterogeneity → Launch duration

Launch volume → Number of sales

Launch duration → Number of sales

I also specified the correlation links required to adjust model 2 for the fact that Launch volume is correlated with Launch diversity and Launch duration.

Table 10b shows the results of applying AMOS to model 2. As expected the statistics for the goodness of fit of model 2 were better than those for model 1. The probability level and the TLI for model 2 are higher than those of model 1. Moreover, the squared correlation for number of sales increased from .371 in model 1 to .386 in model 2.

**Table 10b. Results of using AMOS to obtain regression estimates for
Model 2: number of sales**

(N = 46)

Model 2	Paths	Regression	p
		estimate	
Chi-square = 0.017	TMT tenure heterogeneity → Launch volume	0.423	0.002***
Degrees of freedom = 1	TMT tenure heterogeneity → Launch duration	0.265	0.066*
Probability level = 0.896	Launch volume → Number of sales	0.555	0.000***
TLI = 1.193	Launch duration → Number of sales	0.154	0.210
RMSEA = 0.000			
Squared multiple correlations			
Number of sales = 0.386			
Launch volume = 0.179			
Launch duration = 0.070			

* p < 0.10

** p < 0.05

*** p < 0.01

In model 2, the two regression coefficients for TMT tenure heterogeneity and the regression coefficient for Launch volume are significant at $P < .10$. The regression coefficient for Launch duration is not.

5.6.2 Time-to-first sale

Model 3 specified the set of equations with time-to-first sale as the dependent variable. The relationship between company-level factors and launch aggressiveness for model 3 was specified in the same way as the one for model 1. The relationship between launch aggressiveness and product performance was specified using time-to-first sales as the dependent variable.

Model 3 was specified as follows:

TMT tenure heterogeneity → Launch volume

TMT tenure heterogeneity → Launch duration

Liquidity → Launch diversity

Launch volume → Time-to-first sale

Launch diversity → Time-to-first sale

Launch duration → Time-to-first sale

I also specified the correlation links required to adjust model 3 results for the fact that Launch volume is correlated with Launch diversity and Launch duration.

Table 11a shows the results of applying AMOS to model 3. The model fits the criteria for goodness of fit.

Table 11a. Results of using AMOS to obtain regression estimates for Model 3: time-to-first sale

(N = 46)

Model 3	Paths	Regression	p
		estimate	
Chi-square = 6.973	TMT tenure heterogeneity → Launch volume	0.441	0.000***
Degrees of freedom = 7	TMT tenure heterogeneity → Launch duration	0.265	0.066*
Probability level = 0.432	Liquidity → Launch diversity	0.232	0.046**
TLI = 1.002	Launch volume → Time to first sale	-0.231	0.177
RMSEA = 0.000	Launch diversity → Time to first sale	0.026	0.879
Squared multiple correlations	Launch duration → Time to first sale	-0.173	0.234
Time to first sale = 0.093			
Launch volume = 0.194			
Launch diversity = 0.054			
Launch duration = 0.070			

* p < 0.10

** p < 0.05

*** p < 0.01

Model 4

To improve the reliability of the parameters, I defined model 4 deleting the link in model 3 that had the highest p. The Launch diversity → Time-to-first sale link had a p = .879. The deletion of this link meant that two variables were deleted from the model, Launch diversity and Liquidity.

Model 4 was specified as:

TMT tenure heterogeneity → Launch volume

TMT tenure heterogeneity → Launch duration

Launch volume → Time-to-first sale

Launch duration → Time-to-first sale

The results of applying AMOS to estimate the parameters of model 4 are shown in Tables 11b. The results suggest that the regression estimates for Launch volume and launch duration are not significant at $P < .10$ and the squared multiple correlation for time-to-first sale is low (only .10).

Table 11b. Results of using AMOS to obtain regression estimates for

Model 4: time-to-first sale

(N = 46)

Model 4	Paths	Regression	p
		estimate	
Chi-square = 0.379	TMT tenure heterogeneity → Launch volume	0.423	0.002***
Degrees of freedom = 1	TMT tenure heterogeneity → Launch duration	0.265	0.066*
Probability level = 0.538	Launch volume → Time to first sale	-0.217	0.146
TLI = 1.273	Launch duration → Time to first sale	-0.172	0.249
RMSEA = 0.000			
Squared multiple correlations			
Time to first sale = 0.100			
Launch volume = 0.179			
Launch duration = 0.070			

* p < 0.10

** p < 0.05

*** p < 0.01

6 RESULTS WITH SAMPLE OF 26

6.1 The N = 26 Sample

This section provides the results using a sub-sample of the first sample. The N = 26 sample is comprised of one new product per company per year. This second sub sample was obtained by randomly selecting one of the various new products that a company introduced in one year. For example, Appendix 3 shows that the N = 46 sample includes four products that were introduced in 1997. One of the four new products was selected randomly and is part of the N = 26 sample.

Appendix 4 shows the number of new products by company and year included in the sub-sample. The N = 26 sample includes 26 new industrial products introduced by 15 suppliers of telecommunications equipment with common shares traded in the NYSE, NASDAQ, or TSE in different years. Products were introduced between January 1997 and January 2002.

6.2 Descriptive statistics

Table 12 provides descriptive statistics for the 11 variables in the research model shown in Figure 1.

The last column in Table 12 shows that seven variables included in the model shown in Figure 1 are not normally distributed.

Table 12. Descriptive statistics

(N = 26)

	Min	Max	Mean	Std.	Skewness Std. Error=.46	Kurtosis Std. Error=.89	Normally distributed
TMT education heterogeneity	0.22	0.72	0.56	0.11	-1.06	1.46	No
TMT function heterogeneity	0.44	0.84	0.66	0.10	-0.27	-0.08	Yes
TMT tenure heterogeneity	0.29	1.41	0.77	0.33	0.43	-1.06	Yes
Past performance	-2.28	2.23	0.04	0.88	0.493	2.97	No
Liquidity	0.46	20.68	4.68	4.17	2.62	9.21	No
Company size	204	41000	7213.85	12749.55	2.13	3.42	No
Launch volume	2	21	8.65	4.35	1.00	1.31	No
Launch diversity	0.44	0.88	0.73	0.10	-1.25	1.25	No
Launch duration	1.00	86.00	44.59	19.34	0.13	0.26	Yes
Number of sales	1	15	5.54	4.21	1.04	0.13	No
Time-to-first sale	0	493	128.15	135.67	0.32	-0.82	Yes

6.3 Spearman Correlations

Company-level factors

Table 13 shows Spearman correlations among the six company-level factors.

Table 13. Spearman correlations among company-level factors

(N = 26)

Variables	Spearman's correlation	TMT education heterogeneity	TMT function heterogeneity	TMT tenure heterogeneity	Past performance	Liquidity	Company size
TMT education heterogeneity	Correlation Coefficient Sig. (2-tailed)	1.00					
TMT function heterogeneity	Correlation Coefficient Sig. (2-tailed)	.106 .608	1.00				
TMT tenure heterogeneity	Correlation Coefficient Sig. (2-tailed)	-.048 .818	-.305 .129	1.00			
Past performance	Correlation Coefficient Sig. (2-tailed)	.320 .111	.269 .183	-.476** .014	1.00		
Liquidity	Correlation Coefficient Sig. (2-tailed)	-.091 .660	.203 .320	.109 .596	-.095 .644	1.00	
Company size	Correlation Coefficient Sig. (2-tailed)	.016 .939	-.021 .919	-.352* .078	.453** .020	-.722*** .000	1.00

*** Correlation is significant at the .01 level (2-tailed).

** Correlation is significant at the .05 level (2-tailed).

* Correlation is significant at the .10 level (2-tailed).

Two tailed tests of the alternative hypothesis at $P < 0.10$ show the following associations:

- Past performance is associated with TMT tenure heterogeneity

- Company size is associated with TMT tenure heterogeneity
- Company size is associated with Past performance
- Company size is associated with Liquidity

Components of Product Launch Aggressiveness

Table 14 provides Spearman correlations among the three components of product launch aggressiveness. Two tailed tests of the alternative hypothesis at $P < 0.10$ show that Launch volume is associated with Launch duration, Launch diversity, and Launch duration

Table 14. Spearman correlations among three components of product launch aggressiveness

(N = 26)

Variables	Spearman's correlation	Launch volume	Launch diversity	Launch duration
Launch volume	Correlation Coefficient Sig. (2-tailed)	1.000 .		
Launch diversity	Correlation Coefficient Sig. (2-tailed)	.594*** .001		
Launch duration	Correlation Coefficient Sig. (2-tailed)	.490** .011	.345* .084	1.000

*** Correlation is significant at the .01 level (2-tailed).

** Correlation is significant at the .05 level (2-tailed).

* Correlation is significant at the .10 level (2-tailed).

6.4 Spearman rank order correlation tests

6.4.1 Company-level factors and launch aggressiveness dimensions

Table 15 shows the Spearman correlation coefficients between the six company level factors and the three components of product launch aggressiveness.

Table 15. Spearman correlations among company-level factors and components of product launch aggressiveness

(N = 26)

	Spearman's	Launch volume	Launch diversity	Launch duration
TMT education heterogeneity	Correlation Coefficient Sig. (1-tailed)	-.085 .340	-.149 .234	-.223 .137
TMT function heterogeneity	Correlation Coefficient Sig. (1-tailed)	-.211 .151	.129 .265	-.294 .072
TMT tenure heterogeneity	Correlation Coefficient Sig. (1-tailed)	.506*** .004	.033 .436	.413** .018
Liquidity	Correlation Coefficient Sig. (1-tailed)	.202 .161	.429** .014	-.149 .234
Past performance	Correlation Coefficient Sig. (1-tailed)	-.214 .147	-.282* .082	-.326* .052
Company size	Correlation Coefficient Sig. (1-tailed)	-.123 .275	-.337** .046	-.006 .488

One tailed tests of the alternative hypothesis at $P < 0.10$ show the following association:

- TMT tenure heterogeneity is positively associated with Launch volume

- TMT tenure heterogeneity is positively associated with Launch duration
- Liquidity is positively associated with Launch diversity
- Past performance is negatively related to Launch diversity
- Past performance is negatively related to Launch duration
- Company size is negatively related to Launch diversity

6.4.2 Launch aggressiveness and product performance

Table 16 provides the Spearman correlation coefficients between the three components of product launch aggressiveness and the two measures of the product's performance in the market.

Table 16. Spearman correlations between components of product launch aggressiveness and measures of product performance

(N = 26)

	Spearman's correlation	Number of sales	Time-to-first sale
Launch volume	Correlation Coefficient Sig. (1-tailed)	.469*** .008	-.008 .485
Launch diversity	Correlation Coefficient Sig. (1-tailed)	.409** .019	.151 .230
Launch duration	Correlation Coefficient Sig. (1-tailed)	.299* .069	-.094 .324

*** Correlation is significant at the .01 level (1-tailed).

** Correlation is significant at the .05 level (1-tailed).

* Correlation is significant at the .10 level (1-tailed).

One tailed tests of the alternative hypothesis at $P < 0.10$ show that:

- Launch volume is positively associated with Number of sales
- Launch diversity is positively associated with Number of sales
- Launch duration is positively associated with Number of sales

6.5 Stepwise regressions

6.5.1 Launch aggressiveness dimensions

Each of the three dimensions of launch aggressiveness was regressed against the company-level factors using stepwise regressions. Table 17a provides the results of the stepwise regression with Launch volume as the dependent variable. The F statistics is significant at $P = 0.014$. TMT tenure heterogeneity was the only variable that was entered by the stepwise procedure. The standardized coefficient is .500 and it is significant at $p < .01$.

Table 17a. Stepwise regression with Launch volume as the dependent variable and company-level factors as the potential explanatory variables

(N = 26)

Explanatory Variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	-1.171	0.449		-2.609	0.015	0.219	8.00	0.014**
Tenure Heterogeneity	1.52	0.537	0.500	2.829	0.009***			

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

Table 17b provides the stepwise regression results of Launch diversity as the dependent variable. The Adjusted R^2 of the regression is low. Company size is the only variable entered by the stepwise procedure. The standardized coefficient for Launch liquidity is -.366 and significant at $p < .10$.

Table 17b. Stepwise regression with Launch diversity as the dependent variable and company-level factors as the potential explanatory variables

(N = 26)

Explanatory Variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	-.389	0.045		-8.675	1.000	.098	3.701	0.066*
Liquidity	0.061	0.032	.366	1.924	0.066*			

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

There is no variable entered when Launch duration is regressed against the dimensions of launch aggressiveness.

6.5.2 Performance measures

Each of the two measures of product performance variables was regressed against the four launch aggressiveness dimensions using the stepwise regression procedure. Table 18a shows the results of the stepwise regression analyses.

Table 18a shows that launch volume is the only variable by the stepwise procedure entered in the regression with Number of sales as the dependent variable. The F statistic is significant at $P = 0.000$. The standardized regression coefficient is .615 and it is significant at $p < 0.01$.

Table 18. Stepwise regression with Number of sales as the dependent variable and dimensions of launch aggressiveness as the potential explanatory variables

(N = 26)

Explanatory Variables included	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Adjusted R square	F	Sig.
	B	Std. Error	Beta					
(Constant)	0.000	0.158		0.000	1.000	0.352	14.541	0.00***
Volume	0.615	0.161	0.615	3.817	0.00***			

* p < 0.10
 ** p < 0.05
 *** p < 0.01

No variable was entered by the stepwise procedure in the regression with time-to-first sale as the dependent variable.

6.6 Structural equation models

For each of the two product performance measures (number of sales and time to first sale), models that can be specified using the AMOS software were identified.

6.6.1 Number of sales

Model 5

The results of the stepwise regressions shown in Tables 17a and 17b indicate that TMT tenure heterogeneity explains the variances in Launch volume and liquidity explains launch diversity. Therefore, I specified the following path for Model 5:

TMT tenure heterogeneity → Launch volume

Liquidity → Launch volume

The relationship between launch aggressiveness and product performance was defined as:

Launch volume → Number of sales

Launch diversity → Number of sales

Table 19 shows the results of applying AMOS to model 5 specified above. Model 5 meets the criteria for goodness of fit defined for this research. The probability level is greater than .05, the TLI is greater than .95 and the RMSEA is less than .06.

Table 19. Results of using AMOS to obtain regression estimates for Model 5:

number of sales

(N = 46)

Model 1	Paths	Regression	p
		estimate	
Chi-square = 1.212	TMT tenure heterogeneity → Launch volume	0.500	0.000***
Degrees of freedom = 4	Liquidity → Launch diversity	0.323	0.042**
Probability level = 0.878	Launch diversity → Number of sales	0.107	0.551
TLI = 1.289	Launch volume → Number of sales	0.561	0.002***
RMSEA = 0.000			
Squared multiple correlations			
Number of sales = 0.384			
Launch volume = 0.250			
Launch diversity = 0.104			

* p < 0.10

** p < 0.05

*** p < 0.01

7 DISCUSSION OF RESULTS

This research is the first empirical study examining the relationships between launch aggressiveness and early sales of industrial products. Seven sets of hypotheses were developed building on the competitive dynamics, new product launch and web-based CI literature. Using a sample of 46 and another one of 26 industrial products from 15 publicly traded telecommunications companies, the thesis examines the effects of new product launch aggressiveness on early sales performance, and the company-level factors that influence launch aggressiveness.

There is no significant difference between the results obtained using the $N = 46$ sample and the $N = 26$ sample.

7.1 Company-level factors that affect product launch aggressiveness

TMT Heterogeneity

The first set of hypothesis state that TMT education, function and tenure heterogeneity are positively related to product launch aggressiveness. The results of this study suggest that TMT tenure heterogeneity affects product launch aggressiveness and TMT education and function heterogeneity do not. The results support hypothesis 1g: Tenure heterogeneity is positively related to launch volume and 1i: Tenure heterogeneity

is positively related to launch duration. The results do not support hypotheses 1a, 1b, 1c, 1d, 1e, 1f, and 1h.

I found a strong relationship between TMT tenure heterogeneity. The regression estimates for TMT tenure heterogeneity in stepwise regression shown in Table 8a, model 1 in Table 10a, and model 2 shown in Table 10b are all positive and significant at $P < .01$.

The standardized regression estimate for TMT tenure heterogeneity when regressed against Launch duration using the stepwise or the AMOS procedures is .265 and significant at $P < .10$. This is shown in Table 8c, 10a and 10b.

TMT tenure heterogeneity was not found to affect Launch diversity and TMT education and function heterogeneity do not affect product launch aggressiveness.

Liquidity

The second set of hypotheses predicted that high company liquidity increases product launch aggressiveness. Results show in Table 8a, 8b and 8c that there is no relationship between Liquidity and launch aggressiveness. Liquidity is not related to the volume, diversity and duration of the product launch. Hypothesis 2a, 2b and 2c were not supported.

Past performance

The third set of hypotheses predicted that good past performance decreases the number, diversity and duration of actions that support product launch. There is no support for the relationship between Past performance and product launch aggressiveness.

The results shown in Tables 8a, 8b and 8c indicate that Past performance does not affect any of the three dimensions of launch aggressiveness. Hypotheses 3a, 3b and 3c were not supported.

Company size

The fourth set of hypotheses predicted that company size negatively influences volume and diversity of product launch actions. The results from the stepwise regressions shown in Tables 8a, 8b and 8c provide no evidence of a strong relationship between Company size and product launch aggressiveness. Hypotheses 4a, 4b and 4c were not supported.

The results shown in Tables 4 and 13 also indicate that liquidity is negatively associated with company size. In this research, we use a quick ratio as the measure of liquidity. Since large companies have higher liabilities, especially from year 2000 to year 2002, which is telecommunications industry meltdown period, they may have lower liquidities than smaller companies do.

7.2 Dimensions of launch aggressiveness that affect product performance

Launch volume

The fifth set of hypotheses predicted that Launch volume improves product performance by increasing the number of product sales in the first two years and reducing the time-to-first sale. I found evidence of a strong positive relationship between Launch volume and the number of sales in the first two years and no support for the existence of a relationship between Launch volume and time-to-first sale.

The results of this research provide strong support for hypotheses 5a. The results of the stepwise regressions shown in Table 9a indicate that Launch volume has a positive relationship with Number of sales. The standardized regression coefficient is .603 and it is significant at $P < .01$. The regression estimates for Launch volume in the Number of sales path in models 1 and 2 shown in Tables 10a and 10b are .553 and .55 respectively. They are both significant at $P < .01$.

Diversity

The sixth set of hypotheses posits that launch diversity increases product performance. The results do not support hypotheses 6a and 6b. The stepwise regression results in Tables 9a and 9b show that Launch diversity does not affect number of sales or time-to-first sale. Moreover, the regression estimates for diversity shown in model 1 and 3 shown in Tables 10a and 11a are not significant at $P < .10$.

Duration

The seventh set of hypotheses predicts that launch duration increases product market performance. The stepwise regression results in Tables 9a and 9b show that Launch duration does not affect number of sales or time-to-first sale. Moreover, the regression estimates for Launch duration in models 1, 2, 3 and 4 shown in Tables 10a, 10b, 11a and 11b are not significant at $P < .10$.

7.3 Summary of results of hypothesis testing

This section provides the results of testing each hypothesis for the $N = 46$ sample. Hypothesis testing using the $N = 26$ sample provided identical results. Table 20 shows the outcome of testing each hypothesis and the rationale for the outcome. A hypothesis was supported when:

- all regression estimates in SEM models and stepwise regressions were significant at $p < .10$ and were in the same direction as expected

A hypothesis was not supported when:

- regression estimates in SEM models and stepwise regressions were significant at $p < .10$ and in the opposite direction as expected
- regression estimates in SEM model and stepwise regressions were not significant at $p < .10$
- some regression estimates from stepwise or SEM models were significant at $p < .10$, others were either not significant or significant in opposite directions

Table 20. Results of testing hypotheses using the N = 46 sample

Hypothesis	Test Outcome	Rationale
Hypothesis 1a Education heterogeneity is positively related to launch volume.	Not supported	TMT education heterogeneity does not enter into the stepwise regression with launch volume as the dependent variable.
Hypothesis 1b Education heterogeneity is positively related to launch diversity.	Not supported	TMT education heterogeneity does not enter into the stepwise regression with launch diversity as the dependent variable.
Hypothesis 1c Education heterogeneity is positively related to launch duration.	Not supported	TMT education heterogeneity does not enter into the stepwise regression with launch duration as the dependent variable.
Hypothesis 1e Function heterogeneity is positively related to launch diversity.	Not supported	TMT function heterogeneity does not enter into the stepwise regression with launch diversity

Hypothesis	Test Outcome	Rationale
		as the dependent variable.
Hypothesis 1f Function heterogeneity is positively related to launch duration.	Not supported	TMT function heterogeneity does not enter into the stepwise regression with launch duration as the dependent variable.
Hypothesis 1g Tenure heterogeneity is positively related to launch volume.	Supported	Regression coefficient for TMT tenure heterogeneity in the stepwise regression with launch volume shown in Table 8a is positive and significant at $P < .01$; regression estimate in model 1 shown in Table 10a is significant at $P < .01$.
Hypothesis 1h Tenure heterogeneity is positively related to launch diversity.	Not supported	TMT tenure heterogeneity does not enter into the stepwise regression with launch diversity as the dependent variable.
Hypothesis 1i Tenure heterogeneity is positively related to launch duration.	Not supported	Adjusted R^2 for the stepwise regression shown in Table 8c is too low; squared multiple correlation coefficient shown in Table 10a is too low.
Hypothesis 2a High liquidity is positively related to launch volume.	Not supported	Liquidity does not enter into the stepwise regression with launch volume as the dependent variable.
Hypothesis 2b High liquidity is positively related to launch diversity.	Not supported	Adjusted R^2 for the stepwise regression shown in Table 8b is too low; squared multiple correlation coefficient for launch diversity shown in Table 10a is too low.
Hypothesis 2c High liquidity is positively related to launch duration.	Not supported	Liquidity does not enter into the stepwise regression with launch duration as the dependent variable.

Hypothesis	Test Outcome	Rationale
Hypothesis 3a Good past performance is negatively related to launch volume.	Not supported	Good past performance does not enter into the stepwise regression with launch volume as the dependent variable.
Hypothesis 3b Good past performance is negatively related to launch diversity.	Not supported	Good past performance does not enter into the stepwise regression with launch diversity as the dependent variable.
Hypothesis 3c Good past performance is negatively related to launch duration.	Not supported	Good past performance does not enter into the stepwise regression with launch duration as the dependent variable.
Hypothesis 4a Company size is negatively related to launch volume.	Not supported	Company size does not enter into the stepwise regression with launch volume as the dependent variable.
Hypothesis 4b Company size is negatively related to launch diversity.	Not supported	Company size does not enter into the stepwise regression with launch diversity as the dependent variable.
Hypothesis 4c Company size is negatively related to launch duration.	Not supported	Company size does not enter into the stepwise regression with launch duration as the dependent variable.
Hypothesis 5a Launch volume will increase the number of early sales.	Supported	Regression coefficient for Launch volume in the stepwise regression with number of sales in Table 9a is positive and significant at $P < .01$; regression estimate in model 1 shown in Table 10a is significant at $P < .01$.
Hypothesis 5b Launch volume will decrease the time-to-first sale.	Not supported	Adjusted R^2 for the stepwise regression shown in Table 9b is too low; squared multiple correlation coefficient for time-to-first sale shown in Table 11a

Hypothesis	Test Outcome	Rationale
		is too low.
Hypothesis 6a Launch diversity will increase the number of early sales.	Not supported	Diversity does not enter into the stepwise regression with number of early sales as the dependent variable; regression estimate in model 1 shown in Table 10a is not significant at $P < .10$.
Hypothesis 6b Launch diversity will reduce the time-to-first sale.	Not supported	Diversity does not enter into the stepwise regression with time-to-first sales as the dependent variable; regression estimate in model 3 shown in Table 11a is not significant at $P < .10$.
Hypothesis 7a Launch duration will increase the number of early sales.	Not supported	Duration does not enter into the stepwise regression with volume of sales as the dependent variable; regression estimate in models 1 and 2 shown in Tables 10a and 10b are not significant at $P < .10$.
Hypothesis 7b Launch duration will reduce the time-to-first sale.	Not supported	Duration does not enter into the stepwise regression with time-to-first sale as the dependent variable; regression estimate in models 3 and 4 shown in Tables 11a and 11b are not significant at $P < .10$.

7.4 Key findings

Figure 5 illustrate the key findings obtained in this research study and regression estimates from SEM model 2 (see table 10b). The key findings are:

- Launch volume increases the number of early sales and in turn it is affected by TMT tenure heterogeneity
- Launch aggressiveness does not affect time to first sale
- Tenure heterogeneity affects launch aggressiveness more than education and function heterogeneity do

Figure 5. Key findings supported by the results of the study

7.4.1 Launch volume increases early sales and in turn is affected by TMT tenure heterogeneity

The first key finding of this research is that TMT tenure heterogeneity positively affects launch volume, which in turn increases the number of early sales. High diversity in TMT tenure increases launch volume, which in turn affects number of sales.

These findings support suggestions made by researchers that different TMT heterogeneities influence companies' competitive behaviors in different ways (Bunderson & Sutcliffe, 2002). Our results show that tenure heterogeneity affects launch aggressiveness, while education and function heterogeneities do not.

The results support researchers' conclusions that TMT heterogeneity is positively related to the total number of competitive actions a company undertakes (Ferrier, 2001; Hambrick et al., 1996).

7.4.2 TMT tenure heterogeneity affects launch aggressiveness more than other variables

Based on the literature, six company-level factors found to impact companies' competitive aggressiveness were included in the model shown in Figure 1. The results suggest that, when performance is measured at the product level instead of the company level, TMT tenure heterogeneity is the only firm-level factor that affects product launch aggressiveness.

Past performance and company size have been found to work both as pressures for and resistance to competitive aggressiveness and change (Chen & Hambrick, 1995; Ferrier, 1999; Ginsberg, 1988). Past performance and company size were expected to affect launch volume, diversity, and duration. The results of this study did not identify a relationship between past performance and company size on the one hand and launch aggressiveness dimensions on the other.

The results suggest that a relationship between liquidity and aggressiveness does not exist at the product level.

7.4.3 Time-to-first sale

The results suggest that launch aggressiveness as measured in this research does not affect time to first sale. None of the three launch aggressiveness variables are associated with time-to-first sale

8 CONCLUSIONS, LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

8.1 Conclusions

The objective of this thesis was to develop and test a model that relates product launch aggressiveness with early sales performance and explains how launch aggressiveness is influenced by company-level factors. Product launch aggressiveness refers to the volume, diversity and duration of the actions carried out by a company when introducing a new product. We build on the competitive aggressiveness literature advanced at the company level, and surmise that the greater a product's launch aggressiveness, the greater the number of early sales and the shorter the time-to-first sale.

This study extends competitive analysis framework used by Ferrier (2001) from the company-level to the new product level.

A research model and seven sets of hypotheses relating company-level factors, three components of launch aggressiveness, and two measures of product performance were developed. Using data on launches of 46 and 26 new telecommunications products seven sets of hypotheses were tested.

The results suggest three conclusions.

The first conclusion is that there is a strong relationship between TMT tenure heterogeneity, launch volume and number of early sales. High tenure heterogeneity increases the number of actions undertaken to support the launch of a product, in turn a greater action volume increases early sales.

The second conclusion is that TMT tenure heterogeneity affects the dimensions of product launch aggressiveness while TMT education heterogeneity, TMT function heterogeneity do not.

The third conclusion is that launch aggressiveness is not related with time-to-first sale.

8.2 Limitations

There are at least three limitations to this research.

First, the sample size of 46 is small. The sample is small for three reasons. First, we only included companies that were traded in the NYSE, NASDAQ and TSE in the sample. This was done to ensure data availability and reliability. Thus, the sample includes medium to large size companies and excludes private companies.

The second reason that the sample is small is that the desire to focus solely on the telecommunications industry. This excluded companies from other industries.

The third reason that the sample is small is that a large number of companies that introduced new products between January 1997 and January 2000 went bankrupt or were acquired by other companies during the market meltdown period that started after January 2000.

The second limitation of the study is that product launch actions are defined as publicly observable actions of a specific product launch. Therefore, actions undertaken by companies internally are not included in the analysis (e.g., company sales force enhancements, company office expansions, company internal sales policy, etc.). By keeping launch actions invisible to the public, companies can increase competitors' response lag and thus improve early sales of new products. However, these internal actions are beyond the scope of my study.

The third limitation of the study is that it ignores the effects of product characteristics on product performance.

8.3 Future research

There are three opportunities for further research.

The first research opportunity is to test the model shown in Figure 1 using a larger sample. To increase sample size, new products from companies in other industries need to be included.

The second research opportunity is to incorporate product characteristics into the model shown in Figure 1 and test the new model.

The third research opportunity is to examine how launch actions that are not reported in news releases affect product performance. This addresses the issue that may arise when one company makes public certain competitive actions and others do not. For example, one company may make public price discounts, while others may not even though they all the companies are doing it.

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Appendix 1. List of the 46 products included in the sample

Number	Product	Year	Company
1	10720 router	2001	Cisco
2	CiscoSecure ACS	1997	
3	AccessPath (TM)-TS	1997	
4	Cisco Cache Engine	1997	
5	UBR7246	1997	
6	Cisco 12008	1998	
7	Catalyst 8540	1998	
8	SSR	2001	Avici
9	SmartEdge 800 router	2001	Redback
10	SunSet OCx at OC-48	2000	Sunrise Telecom
11	NetScreen-Global PRO	2001	Netscreen
12	NetScreen-500	2001	
13	NetScreen-5XP	2001	
14	NetScreen-200 series(208,204)	2002	
15	NetScreen-25 and NetScreen-50	2002	
16	Multiwave Firefly	1997	CIENA
17	MultiWave Sentry	1997	
18	MultiWave Metro	1997	
19	MultiWave TM 4000	1998	
20	LightWorks	1999	
21	CoreStream	1999	
22	XAUI	2001	Ixia
23	PacketDrive	1999	Airspan Networks
24	Total Access 850	2000	Adtran
25	ANT-10Gig	2000	Acterna

Number	Product	Year	Company
26	Optical Network Testers (ONT)	2001	
27	NetOptimize Capacity Manager	2001	
28	FLASH 750 memory test system	2000	Teradyne
29	e-TEST(TM) suite	2000	
30	EJB-test	2000	
31	Tiger	2000	
32	Celerity, a DSL test system	2000	
33	NetFlare	2001	
34	GR Force(A3 & strategist)	2002	
35	IPSX 9000	1999	CoSine Communications
36	IPSX 3500 Service Processing Switch	2001	
37	GigaMux	2000	Sorrento Networks
38	JumpStart 400	2001	
39	Atlys (SM)	1999	Convergys
40	Catalys (SM)	1999	
41	BE 2000	2000	Terayon
42	MainSail 8000:	2000	
43	TJ615 cable modem	2001	
44	BW 3000 series of CMTSs	2001	
45	DM 3200	2001	
46	TA 102 embedded Media Terminal Adapter	2001	

**Appendix 2. List of the 15 companies that introduced the 46 New Products that are
part of the sample**

	Company	Number of Products in Sample	Website
1	Cisco	7	http://www.cisco.com/
2	Avici	1	http://www.avici.com/
3	Redback	1	http://www.redback.com/
4	Netscreen	5	http://www.netscreen.com/
5	Sunrise Telecom	1	http://www.sunrisetelecom.com/
6	CIENA	6	http://www.ciena.com/
7	Airspan Networks	1	http://www.airspan.com/
8	Adtran	1	http://www.adtran.com/
9	Acterna	3	http://www.acterna.com/
10	Ixia	1	http://www.ixiacom.com/
11	Teradyne	7	http://www.teradyne.com/
12	CoSine Communications	2	http://www.cosinecom.com/
13	Sorrento Networks	2	http://www.sorrentonet.com/
14	Convergys	2	http://www.convergys.com/
15	Terayon	6	http://www.terayon.com/

**Appendix 3. Number of new products in the N = 46 sample by company and by year
of introduction**

	1997	1998	1999	2000	2001	2002	Sub- total
Cisco	4	2			1		7
Avici					1		1
RedBack					1		1
Sunrise Telecom				1			1
Netscreen					3	2	5
Ciena	3	1	2				6
Ixia					1		1
Airspan Networks			1				1
Adtran				1			1
Acterna				1	2		3
Teradyne				5	1	1	7
CoSine Communications			1		1		2
Sorrento Networks				1	1		2
Convergys			2				2
Terayon				2	4		6
Total:	7	3	6	11	16	3	46

**Appendix 4. Number of new products in the N = 26 sample by company and by year
of introduction**

	1997	1998	1999	2000	2001	2002	Sub- total
Cisco	1	1			1		3
Avici					1		1
RedBack					1		1
Sunrise Telecom				1			1
Netscreen					1	1	2
Ciena	1	1	1				3
Ixia					1		1
Airspan Networks			1				1
Adtran				1			1
Acterna				1	1		2
Teradyne				1	1	1	3
CoSine Communications			1		1		2
Sorrento Networks				1	1		2
Convergys			1				1
Terayon				1	1		2
Total:	2	2	4	6	10	2	26