A FIELD RESEARCH PROJECT REPORT

NATIONAL TECHNOLOGICAL UNIVERSITY
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INNOVATION MANAGEMENT IN MULTI-DIVISIONAL FIRMS

FACTORS THAT LEAD TO SUCCESSFUL DEVELOPMENT OF NEW PRODUCTS

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EXECUTIVE SUMMARY

This study examines the role of a product's technology and market newness, R&D/marketing intercooperation, organizational networking, top management support and project execution in the success of new product development, and whether the product's technology and market newness influence the success of the innovation indirectly. As part of the study a model for testing the technology success over commercial success and a contingency model for testing the effects of technology and market newness on the organizational predictor variables were introduced. The goal of the study is to observe which factors lead to product development success and to determine the influence of product newness on these factors. Implications for management are provided in the conclusion.

Although new product introductions are crucial to a firm's success as they create a competitive portfolio and establish long-term and sustainable competitive advantage for the firm, new product development can be a very costly and risky undertaking for a firm. The ability to commercialize technology, to move a product from concept to market quickly and efficiently, is crucial and among the most important challenges managers are facing today. Several decades of research on the management of technology and innovation have created many insights into the new product development process, but unfortunately no clear-cut framework has been developed to consistently succeed in new product development. Furthermore, some new product developers are more successful than others when it comes to new product introductions. This realization drove the research question for this study:

Research Question: Why are some new product development projects more successful than others?

The new product development projects studied in this research took place in a single firm, in the computer and peripherals industry. Data were gathered from 30 new product development projects, from divisions located in several geographical areas of the United States. The study results showed that the product's market newness, top management support and project execution had a direct influence on the innovation's success, while technology newness indirectly influenced the predictive variables.

The major insight yielded by this study is that the new product development success factors studied in this research are contingent upon the technology newness of the product. Strong contingency effect was found for technology newness vs. social networking and interaction components of the study (R&D/marketing intercooperation and organizational networking), indicating that the organizations should alter their social interaction processes based on the technology newness of the product in development. The findings suggest that social networking is more positively associated with development success when dealing with newer technologies. Interestingly, the relationship between success and social networking was negative for projects dealing with familiar technologies.

Implications for the management are clear. Management should recognize the influence of top management support and project execution in getting products to commercialization; yet they should also realize that this does not guarantee success. Regardless, the management should encourage as well as require quality project execution proficiency from their development teams. The management also needs to recognize the innovation characteristics and adjust the organizational processes accordingly, especially for technology 'newness'. The qualitative data also indicated that the business requirements and financial expectations need to be re-adjusted to foster new product development.

INTRODUCTION AND RESEARCH OBJECTIVE

New product introductions are crucial to a firm's success; they create a competitive portfolio and establish long-term and sustainable competitive advantage of the firm. For market leaders, new products are the vehicles through which new markets are created and old ones revolutionized. For market followers, new products provide an opportunity to set new standards in cost and quality and to make minor enhancements which may later result in considerable competitive advantage (Maidique and Zirger 1984). Yet, winning in the new product commercialization is like a poker game; some new product developers are more successful than others when it comes to new product introductions.

The ability to commercialize technology, to move a product from concept to market quickly and efficiently, is crucial and among the most important challenges managers are facing today. This increased emphasis on new product innovation has resulted in a number of studies that are directed at understanding the drivers of new product success. Several decades of research about the management of technology and innovation have created many insights into the new product development process, but unfortunately no clear cut framework has been developed to consistently succeed in new product development. Tidd (2001) also discusses the lack of a comprehensive framework to guide the innovation process. He argues that although numerous studies on the topic of management of technology and innovation have created many insights into the innovation process, the diversity of the research, along with the failure to create a consistent measure of "success" and "new product" made it difficult to translate the research into management prescription.

In addition to examining these studies, the author has also been involved with various new product development attempts; some resulting in successes, others in cancellations at various points in the product development lifecycle. Experiences have shown the importance and influence of technology challenges, market newness, management support, the organizations' ability to bridge its competency gaps and various other organizational factors on the successful development of the new products. In summary, these experiences and questions around the new product development process and activities drove the research question for this study:

Research Question: Why are some new product development projects more successful than others?

This research study focus is on understanding the factors that lead to successful development of new products in multi-divisional firms, as divisional-specific characteristics are likely to undermine the notion of universal formula for successful innovation. Another aspect of this study is to investigate both commercial and technology success factors as indicators of development success. Technology success is also important to build future innovation base at the firm. This research further investigates the impact of 'product newness' to development success. 'Newness' is further divided into market and technology newness to understand potential relationships with product development success factors.

The objective of this study is to answer this question by developing a model, identifying testable propositions that would predict the relationship between new product development activities and its success, and testing these propositions. The new product development projects studied in this research took place in a single-firm within the computer and peripherals industry, with projects varied from various divisions located in wide geographical areas in the United States. A literature review is conducted to understand the current thinking on the subject, thereby developing the model and propositions.

LITERATURE REVIEW

The relevant literature is summarized in this chapter as it pertains to the research topic explored here – factors that lead to successful development of new products. Note that the goal of this research is to further the previous studies by adding the author's own experiences and insights gained from working in various new product development projects, and then creating a model to test the factors that lead to success development of new products.

NEW PRODUCT DEVELOPMENT – BENEFITS AND CHALLENGES

Cooper (2001) has outlined the importance of new product development quite well. He points to research that shows on average new products account for 33% of company sales; that is one-third of corporations' revenues are coming from products they did not sell five years ago. He also shows that the new products on average are very profitable: average Return on Investment (ROI) for successful new products is 96.9% with an average payback period of 2.49 years. In summary, new products are critical to firms' long-term success as they create competitive product portfolio and establish a sustainable competitive advantage. However, new product development is not without its challenges.

The literature review points to different success and failure rates for new product development (Cooper 2001, Freeman *et al.* 1974, Maiduque and Zirger 1984, Cooper and Kleinschmidt 1990). In a study of 122 industrial product firms, an average success rate of fully developed products was found to be 67%; however the success rate in different firms also varied from a low of 0% to a high of 100% (Cooper 2001). A study from Product Development and Management Association (PDMA) claims that new products currently have a success rate of only 59% at launch (Cooper 2001). Why are there such high failure rates for new product development?

The literature review sites various reasons for new product failures. The most frequently cited factor is the lack of understanding the real needs in the marketplace and identifying the customer requirements through market surveys (Cooper 2001, Rangan and Bartus 1995, Leonard-Barton and Wilson 1994, Shenhar *et al.* 2002, Henard and Szymanski 2001). One study of 203 new product projects revealed that 78% of the total effort was spent on technological and/or production activities, whereas only 16% is devoted to marketing activities, with a large focus on product launch (Cooper 2001). Unfortunately, devoting so little effort early on in the project delays testing the market, understanding the customer needs and determining the competitor responses, potentially resulting in the invalidation of earlier assumptions. This combined with likelihood of poor execution of the new project by skipping key activities (such as market research study, trial sell) increases the failure potential of the new product.

The difficulty of bringing new products to market in established organizations is has been discussed by many (Drucker 1985, Cooper 2001, Jolly 1997, Christensen 1997). Challenges include issues relating to the lack of management skills for new product development, the lack of processes within the organization to nurture the vagueness of new product concepts, and the organization's inability to network and bridge its competency gaps to bring the new product to market. In many cases the team turns to starting a "skunk works" effort to overcome the organization's bureaucracy to bring the product to market. The established organization could also have concerns for cannibalizing the existing businesses, as such would not make the needed resource investment into the new product development, resulting in its failure. Drucker (1985, pg 174) emphasizes this point greatly, "The most important caveat is not to mix managerial units and entrepreneurial ones… Do not make innovation an objective for people charged with running, exploiting, optimizing what already exists."

In product innovation it is also important to make the distinction between mature markets and immature markets. In mature markets the focus is on process innovation, making existing things better; while immature markets the focus is on product innovation, coming up with new things. John Chambers, CEO and President of Cisco, extends on the difference between the mature and immature markets: "…immature markets …[networked innovation] includes partnering, acquisitions and internal and external investments as the goal is to be best in class at various levels and to create an 'ecosystem' of partners" (Loudon 2001). As such, it is important to build these networks to enable the organization to bridge its competency gaps, enabling the innovation to get to market faster, such as by leveraging a partner's channel instead of building the competency internally. Successful innovation requires a high-degree of focus on reducing or eliminating risk at every step of the way. This requires networking; ability to partner both inside and outside of the firm; to create an 'ecosystem' of partners; yet networking for established organizations can be unnatural. Outside the firm, strategic partnerships facilitate the rapid development of product, as they force concurrent rather than sequential activities in the development cycle. A partner could provide the missing technology pieces or market-know-how in a time frame that allows the firm to be competitive, enabling technology and business development to proceed in parallel.

The literature also showed that a firm's ongoing success depends on its ability to recognize and nurture the technologies necessary for the continual refinement and extension of its product families. This is referred to as core competencies and capabilities, which describe a set of differentiated skills, complementary assets, and routines that provide the basis for a firm's competitive capacities and sustainable advantage in a particular business (Leonard-Barton 1992.)

CLASSIC NEW PRODUCT DEVELOPMENT STUDIES

Early new product development research mainly consisted of exploratory case studies from Morison (1966), Sorenson (1971), Baruch and Barbour (1971, 1972). These studies have provided a rich source of hypotheses for larger samples and structured surveys. Booz-Allen & Hamilton, Maidique, Myers and Marquis are known for large studies of innovations in various industries. Notable studies for new product development includes Project SAPPHO, performed in the UK in the early seventies (Rothwell *et al.* 1974), NewProd project, executed in Canada in the early eighties (Cooper 1983), the Stanford innovation study (Maidique and Zirger 1984), and the studies of Cooper and Kleinschmidt (1987).

Rothwell *et al.* (1974) conducted the SAPPHO study in the United Kingdom that compared/contrasted successful and unsuccessful innovations. Using the paired comparison methodology (successful innovation is compared with an unsuccessful innovation and any difference between the two noted), the SAPPHO group studied 29 pairs of innovations in the instruments and chemicals industries and compared them along 122 different dimensions. The SAPPHO phase I results were grouped into five general areas that discriminate between failure and success, which were further categorized by the team into "market factors" and "organizational variables". Market factors are: understanding of user needs, attention to marketing and publicity and efficiency of development. Organizational variables are: effective use of outside technology and external scientific communication and seniority and authority of responsible managers. Phase II of the project confirmed the findings from phase I, which extended to include a new total of 43 pairs in chemical processes and scientific instruments. The phase II study also identified new factors: good communications and existence of communications network, relative size, efficiency and strength of R&D efforts, 'key individual' as a 'product champion' within the organization (especially when s/he is business innovator or the technical innovator, or both), attention to market explanation and importance of need satisfaction (Rothwell *et al* 1974.)

The project NewProd followed SAPPHO, which was an exploratory study into success vs. failures in 102 companies and 195 new product case histories. The overall results were divided into three general areas: having a unique or superior product in the eyes of the customer, having marketing knowledge and proficiency, and having technical and production synergy and proficiency (Cooper 2001). Cooper and Kleinschmidt (1986) conducted the phase II of the NewProd study with a focus on the new product process. NewProd phase II study included 123 firms and 252 new product case histories. The results of the study highlighted the importance of the completeness of new product process and how these activities were strongly linked to project outcomes. This is further discussed in the section Project Management Execution.

Madique and Zirger (1982) conducted the Stanford Innovation Project. The study was divided into three parts which was conducted serially to provide progressive hypotheses refinement and validation. First part of the study was an open-ended survey, which was administered to 120 participants of the Stanford-AEA Executive Institute. The second part of the study was a detailed questioner consisting of 60 questions. The third phase consisted of in-depth case studies of 20 companies that collaborated in both surveys. The highlights of their findings included the importance of the in-depth understanding of the customers and marketplace to introduce a product with high performance-to-cost ratio; importance of marketing and committing significant amount of resources to selling and promoting the product; importance of planning and execution of the R&D process; well interfaced and coordinated functions from creation to marketing; importance of time-to-market; importance of project's synergy and alignment with the business unit's strengths; and lastly the high-level management support from development to launch (Maidique and Zirger 1984.)

The comparison of the SAPPHO, NewProd and the Stanford Innovation Project shows agreement regarding the importance of having a good understanding of the marketplace as essential for new product success. At the project level, execution and players involved also influence the project's success, along with the organization's management support, needed synergy and alignment with existing competencies and organization's ability to network. The studies also showed that considerable effort and skill must be employed in order to effectively communicate the characteristics of the new product offering to the marketplace as a consistent theme.

FACTORS INFLUENCING NEW PRODUCT DEVELOPMENT SUCCESS

The SAPPHO, NewProd and Stanford Innovation Project became the foundation for additional studies that are directed at understanding the drivers of new product success; Booz Allen Hamilton, Rothwell, Cooper and Kleinschmidt are some of the researchers that have made tremendous contributions in this area. Each one of these studies brings insights into new product development success factors; overall common themes that have emerged from these studies are: product advantage, market knowledge, clear product definition, project organization and networking, proficiency of execution, top management support, project synergies and financial measures (Cooper 2001, Cooper and Kleinschmidt 1990, Damanpour 1991, Leonard-Barton and Wilson 1994, Maidique and Zirger 1984.)

Given this breadth of new product development studies, the focus of this research was shifted to understand the factors that lead to successful development of new products from the division's perspective. With this, key organizational factors that emerged from the literature review along with author's new development product experience within her own firm became the foundation for further investigation on understanding the new product development success factors: the degree of product newness, R&D/Marketing intercooperation, organization's ability to network, top management support, and project management execution. The literature findings in these areas are discussed in detailed below.

PRODUCT MARKET AND PRODUCT TECHNOLOGY NEWNESS

As indicated before, the literature review points to different success and failure rates for new product development. In many ways, these differences in studies can be attributed to how one defines "new product"; however, the literature review did not point to any single, commonly accepted framework. On the other hand, the literature review revealed that the degree and type of new product innovation does affect its success (Cooper 2001, Tidd 2001, Gobeli and Brown 1987, Shenhar *et al.* 2002).

Gobeli and Brown (1987) propose a framework that examines the different categories of innovation and understanding the associated benefits and failure rates. They have classified new products into categories by measuring how new a product is to the buyers and the producers in the industry; see Figure 1. From the buyers' view, product innovation is an indication of the perceived benefits; from the producers' view, product innovation is an indication of the perceived newness of the technology embodied in the product. Gobeli and Brown (1987) provide this product innovation matrix as a framework to be used between the R&D and marketing managers. They indicate that the incremental innovations (1) would mainly be targeted for protecting market share. In return, technical innovations (2) tend to represent a "technology-push" approach with no "market-pull", as such tends to result in low returns. In contrast, they discuss the application innovations (3) and that they tend to be more "market-pull" with little technology innovation. They emphasize that since this type of innovation requires effort in identifying opportunities and developing new delivery systems, it would likely to occur in organizations where good R&D and marketing relationships have been established. They also highlight that radical innovations (4), while most likely to lead to the greatest increase in market growth and sales, are also expensive to develop both from R&D and marketing perspectives. Radical innovations combine "technology-push" with "market-pull." Christensen (1997) also distinguishes between sustaining innovation and disruptive or radical innovation. He further makes the point that established firms tend to be challenged on exploiting the potential of disruptive or radical innovation, which is more likely to be exploited by new entrants.

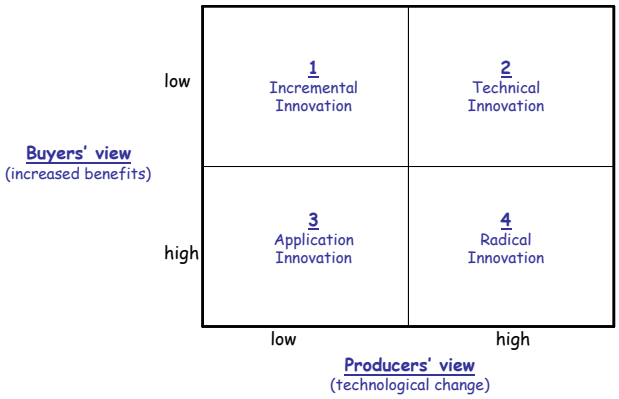


Figure 1 - Product innovation matrix; Gebeli and Brown (1987)

Booz Allen Hamilton (Cooper 2001) have taken a different approach and created a 'newness' framework based on the product's newness to the market and newness to the company; thereby grouping projects into six distinct categories: improvements to existing products, new-product lines, additions to existing product lines, new to the world products, cost reductions, and repositioning. Cooper (2001) concludes that the success rates and new product performance depends on the product type and newness of the product; his studies uses the Booz Allen Hamilton framework to identify product 'newness.'

The literature review also highlights the importance of leverage and synergy with the division's competency during the new product development process (Cooper 2001, Leonard-Barton 1992). Studies have shown that ability to leverage existing and in-house strengths, competencies, resources and capabilities increases the probability of success of the new product project. Cooper (2001) has identified two types of leverage that are important to new product innovation: technological leverage and marketing leverage. Technological leverage is the project's ability to build on in-house technologies, utilize existing engineering skills. Marketing leverage is the project's fit with the division/firm in terms of existing customer base, sales force, distribution channels, market-intelligence skills, knowledge and resources. This further supports the need to study the new product project newness from both technology and marketing 'newness' perspectives.

Literature research points to various other innovation related factors that affect the management of innovation and its success. These are mainly the type of innovation, scope of the innovation, uncertainty surrounding the technologies and markets and their interdependencies, complexity of technologies involved, organizations' ability to leverage existing market and technology competencies, and the ability to build partnerships to reduce the risk and cost associated with introducing new technologies and/or entering new markets (Damanpour 1991, Tidd 2000, Cooper 2001, Nevens *et. al.* 1990, Tidd 2001, Calantone 1993). Overall these can be categorized into factors relating to market newness and technology newness.

From all the literature review on the topic of 'newness', Tidd and Bodley's (2002) comments ring true to the author. They point out the fact that new product categorization is subjected to different interpretations and experiences of the firm, and that how close a project to the existing skills and past experiences is particularly important to the managers. This highlights the fact that the organization-specific characteristics and experiences very likely affect the management of innovation and its success. As such, it can be concluded that the success of the new product development is depended on the product's market newness and technology newness from the perspective of the division that is developing the new product.

> **Proposition 1:** *The degree of the market newness of the product from a division's perspective directly relates to its development (commercial and technology) success; i.e. negative correlation exists: the higher the degree of the market newness less likelihood of development success.*
>
> **Proposition 2***: The degree of the technology newness of the product from a division's perspective directly relates to its development (commercial and technology) success; i.e. negative correlation exists: the higher the degree of the technology newness less likelihood of development success.*

A study done by Shenhar (*et al.* 2002) discusses the importance of managing projects differently for high-technology uncertainty vs. low-technology uncertainty. The study used a project-specific typological approach with multidimensional criteria for assessing project success and a multivariate statistical analysis method. The study had 127 projects, and the typology projects were classified according to their technological uncertainty at project initiation. They concluded that the technological uncertainty is a dominant dimension influencing the managerial variables, suggesting that high-uncertainty projects must be managed differently than low-uncertainty projects.

This study draws upon the conclusions of Shenhar (*et al.* 2002) regarding the need to manage projects differently based on their technological uncertainty. Also considered are the comments of Tidd and Bodley (2002) about existing skills and past experiences being very likely to influence the management of innovation and its success. With that, it is the author's conclusion that the 'newness' amplifies the demands on the organizational predictor variables relating to development success, and further the contingency effect of the technology 'newness' and the market 'newness' should be tested on all propositions. As such, propositions A and B have been created for each organizational predictor variable to test the contingency effects of 'newness' on the given variable.

R&D/MARKETING INTERCOOPERATION

Successful new product development requires firms to link their technical capabilities to products or services which customers want; that the new product does indeed meet customer needs and requirements at introduction. This requires seeking the customers input and feedback, as well as understanding the market needs and determining competitive positioning of the product. The resulting factors would then be prioritized with the new product development team who at a minimum consists of individuals from both R&D and marketing.

Competence in the area of marketing is frequently cited as being a key determinant impacting the success or failure of the new product development (Cooper 2001, Cooper and Kleinschmidt 1986, Rothwell *et al.* 1974.) As such, it can be concluded that adequate coordination between the marketing and R&D functional areas is a key success factor in new product development. Moenaert *et al* (1994) have also showed that the information R&D receives from marketing was found to correlate significantly with project success. Their workgroup sessions also suggested that R&D depends very much on inputs from the commercial side of the organization to accomplish adequate progress.

Literature review also showed that customer sophistication significantly increases the need for the R&D/marketing intercooperation. In summary, when customers become more sophisticated and demanding, firms are prompted to intensify their efforts to integrate marketing and R&D activities (Li 1999). As such, it can be concluded that the success of the new product development is depended on the degree of R&D/Marketing intercooperation; this intercooperation is further influenced by the product's market newness and technology newness from the perspective of the division that is developing the new product.

> **Proposition 3:** *R&D and marketing interrelation/intercooperation positively impacts the development (commercial and technology) success; i.e. projects with good R&D/Marketing intercooperation will result in development success.*
>
> > **Proposition 3a:** *R&D and marketing intercooperation is more important for products with higher degree of market newness.*
> >
> > **Proposition 3b:** *R&D and marketing intercooperation is more important for products with higher degree of technology newness.*

ORGANIZATIONAL NETWORKING

Innovation process is a set of activities that requires communication and coordination across different functional areas with both internal and external partners. Given that the problem solving (both in terms of technology and marketing) is an integral part of the process of innovation, communication and information processing must be treated as core to the new product development process. Various studies have been done to understand the frequency and reach of the organizations' communication and networking skills on the new products success.

Freeman *et al.* (1974) research showed that successful firms generally had better communications networks (internally and externally), and had greater coupling with the outside scientific and technological community, and demonstrated a more efficient use of outside technology where appropriate. Their research indicated that the geographical separation per se was not necessarily a barrier to success, but failure to communicate satisfactorily between the separate organizational units was the hallmark of failure.

Ebadi and Utterback (1984) also have shown that frequency of communication of the principal investigator did have a positive correlation with project success. Their finding was also consistent with earlier research with Allen (1970), Katz and Tushman (1979), Myers and Marquis (1969), and

others. Based on this finding, they concluded that the frequency of communication affects project success not only when a single organization is considered, but also when researchers are from different organizations, in different geographical locations. Based on their research, Ebadi and Utterback (1984) recommend that management should make attempts to create an environment conducive to the exchange of information among researchers and organizations. As such, it can be concluded that the success of the new product development is depended on the degree of organizational networking; this networking is further influenced by the product's market newness and technology newness from the perspective of the division that is developing the new product.

> **Proposition 4**: *Organizational networking (division & project teams' ability to network) positively impacts the development (commercial and technology) success; i.e. projects with strong organizational networking will result in development success.*
>
> > **Proposition 4a:** *Organization's ability to network is more important for products with higher degree of market newness.*
> >
> > **Proposition 4b:** *Organization's ability to network is more important for products with higher degree of technology newness.*

TOP MANAGEMENT SUPPORT

Management must be able to create an atmosphere of trust, coordination and control from concept through to launch. Literature shows that top management support is a necessary ingredient in the innovation process.

Maidique and Zirger (1984) indicate that management support is essential to overcome the internal obstacles that arise when significant change is necessary to accommodate a new product, especially for incremental and significant innovations. Management support's importance was highlighted especially by the functional managers as a mechanism of obtaining resources for new product development projects.

The Stanford Innovation Project and Hewlett-Packard study found top management support to be directly linked to the new product success (Cooper 2001). The NewProd study highlighted that top management support is critical getting the product to market: to acquire resources, to cut through red tape and push the right buttons to get the project done (Cooper 2001). As such, it can be concluded that the success of the new product development is depended on the degree of top management support; this support is further influenced by the product's market newness and technology newness from the perspective of the division that is developing the new product.

> **Proposition 5:** *Top management support positively impacts the development (commercial and technology) success; i.e. projects with strong top management support will result in development success.*
>
> > **Proposition 5a:** *Top management support is more important for products with higher degree of market newness.*
> >
> > **Proposition 5b**: *Top management support is more important for products with higher degree of technology newness.*

PROJECT MANAGEMENT EXECUTION

The comparison of the SAPPHO, NewProd and Stanford Innovation Project has highlighted the importance of project execution, as it strongly influences the project's success. In summary, research findings indicate that success is not just a matter of technology, market, or product, but also how well the project is undertaken and its quality of execution.

Cooper and Kleinsschmidt (1986) conducted the NewProd phase II study in Canada with a focus on project management activities, and execution for new products. They divided the project activities into thirteen distinctly separate activities: initial screening, preliminary market assessment, preliminary technical assessment, detailed market study/market research, business/financial analysis, product development, in-house product testing, customer tests of product, test market/trial sell, trial production, pre-commercialization business analysis, production start-up and market launch. The results of the study showed that the completeness of new product process and how proficiently these activities were undertaken are strongly linked to project outcomes. They also showed that more successful projects (based on overall success rating and payback period) featured a more complete process.

Although they weren't able to show a causal relationship between project outcomes (success and failure) and performing certain activities well, their results highlighted initial screening, preliminary market assessment, detailed market study/market research, business/financial analysis, product development, in-house testing and market launch as key activities. They also showed that three of the activities were strongly related to project outcomes: initial screening, preliminary technical assessment and product development.

Based on their study, they recommend: 1) to establish a new product process model to ensure the activities that should or must be undertaken as the new product moves from idea to launch. This would ensure that any omission of steps that would be made will be a conscious decision; 2) discipline is needed to ensure the new product process model is followed; 3) that management must provide the necessary time, effort and resources for the new product process activities; 4) to pay special attention to market studies, initial screening and preliminary market assessment, as these were particularly weak activities that had strong association with success. As such, it can be concluded that the success of the new product development is depended on the quality of the project execution; this support is further influenced by the product's market newness and technology newness from the perspective of the division that is developing the new product.

Proposition 6: *Project management and execution positively impacts the development (commercial and technology) success; i.e. products with higher quality of project execution will result in development success.*

Proposition 6a: *Project management and execution is more important for products with higher degree of market newness.*

Proposition 6b: *Project management and execution is more important for products with higher degree of technology newness.*

KEY DEFINITIONS: NEWNESS AND SUCCESS

NEWNESS

The literature review and the author's own experience emphasized the importance of organizational-specific characteristics and experience in achieving success for the new product development. As noted by Tidd and Bodley (2002), determining product 'newness' is subjected to different interpretations and experiences of the firm, and that how close a project to the existing skills and past experiences is particularly important to the managers.

In addition, the literature review highlighted the importance of leverage and synergy with the division's competencies, and that the ability to leverage existing and in-house strengths, competencies, resources and capabilities increases the probability of success of the new product project. This is further categorized into technological leverage and marketing leverage by Cooper (2001), as discussed previously. As such, the author concluded to study the new product project

newness by categorizing it into the marketing 'newness' and the technology 'newness' from the perspective of the division that is developing the new product.

DEFINING NEW PRODUCT SUCCESS

The first step in investigating the interdependence between the new product development variables and project success is to define 'success'. The literature search has shown that there is no standard framework that defines new product success, and that more importantly it is multifaceted and difficult to measure. Research shows that variables that are used to measure project success include consumer-based, financial, and technical success measures (Griffin and Page 1996).

Creating a definition for 'success' is further complicated by the fact that projects that have been released to market at different times will have different success results for profitability and market share. This further complicates the ability to gather any financial results. Also some products are for sale while others are freely given away, making it difficult to create a common framework to measure financial success. In addition to commercial success, it is also important to measure the technical success of the given innovation. Even though the product may never make it to the market, the learnings from the technology development could enable success of the follow on products. In summary, the use of general objectives attainment measure was necessary because sample included projects at various stages of completion. Although obtaining new products' financial return data were desired, they were mostly not attainable.

Based on these factors, the author has defined success from three perspectives: 1) whether the project was commercialized; 2) perceived degree to which the project's commercial objectives (profit and market share) had been attained to date; 3) regardless of the commercial success, perceived degree to which the project's technology development has been successful based on the learnings gathered.

SUMMARY OF PROPOSITIONS

Research propositions are captured in Figure 2. The effect of each of the propositions on development outcomes (commercial and technology success) of the new product innovation is tested, as well as the relationship of marketing and technology newness on the innovation's outcome.

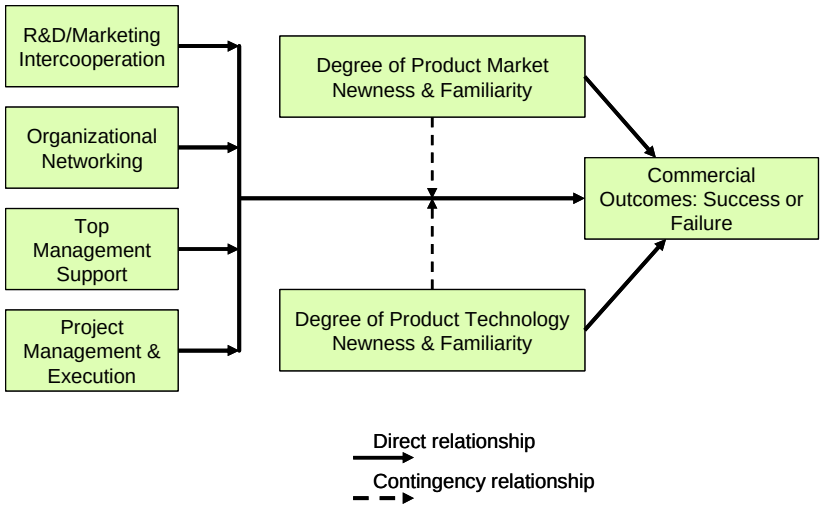


Figure 2 - Research Propositions

P1	**Higher degree of product market newness**	→	**Less likelihood of development success**

Proposition 1: *The degree of the market newness of the product from a division's perspective directly relates to its development (commercial and technology) success; i.e. negative correlation exists: the higher the degree of the market newness less likelihood of development success.*

Degree of market newness indicates the division's familiarity with the given market; its ability to determine the customer needs, educate the customer on the value of the innovation, and the ability to leverage existing marketing resources. The higher degree of product market newness will challenge the organization's ability to successfully develop the new product.

P2	**Higher degree of product technology newness**	→	**Less likelihood of development success**

Proposition 2: *The degree of the technology newness of the product from a division's perspective directly relates to its development (commercial and technology) success; i.e. negative correlation exists: the higher the degree of the technology newness less likelihood of development success.*

Degree of technology newness indicates the division's familiarity and experience with the given technology, as well as the ability to leverage its existing engineering skills. The higher degree of product technology newness will challenge the organization's ability to successfully develop the new product.

P3	More R&D and marketing intercooperation	→	Higher likelihood of development success

Proposition 3: *R&D and marketing interrelation/intercooperation positively impacts the development (commercial and technology) success; i.e. projects with good R&D/Marketing intercooperation will result in development success.*

Successful new product development requires firms to link their technical capabilities with products or services which customers want; to ensure that the new product does indeed meet customer needs and requirements at introduction. This requires seeking the customer input and feedback, as well as understanding the market needs and determining competitive positioning of the product. As such, the new product project teams with higher degree of R&D/marketing intercooperation will have higher likelihood of commercial success. The relationship between the product's market and technology newness to R&D/marketing intercooperation is tested with Proposition 3a and Proposition 3b.

P3-a	Higher degree of product market newness	→	More need R&D/marketing intercooperation

P3-a: *R&D and marketing intercooperation is more important for products with higher degree of market newness.*

P3-b	Higher degree of product technology newness	→	More need for R&D/marketing intercooperation

P3-b: *R&D and marketing intercooperation is more important for products with higher degree of technology newness.*

P4	More organizational networking	→	Higher likelihood of development success

Proposition 4: *Organizational networking (division & project teams' ability to network) positively impacts the development (commercial and technology) success; i.e. projects with strong organizational networking will result in development success.*

Innovation process is a set of activities that requires communication and coordination across different functional areas with both internal and external partners. As such, organizations with good networking abilities will have higher likelihood of success. The relationship between the product's market and technology newness to organizational networking is tested with Proposition 4a and Proposition 4b.

P4-a	Higher degree of product market newness	→	More need for organizational networking

P4-a: *Organization's ability to network is more important for products with higher degree of market newness.*

P4-b	Higher degree of product technology newness	→	More need for organizational networking

P4-b: *Organization's ability to network is more important for products with higher degree of technology newness.*

P5	**More top management support**	→	**Higher likelihood of development success**

Proposition 5: *Top management support positively impacts the development (commercial and technology) success; i.e. projects with strong top management support will result in development success.*

Top management support is critical getting the product to market: to acquire resources, to cut through red tape and push the right buttons to get the project done. As such new product projects with higher top management support will have higher likelihood of success. The relationship between the product's market and technology newness to top management support is tested with Proposition 5a and Proposition 5b.

P5-a	**Higher degree of product market newness**	→	**More need for top management support**

P5-a: *Top management support is more important for products with higher degree of market newness.*

P5-b	**Higher degree of product technology newness**	→	**More need for top management support**

P5-b: *Top management support is more important for products with higher degree of technology newness.*

P6	**Higher quality of project execution**	→	**Higher likelihood of development success**

Proposition 6: *Project management and execution positively impacts the development (commercial and technology) success; i.e. products with higher quality of project execution will result in development success.*

Projects with better execution will result in higher likelihood of commercial success. The relationship between the product's market and technology newness to project execution is tested with Proposition 6a and Proposition 6b.

P6-a	**Higher degree of product market newness**	→	**More need for better project execution**

P6-a: *Project management and execution is more important for products with higher degree of market newness.*

P6-b	**Higher degree of product technology newness**	→	**More need for better project execution**

P6-b: *Project management and execution is more important for products with higher degree of technology newness.*

METHODOLOGY

SAMPLE

The new product development projects studied in this research took place in a single-firm, within the computers and peripherals industry. The projects were located in various divisions throughout the United States. Most projects came from a single location; however, collected from various divisions in that single location.

The study is based on a survey of 30 projects. Some of the projects have been fully commercialized or released as a pilot study to a narrower market segment. Others were cancelled somewhere in the development lifecycle. The questionnaire was developed from the relevant literatures on product development, marketing and technology management. Aside from obtaining qualitative information on each project, a number of quantitative variables were measured.

SURVEY PROCESS

A prototype survey instrument was distributed to two individuals to test the clarity of questions and responses. After reviewing the results of the prototype surveys, revisions were made and the interviews were started at the end of April and finished mid-June of 2002. The survey was used during in-person or via-the-phone interviews to direct the responses and capture the key points and learnings relating to each project's success or failure.

The questionnaire was addressed to mainly R&D Project Managers or individuals who had in-depth involvement with the product that was surveyed. The survey was also followed with a short discussion on why the new product development was successful, or what led to problems. The interviews lasted approximately 30-45 minutes per project.

As each completed survey was received, its data was loaded into a spreadsheet for analysis and charting. Each question was assigned a numerical value representing the choice marked. The scoring of each response is discussed further below. The student version of SPSS was used for data analysis.

INSTRUMENT

The survey was constructed to gather data on the project success influences. Answers to most items were measured on five-point Likert scales. A blank copy of the survey can be found in Appendix A.

The questionnaire consisted of nine parts: personal information, project background information, establishing project newness, establishing project success, assessing R&D and marketing intercooperation, assessing the team's and division's ability to network, determining top management support, assessing project management execution and general comments on the success or failure of the project. The survey asked more questions than were needed to assess the propositions. Some extra questions were used to confirm or qualify other answers.

MEASURES

The survey answers enabled measurement of many variables. Table 1 is a summary of the definition and construction of each variable needed to evaluate the research propositions. The reliability coefficients are also captured in Table 2. Most of the items were assessed on a 1-to-5 scale, where 1 was "strongly disagree" and 5 was "strongly agree."

Project success. This is a single item dichotomous value indicating whether the project was commercialized or not. The projects that were commercialized as a pilot study were also captured as commercialized.

Commercial success. This is a two-item scale testing the product's overall project profitability and achieved market-share based on the perceived degree to which the project objectives have been obtained to date. (α = .97).

Technology success. This is a single item value determining the innovation's success based on the learnings gather from the development process.

Market newness. This is a four-item scale determining the project's market newness from the division's perspective. 'Newness' questions were based on Cooper and Kleinschmidt (1990). Example items included "Product created a new product category for the division", and "Product created a new market for the division." (α = .77).

Technology newness. This is a three-item scale determining the project's technology newness from the division's perspective. 'Newness' questions were based on Cooper and Kleinschmidt (1990). Example items included "How would you rate the level of technology experience for this product from the division's perspective", and "Product required new engineering skills." (α = .75).

R&D/market intercooperation. This is a four-item scale determining the R&D and marketing team intercooperation. Questions were based on Moenaert *et al.* (1994). Example items included "During this project, marketing and R&D regularly communicated for new product development", and "Project team was regularly informed about what the competition was doing." (α = .86).

Organizational networking. This is a nine-item scale determining the organization's ability to network in terms of technology and market. Questions were based on Ireland *et.al.* (2001) and Freeman *et. al.* (1974). Example items included "How frequently did team members contact others within the division with technical questions", "How frequently did team members contact others in other divisions with market related questions", and "Team was good at coordinating work with other teams doing related work." (α = .72).

Top management support. This is a five-item scale determining the top management support for the project. Questions were based on Maidique and Zirger (1984). Example items included "Team had division's total support" and "Senior management had a central role in project review process and investment decisions." (α = .76).

Project execution. This is a thirteen-item scale determining how well the project management activities were performed. Questions were based on Cooper and Kleinschmidt (1986). Example items included "Initial screening", "Detailed market study/market research" and "In-house product testing." (α = .87).

SCALE DEVELOPMENT

Items were grouped based on their relationship and potential creation of scale variable. Scales were tested and created using reliability analysis. Definition of reliability is straight forwards: a measurement is reliable if it reflects mostly true score, relative to error. The alpha model was used to test internal consistency based on the average inter-item correlation (SPPS 1993). Internally consistent items were chosen by using the 'descriptives for: scale if item deleted' method and the best scale among the related group of items were built. Items that created a reliable scale are listed in Table 1 and coefficient alpha for the scales are also presented in Table 2.

SUMMARY OF MEASURES OF PROPOSITION VARIABLES

Table 1 - Measures of proposition variables

Variable	Description	Measurement Construction
Project Success	A measure of whether product was commercialized or not.	Single value of question #8. 0-project killed prior to market launch; 2-project was commercialized. Based on Cooper and Kleinschmidt (1986).
Project Stage	Determines the stage of the project: 1-Proposal; 2-Investigation; 3-Development; 4-Testing; 5-Launch; 6-Full commercialization;7-Discontinued	Determined using answers to questions 8, 8a and 8b. The stages were constructed using Cooper's stage-gate process (2001) as a reference.
Market newness	A measure used to determine the project's market newness from the division's perspective.	Single scale is created using questions 15b, 15c, 15d and 14. High newness is captured with higher numbers. Based on newness variables from Cooper & Kleinschmidt (1990). (α = .77).
Technology newness	A measure used to determine the project's technology newness from the division's perspective.	Single scale is created using questions 16a, 16b, 15d and 13. High newness is captured with higher numbers. Based on newness variables from Cooper & Kleinschmidt (1990). (α = .75).
Commercial Success	A measure used to determine the commercial success (profitability and market share) of the project. Measured in terms of the achieved degree of the actual market performances based on the original goals set by management.	Single scale is created using questions 17a and 17b. Higher number indicates more commercially successful project. (α = .97).
Technology Success	A measure used to determine the technology success of the project.	Single value of question #18a. Higher number indicates more successful technology innovation.
R&D/Market Intercooperation	A measure of R&D and marketing team relationship.	Single scale is created using questions 20a-20d. Higher number indicates stronger R&D/marketing relationship. Based on research from Moenaert *et al.* 1994. (α = .86).
Organizational Networking	A measure of organization's ability to network in terms of technology and market.	Single scale is created using questions 21a-i. Higher number indicates stronger organizational networking. Based on research from Ireland, *et. al.* (2001) and Freeman *et. al.* (1974). (α = .72).
Top Management Support	A measure of top management support for the project.	Single scale is created using questions 22a-e. Higher number indicates stronger top management support. Based on research from Maidique and Zirger (1984). (α = .76).
Project Execution	A measure of how well the project management activities were performed.	Single scale is created using questions 23a-m. The higher the number the better project execution. Based on research from Cooper & Kleinschmidt (1986). (α = .87).
Months since Initiation	An approximate measure used to determine time lapse in months since project was initiated.	Single value of question #9a. The duration is computed in months till July 2002.

ANALYSES

Propositions are tested using correlation analysis methods. Pearson (Table 2) and Spearman (Table 8). Correlations measure how variables are related. Pearson's correlation coefficient is a measure of linear association. Spearman measures the association between rank orders. It is the non-parametric counter part to the Pearson's correlation.

The correlation coefficient (r) is a measure for the level of linear association of these variables; r of +1.0 indicates a perfectly positive association while r of -1.0 indicates a perfectly negative association; r of 0.0 indicates there is no linear association between the two variables. This association between the variables can be visually observed by a scatter plot. Statistical significance of the association (p) is tested using the two-tailed test. A low p-value (≤ 0.05) means that there is a statistically significant relationship between two variables, there is evidence to reject the null hypothesis in favor of the alternative hypothesis. Note that p-value of 0.10 is also presented in this study due to the small sample data.

The scatter diagram, regression line, and coefficient of determination (R^2) have been calculated for the relationships that were supported. The R^2 –coefficient of determination value is the most common "goodness of fit" measurement. It can be interpreted as the *proportion of the total variation in the dependent variable explained by the independent variable* (Cooper and Schindler 2001).

MODERATOR VARIABLES

Moderator variables are implied whenever a model argues that a relationship between two variables is contingent on the value of a third variable. Tests of interaction of the two newness variables (market/technology) with the organization predictive variables were conducted by creating subgroups based on the newness measures. Projects were categorized into high or low market newness groups by dividing the sample based on the median score for the market newness variable. The same process was used to create high and low technology newness groups based on the technology newness variable. Then the regression slopes and regression coefficients predicting our criteria for different subgroups were examined. For the second step, exploring the specific propositions involved taking the dichotomized high/low 'newness' subgroups and plotting and analyzing the relationship between the predictor variable and development success.

The moderated multiple regression (MMR) strategy for identifying moderator variables involves the use of hierarchical ordinary least squares regression to determine if a suspected moderator variable interacts with another variable in predicting scores on a criterion (Stone 1988). As Cohen and Cohen (1975, pg. 302) stated: "Two variables … are said to interact in accounting for variance in Y when over and above their separate effects, they have a joint effect." This joint effect implies that both the nature and degree of relationship between the predictor and criterion depend on the value of the moderator. The linear regression method of SPSS was used to test the main effects and joint effect between the variables. In addition to the significance of the interaction term, it is also important to assess the change in R^2 resulting from inclusion of the interaction term. The overall significance of the regression equations was also assessed.

CONTROL VARIABLES

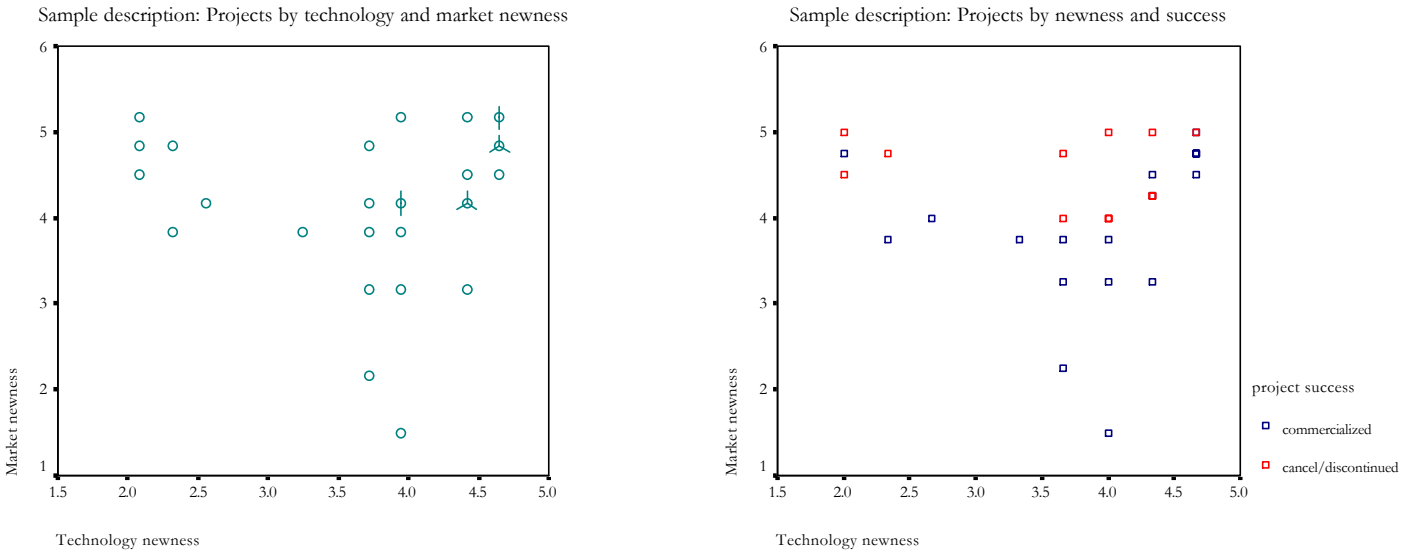
Control variables are variables that must be held constant, neutralized/balanced or eliminated so that they don't have biasing effect on the other variables. Perceived commercial and technology success could be related to the amount of time the product has been on the market. As such, partial correlation test was also run controlling for months since initiation (SPPS 1993). The results of the test were tabled (Table 9) and compared with Pearson's correlation findings to rule out the argument that time since initiation contaminated the study.

RESEARCH RESULTS, ANALYSIS AND DISCUSSION

SAMPLE DESCRIPTION

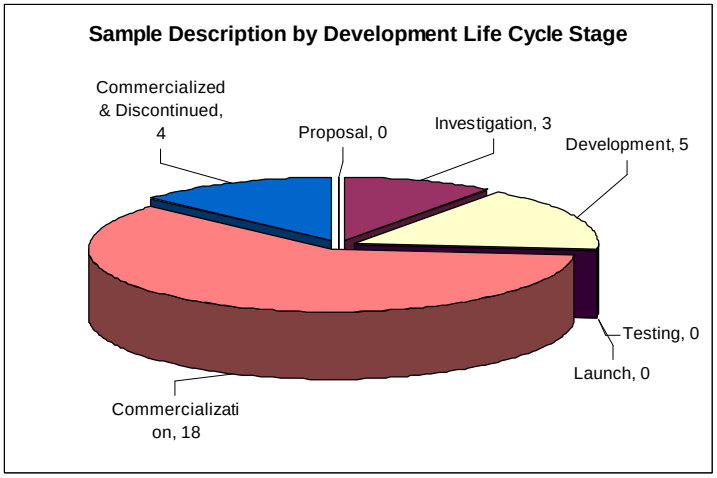
Overall thirty projects were surveyed from various divisions in the firm. Some of these projects were successfully commercialized and have been in the market longer, and others were killed at various stages in the development life cycle. Graph 1 on the left shows the sample description by project newness. As seen from the graph, there is a cluster of projects on the upper right corner indicating the high newness nature of the products surveyed. Note that the sunflower pedals represent the overlapping cases at the same location.

Graph 1 on the right highlights that there is a tendency for failure (project/product cancellations and discontinuations after commercialization) when the product 'newness' is higher. This provides some support of the propositions that 'newness' (technology and market) is negatively associated with development success.



Graph 1 - Sample description: Projects by newness and project success (commercialized yes/no)

Graph 2 shows the projects by their development life cycle stage; note that the sample does not contain projects that have been cancelled at proposal, testing or launch stage. Of the 30 projects studied, 18 made were commercialized, 4 were discontinued after commercialization due to being recognized as a failure, 3 were killed at the investigation stage, and 5 were killed at the development stage. This indicates a 60% successful commercialization rate, or 73% overall commercialization rate when including the projects that were discontinued after release. These figures are in the ballpark of previous reports that discussed the average success rate for new product development (Cooper 2001).



Graph 2 - Sample description: Projects by life cycle stage

PROPOSITION ANALYSIS

Means, standard deviations and bivariate correlations for all variables used to test hypotheses are presented in Table 2. Note, Table 8 captures the Spearman's correlation matrix. Results summary of the propositions are tabled in Table 7.

Proposition 1: *The degree of the market newness of the product directly relates to its commercial & technology success; i.e. negative correlation exists: the higher the degree of the market newness less likelihood of commercial & technology success.* → *Some support/influence*

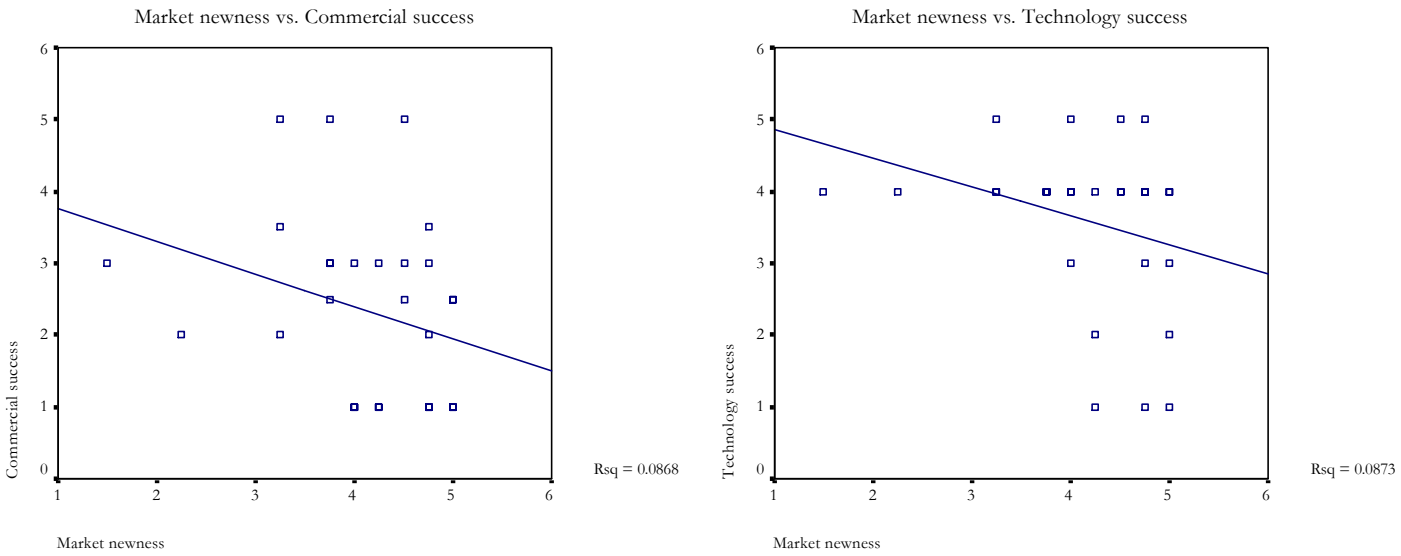
It was reasoned that the market newness would negatively impact the product's commercial and technology success. Pearson correlation (Table 2) shows hint of negative association with market newness vs. commercial and technology success ($r=\sim-.30$). The R^2s associated with these relationships (~.09) are not particularly large; however, they indicate that the market newness variable only accounts for about 9% of the variance in the success measures. These R^2s are a direct function of the correlations presented in Table 2 (the square root of .09 = .30). Although Pearson's correlation coefficient (Table 2) does not show any significant relationship and failed to reject the null hypothesis, rank order correlation test (Table 8) shows some indication of support: for commercial success $r=-.38$, $p\leq.05$ and for technology success $r=-.35$, $p\leq.10$. As such, it is concluded that some support exists that the market newness negatively influences commercial and technology success of the product.

The relationship between the products' market newness vs. commercial success and technology success is captured in Graph 3. The regression lines graphically show that the degree of market newness tends to be negatively associated with the commercial success and technology success.

Table 2 - Means, Standard Deviations, Correlations and Reliability Coefficients (Pearson Correlation Coefficient)

Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9	10
1.Success-dichotomous	.73	.45	- -									
2.Commercial Success	2.33	1.28	.64**	(.97)								
3.Technology Success	3.60	1.13	.60**	.57**	- -							
4.Market Newness	4.14	.83	-.22	-.29	-.30	(.77)						
5.Technology Newness	3.77	.87	-.05	.07	-.02	.01	(.75)					
6.R&D/Market Interrelationship	3.76	1.09	-.03	-.01	.18	.03	-.23	(.86)				
7.Organizational Networking	3.10	.64	.08	-.07	.06	.17	-.20	.52**	(.72)			
8.Top Management Support	3.91	.97	.56**	.35+	.42*	-.06	.25	.20	.23	(.76)		
9.Project Execution	3.41	.91	.62**	.33+	.30	.10	-.17	.35+	.42*	.62**	(.87)	
10. Months since Project Initiation	58.97	38.89	.31+	.47**	.35+	-.15	-.08	-.19	-.08	.06	.09	- -

n = 30
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
+ Correlation is significant at the 0.10 level (2-tailed).
( ) Reliability coefficient alpha.
- - Single item scale.



Graph 3 - Market newness vs. commercial & technology success

As seen from the graph, even with high degree of market newness projects can be very successful. The qualitative data on these projects shares the common theme: small, fully empowered teams that were given needed resources without any reevaluation or questioning; in summary these projects "flew under the radar". These projects were also viewed as "critical need" by multiple teams that were unable to deliver. The projects also identified the channel early on and built a large installed-base quickly by partnering and requiring the new product to be used and be very visible to the target customer base.

Proposition 2: *The degree of the technology newness of the product directly relates to its commercial & technology success; i.e. negative correlation exists: the higher the degree of the technology newness less likelihood of commercial & technology success.* → *Not Supported*

It was reasoned that the technology newness would negatively impact the product's commercial and technology success. Correlation coefficient tests (both Table 2 and Table 8) do not show any significant relationships between the newness of the technology and commercial as well as technology success. As such, it is concluded that this proposition is not supported.

Proposition 3: *Divisions with good R&D and marketing interrelation/intercooperation will have more likelihood of commercial & technology success.* → *Not supported*

It was reasoned that R&D and marketing intercooperation would positively impact the product's commercial and technology success. Correlation coefficient tests (both Table 2 and Table 8) do not show any significant relationships between the R&D and marketing interrelationship and commercial as well as technology success. As such, it is concluded that this proposition is not supported.

Propositions 3a and 3b are tested using multiple regression analysis; results are captured in Table 3.

Table 3 - Propositions 3a & b: Moderated Regression Analyses

	Market Newness				Technology Newness			
	Commercial Success		Technology Success		Commercial Success		Technology Success	
Independent Variables	Main Effects	With Interactn	Main Effects	With Interactn	Main Effects	With Interactn	Main Effects	With Interactn
R&D/Market Interrelationship	-.00		.19		-.01		.18	
Dichotomous Market Newness	-.14		-.15					
R&D/Market Interrelationship x Dichotomous Market Newness		.24		-.59				
Dichotomous Technology Newness					-.03		-.02	
R&D/Market Interrelationship x Dichotomous Tech Newness						1.44+		1.72*
R^2	.02	.02	.06	.08	.00	.13	.04	.22+
Adj. R^2	-.05	-.09	-.02	-.03	-.07	.03	-.04	.13+

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

P3-a: *R&D/Marketing intercooperation is more important for products with higher degree of market newness.* → *Not supported.*

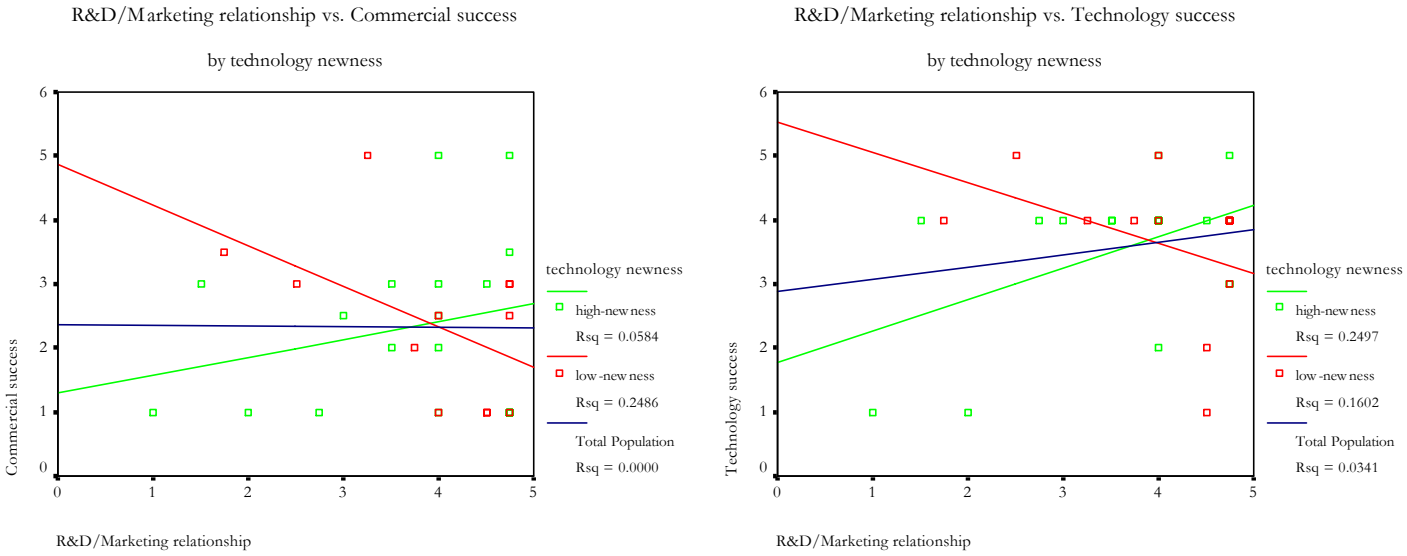
It was reasoned that R&D and marketing intercooperation would be more important for commercial and technology success when the degree of market newness is higher. However, this joint effect between the market newness and R&D/Marketing intercooperation has not been supported as shown in Table 3.

P3-b: *R&D/Marketing intercooperation is more important for products with higher degree of technology newness.* → *Some support, particularly for technology success*

It was reasoned that R&D and marketing intercooperation would be more important for commercial and technology success when the degree of technology newness is higher. As shown in Table 3 there is some support for this joint effect between R&D/marketing intercooperation, the degree of technology newness and commercial as well as technology success. The cross product coefficient of R&D/Marketing interrelationship and technology newness for commercial success is significant at the .10 level and for technology success it is significant at the .05 level. Furthermore, the change in R^2 is significant at the .10 level for technology success, indicating that the relationship is stronger for technology success than commercial success. As such, it is concluded that technology newness requires more R&D/Marketing intercooperation for the technology success of the product. However, the results show only some support for commercial success of the product for technology newness.

The relationship between the products' technology newness and R&D/Marketing relationship vs. commercial success and technology success is captured in Graph 4. The regression lines are

shown for both high-newness and low-newness. The graphs illustrate the *X-like* relationship resulting from the differential slopes between R&D/Marketing relationship and commercial and technology success by degree of technology newness. As shown in the graphs, the high-technology newness subgroup has a greater positive relationship with technology success (r=+.49) and some positive relationship (r=.24) with commercial success indicating that the development success increases as R&D/Marketing intercooperation increases. The low-technology newness subgroup (familiar technology) has a negative relationship with commercial (r=-.50) and technology (r=-.40) success indicating that stronger R&D/Marketing intercooperation on familiar technologies is potentially an inhibitor for development success.



Graph 4 - R&D/Marketing intercooperation vs. commercial & technology success by technology newness

The qualitative data on the highly successful projects with high degree of technology newness shows that these projects shared a common theme: fairly focused, rapid prototype development model where the new functionality concepts were tested with customers regularly. In many ways, the products were frozen and released to the customer with plans to roll every 3-4 months, and the marketing and R&D team controlled the implementation and functionality well.

Proposition 4: *Organizational networking (division & project teams' ability to network) positively impacts the commercial & technology success; i.e. projects with strong organizational networking will result in commercial & technology success.* → *Not supported*

It was reasoned that the organizational networking would positively impact the product's commercial and technology success. Correlation coefficient test (both Table 2 and Table 8) does not show any significant relationships between the organizational networking and commercial as well as technology success. As such, it is concluded that this proposition is not supported.

Propositions 4a and 4b are tested using multiple regression analysis; results are captured in Table 4.

Table 4 - Propositions 4a & b: Moderated Regression Analyses

	Market Newness				Technology Newness			
	Commercial Success		Technology Success		Commercial Success		Technology Success	
Independent	Main Effects	With Interactn	Main Effects	With Interactn	Main Effects	With Interactn	Main Effects	With Interactn
Variables								
Organizational Networking	-.06		.07		-.08		.056	
Dichotomous Market Newness	-.14		-.15					
Organizational Networking x Dichotomous Market Newness		1.03		-.92				
Dichotomous Technology Newness					-.04		-.04	
Organizational Networking x Dichotomous Tech Newness						1.01		1.66+
R^2	.02	.06	.03	.05	.01	.05	.01	.11
Adj. R^2	-.05	-.05	-.05	-.06	-.07	-.06	-.07	.01

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

P4-a: *Organization's ability to network is more important for products with higher degree of market newness.* → *Not supported*

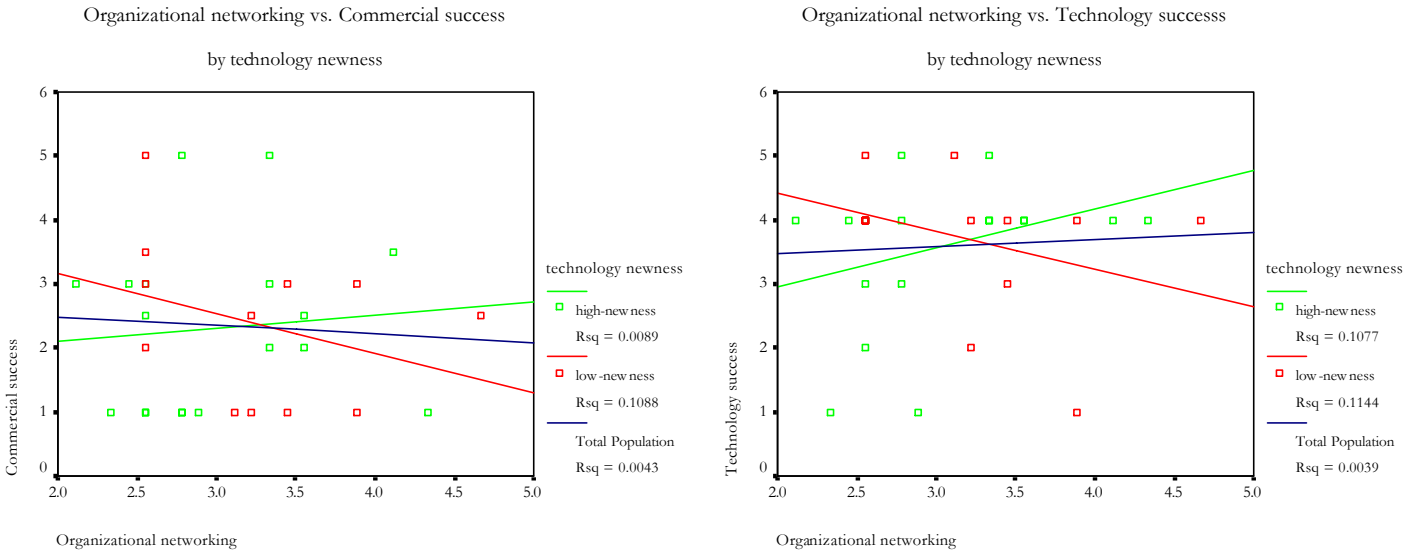
I reasoned that the organizational networking would be more important for commercial and technology success when the degree of market newness is higher. However, this joint effect between the market newness and organizational networking has not been supported as shown in Table 4.

P4-b: *Organization's ability to network is more important for products with higher degree of technology newness.* → *Some support for technology success only*

It was reasoned that organizational networking would be more important for commercial and technology success when the degree of technology newness is higher. As shown in Table 4 there is some support for this joint effect between R&D/marketing intercooperation, degree of technology newness and technology success, but not for commercial success. The cross product coefficient of organizational networking and technology newness for technology success is significant at the .10 level. As such, it is concluded that some support exists that the technology newness requires more organizational networking for the technology success of the product.

The relationship between the products' technology newness and organizational networking vs. commercial success and technology success is captured in Graph 5. The regression lines are shown for both high-newness and low-newness. The graphs illustrate the *X-like* relationship resulting from the differential slopes the organizational networking and commercial and technology success by degree of technology newness. As shown in the graph, the high-technology newness subgroup has a greater positive relationship with technology success (r=+.32) indicating that the technology success increases as organizational networking increases. The low-technology newness subgroup has a negative relationship with technology success (r=-.34) suggesting that stronger organizational networking on familiar technologies is potentially an inhibitor for technology success. Note:

although the *X-like* relationship between organizational networking and commercial success looks tempting, no significant relationship has been discovered (Table 4).



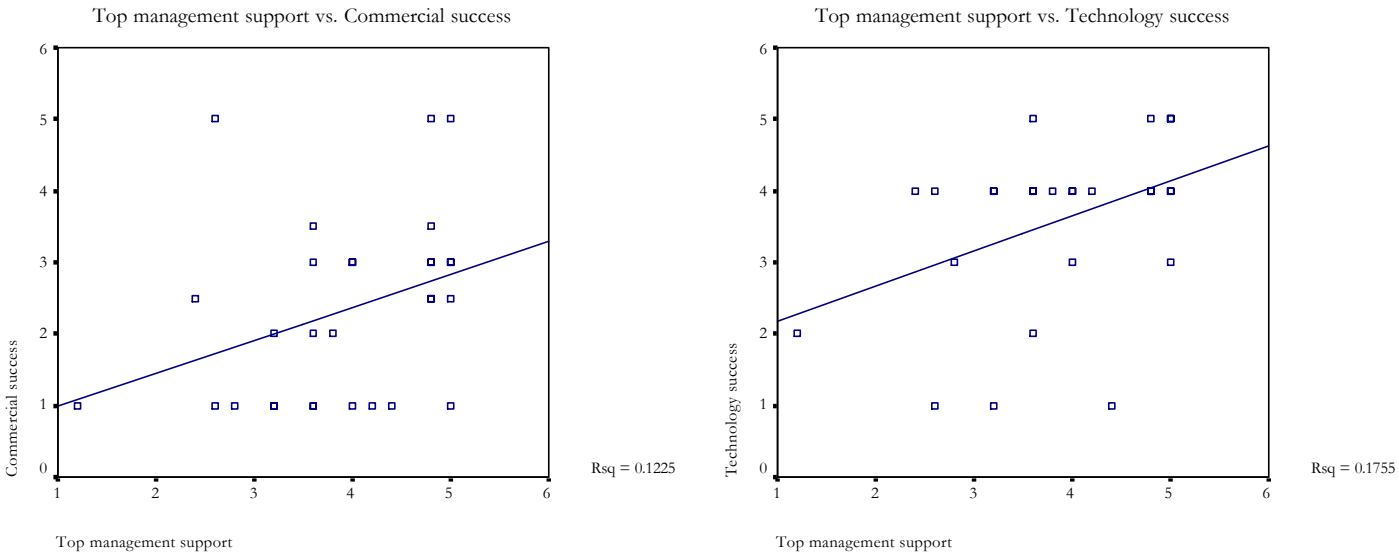
Graph 5 – Organizational networking vs. commercial & technology success by technology newness

The success reasons for projects that have a lower degree of organizational networking are unclear. However, these projects shared common characteristics in that they were small and focused teams that built good relationships with their channel partners.

Proposition 5: *Top management support positively impacts the commercial & technology success; i.e. projects with strong top management support will result in commercial & technology success.* → *Supported*

It was reasoned that top management support would positively impact the product's commercial and technology success. Correlation coefficient test (both Table 2 and Table 8) supports this proposition. Pearson's correlation coefficients for top management support and product commercialization is positive and statistically significant ($r=.56$, $p<.01$) indicating that top management support has a large influence on getting products to market. However, the relationship between top management support and commercial success ($r=.35$) is significant only at the .10 level indicating that top management support does not guarantee commercial success once the product is commercialized. The relationship between top management support and technology success is significant ($r=.42$, $p<.05$) suggesting that top management support does influence the success of the project from the technology perspective. As such, it is concluded that support exists that the top management support positively influences commercial and technology success of the product.

The relationship between top management support vs. commercial success and technology success is captured in Graph 6. The regression lines graphically show that the degree of top management support positively relates to the products' commercial and technology success.



Graph 6 – Top management support vs. commercial & technology success

As shown in the above graph, there are times that projects are successful with little top management support. The qualitative data points out that these projects did receive needed resources without any reevaluation and questioning; in summary these projects "flew under the radar". The projects were mainly started at a time the division had resources, and would support new product development project proposals without requiring large financial returns.

Propositions 5a and 5b are tested using multiple regression analysis; results are captured in Table 5.

Table 5 – Propositions 5a & b: Moderated Regression Analyses

	Market Newness				Technology Newness			
	Commercial Success		Technology Success		Commercial Success		Technology Success	
Independent Variables	Main Effects	With Interactn	Main Effects	With Interactn	Main Effects	With Interactn	Main Effects	With Interactn
Top Management Support	.35^{+}		.42*		.36^{+}		.43*	
Dichotomous Market Newness	-.14		-.14					
Top Management Support x Dichotomous Market Newness		-.07		-.23				
Dichotomous Technology Newness					-.08		-.11	
Top Management Support x Dichotomous Tech Newness						2.09**		1.45^{+}
R^2	.14	.14	.20	.20	.13	.35**	.19^{+}	.29*
Adj. R^2	.08	.04	.14	.11	.06	.28**	.13^{+}	.21*

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
$^{+}$ Correlation is significant at the 0.10 level (2-tailed).

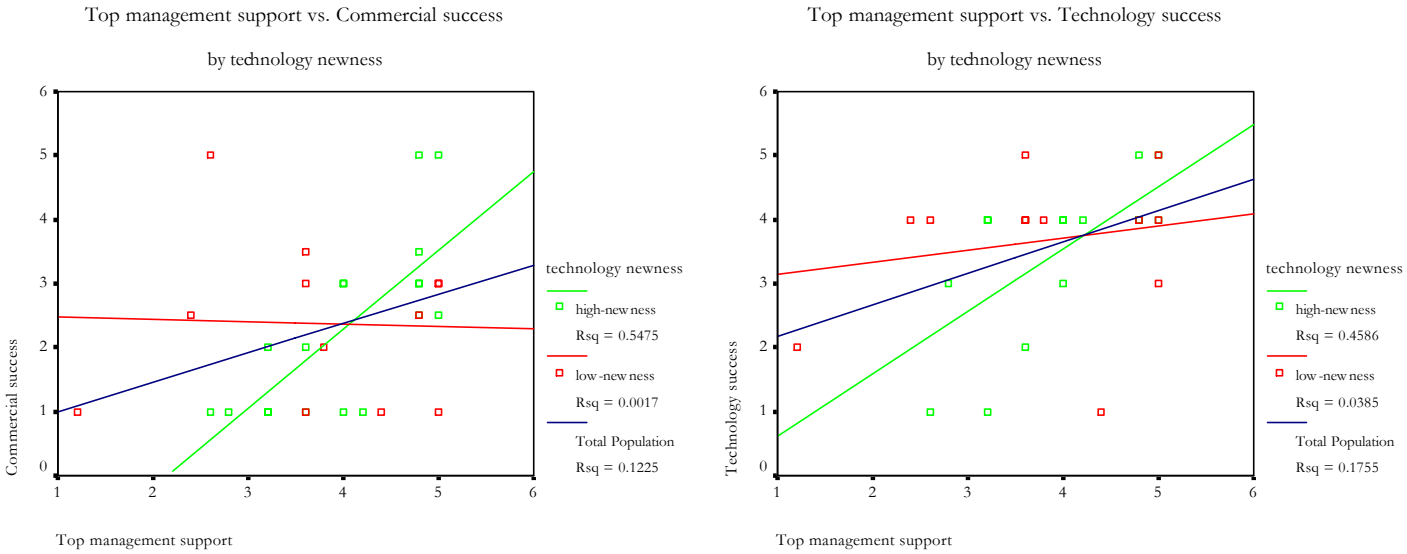
P5-a: *Top management support is more important for products with higher degree of market newness.* → *Not supported*

It was reasoned that top management support would be more important for commercial and technology success when the degree of market newness is higher. However, this joint effect between the market newness and top management support was not supported as shown in Table 5.

P5-b: *Top management support is more important for products with higher degree of technology newness.* → *Support for commercial success; some support for technology success*

It was reasoned that top management support would be more important for commercial and technology success when the degree of technology newness is higher. As shown in Table 5 there is some support for this joint effect between top management support, degree of technology newness and commercial as well as technology success. The cross product coefficient of top management support and technology newness for commercial success is significant at the .01 level; the coefficient for the technology success is significant at the .10 level. Furthermore, the change in R^2 is significant at the .01 level for commercial success, and the .05 level for technology success demonstrating the support for this proposition. As such, it is concluded that some support exists that the technology newness requires more top management support for development success, particularly for the commercial success of the product.

The relationship between the products' technology newness and top management support vs. commercial success and technology success is captured in Graph 7. The regression lines are shown for both high-newness and low-newness. The graphs illustrate the *X-like* relationship resulting from the differential slopes between top management support and commercial and technology success by degree of technology newness. As shown in the graphs, the high-technology newness subgroup has a strong positive relationship with commercial success (r=+.74) and technology success (r=+.68) indicating that the development success increases as top management support increases. The low-technology newness subgroup also benefits from the top management support in predicting technology success, however not as dependent on it as the high-technology newness subgroup. Note that the low technology newness group does not benefit from top management support.

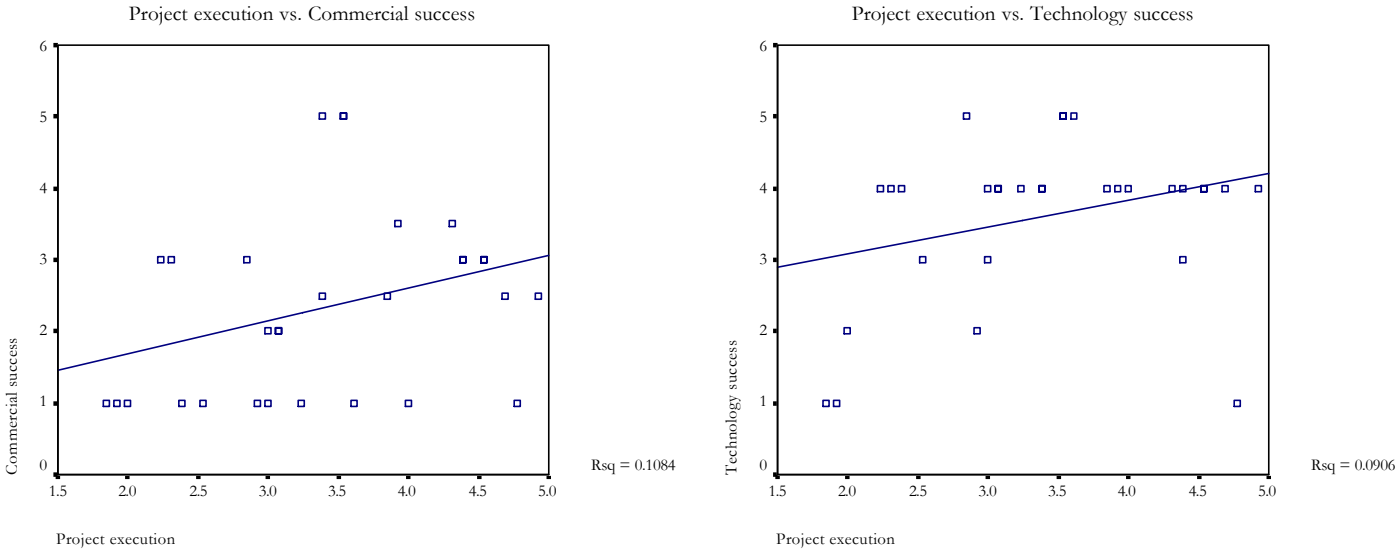


Graph 7 - Top management support vs. commercial & technology success by technology newness

Proposition 6: *Project management and execution positively impacts the commercial & technology success.*
→ *Some support for commercial success; no support for technology success*

It was reasoned that project execution would positively impact the product's commercial and technology success. Correlation coefficient tests (both Table 2 and Table 8) support this proposition for commercial success. The Pearson's correlation coefficient for project execution and product commercialization is positive and statistically significant (r=.62, p≤.01 level) indicating that project execution has a large influence on getting products to market. However, the relationship between project execution and commercial success (r=.33) is significant only at the .10 level indicating that project execution does not guarantee commercial success once the product is commercialized. There was no significant relationship found between project execution and technology success. As such, it is concluded that there is some support exists that the project execution positively influences commercial success, but not technology success.

The relationship between the project execution vs. commercial success and technology success is captured in Graph 8. The regression lines graphically show that the degree of project execution positively influences the products' commercial and technology success. Note that some relationship was found between project execution and commercial success, but not for technology success (Table 2).



Graph 8 - Project execution vs. commercial & technology success

The projects that were successful yet had low project execution rigor seemed to have built tight relationship with channel partners, or had strong requirements from other partners. These projects also leveraged heavily from learnings of previous projects that had some similarities.

Propositions 5a and 5b are tested using multiple regression analysis; results are captured in Table 6.

Table 6 - Propositions 6a & b: Moderated Regression Analyses

	Market Newness				Technology Newness			
	Commercial Success		Technology Success		Commercial Success		Technology Success	
Independent Variables	Main Effects	With Interactn	Main Effects	With Interactn	Main Effects	With Interactn	Main Effects	With Interactn
Project Execution	.34+		.32+		.36+		.32	
Dichotomous Market Newness	-.17		-.17					
Project Execution x Dichotomous Market Newness		-.62		-.49				
Dichotomous Technology Newness					.10		.06	
Project Execution x Dichotomous Tech Newness						.67		1.89*
R^2	.14	.16	.12	.13	.12	.14	.09	.28*
Adj. R^2	.07	.06	.05	.03	.05	.04	.03	.19*

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

P6-a: *Project management and execution is more important for products with higher degree of market newness.* → *Not supported*

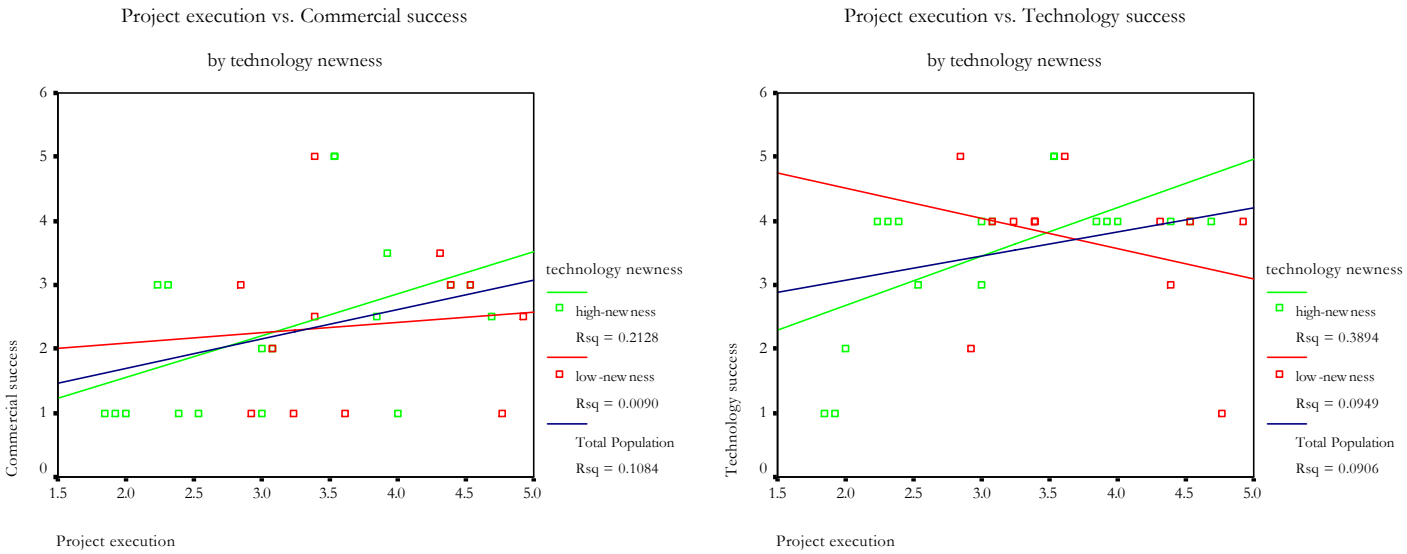
It was reasoned that project execution would be more important for commercial and technology success when the degree of market newness is higher. However, this joint effect between the market newness and project execution was not proven as shown in Table 6. As such, it is concluded that this proposition is not supported.

P6-b: *Project management and execution is more important for products with higher degree of technology newness.* → *Supported for technology success; not for commercial success*

It was reasoned that project execution would be more important for commercial and technology success when the degree of technology newness is higher. As shown in Table 6 there is some support for this joint effect between project execution, degree of technology newness and technology success, but not for commercial success. The cross product coefficient of project execution and technology newness for technology success is significant at the .05 level. Furthermore, the change in R^2 is significant at the .05 level for technology success indicating that there is support for this proposition. As such, it is concluded that there is some support exists that the technology newness requires more project execution for technology success of the product.

The relationship between the products' technology newness and project execution vs. commercial success and technology success is captured in Graph 9. The regression lines are shown for both high-newness and low-newness. The graphs illustrate the *X-like* relationship resulting from the differential slopes between project execution and commercial and technology success by degree of technology newness. As shown in the graph, the high-technology newness subgroup has a greater positive relationship with technology success (r=+.62) that the technology success increases as project execution quality increases. The low-technology newness subgroup has a negative

relationship with technology success (r=-.31) indicating that stronger project execution on familiar technologies is potentially an inhibitor for technology success. Note that no significant relationship was found for project execution and commercial success (Table 6).



Graph 9 - Project execution vs. commercial & technology success by technology newness

DISCUSSION

The primary objective of this study was to understand the organizational factors relating to successful development of new products, with a specific focus on understanding the impact of 'newness' on the development success. The result of the study supports only some of my suspicions, which are summarized in Table 7.

Note: The perceived commercial and technology success could be related to the amount of time the product has been on the market. As such, before starting the detailed proposition analysis, a partial correlation test was performed controlling for 'months since initiation'. The results of the partial correlation test are tabled in Table 9. The comparison of the partial correlation test shows that it is in support of Pearson and Spearman's correlation findings, indicating that 'months since initiation' have a minimal to no biasing effect on the results.

In support of the expectations, the results indicate that (1) the product's market newness has some negative relationship with its development success; (2) top management support and project execution positively impacts the development success; (3) the relationships tested in this study were mostly contingent upon the degree of technology newness of the new products. Moreover, although the top management (r=.56, p≤.01) and project execution (r=.62, p≤.01) had strong association with product commercialization, they did not guarantee project's commercial success (r=.35, r=.33, p≤.10).

There was no moderated relationship found between the degree of market newness and the organizational predictive variables for product development success. However, there was some relationship found between the degree of technology newness and the organizational predictive variables. More importantly, the analysis showed some negative association between the technology newness and R&D/Market intercooperation (r=-.23), organizational networking (r=-.20) and project execution (r=-.17).

Table 7 - Research proposition results summary

	#	Propositions	CommSucc	TechSucc
Main effects	P1	Higher degree of product market newness → Less likelihood of commercial and/or technology success	Some	Some
	P2	Higher degree of product technology newness → Less likelihood of commercial and/or technology success	No	No
	P3	More R&D and marketing intercooperation → Higher likelihood of commercial and/or technology success	No	No
	P4	More organizational networking → Higher likelihood of commercial success	No	No
	P5	More top management support → Higher likelihood of commercial success	Yes	Yes
	P6	More focus on project execution → Higher likelihood of commercial success	Yes	No
Market Newness	P3-a	Higher degree of product market newness → More need for R&D/Marketing intercooperation	No	No
	P4-a	Higher degree of product market newness → More need for organizational networking	No	No
	P5-a	Higher degree of product market newness → More need for top management support	No	No
	P6-a	Higher degree of product market newness → More focus needed for project execution	No	No
Technology Newness	P3-b	Higher degree of product technology newness → More need for R&D/Marketing intercooperation	Some	Some
	P4-b	Higher degree of product technology newness → More need for organizational networking	No	Some
	P5-b	Higher degree of product technology newness → More need for organizational networking	Yes	Some
	P6-b	Higher degree of product technology newness → More focus needed for project execution	No	Yes

The study did not support the main effects of R&D/marketing intercooperation and organizational networking to new product development success. This finding is quite puzzling as literature highlights the importance of the R&D/marketing relationship and organizational communication on innovation success (Moenaert *et al.* 1994, Ebadi and Utterback 1984). However, further study of the two (high/low) technology newness subgroups shows that these subgroups are behaving almost completely opposite of each other resulting in no significant relationship for the main effect for both R&D/marketing intercooperation and organizational networking. As an example, for R&D/marketing intercooperation vs. technology success (Graph 4) the positive association of high-technology newness (r=+.50) and negative association of low-technology newness (r=-.40) cancels out the overall population resulting in a low association between R&D/marketing intercooperation and technology success (r=.18) that is not significant. The same relationship is observed in organizational networking vs. development success (Graph 5) while testing for the technology newness moderator effects. In summary, the social networking and interaction components of the study (R&D/marketing intercooperation and organizational networking) for development success showed a greater contingency effect with technology newness than initially predicted.

HIGHLIGHTS FROM THE QUALITATIVE DATA

General discussion section of the interview included questions on "why the project was successful", "what went wrong" as well as "would the project be successful today".

Why the project was successful?

- Small, focused teams that were fully empowered.

- "It was viewed as a critical need by multiple divisions that were unable to deliver. So, the team had full empowerment. It was done by a small team, fairly closed, quick rapid prototyping… Longer term the ability to turn the product around quickly was a significant advantage."
- "Team was given the resources needed for success, and it was given that without much the need for process, reevaluation and questioning. Project 'flew under the radar'."
- "We operated as a very strong cross-functional team; war room meeting every Friday (everyone in the product, channel dev, support, marketing …). Everyone was fully aware what was going on."

- External partnerships and reliance on partners for technology and channel enabled new products to market fast. This also reduced the new technology investment and good market knowledge was acquired thru partners.
  - "We had the partner of all partners; we had the channel nailed!!!!"
- Concept testing with customers on functionality and future direction.
  - "Locked and learned the product: get it out there, and get customers using it, and plan for rolls every 3 months. This was successful in implementation; the functionality was controlled well. Marketing really liked this functionality, as it enabled new features to come in every 3-4 months."

What went wrong?

- Lack of strategic alignment.
  - "Didn't meet the (firm's) strategy and objective."
  - "(Firm's) reorganization resulted in the division's closure. The new management pushed project as lower priority, and eventually the project was cancelled."
  - "This was a product before its time."
  - "… Had no channel! We knew nothing about the channel."
- Lack of support from management and marketing.
  - "What led to failure was the fact that there was no business basis for the investment. Broad R&D commitment without other functional areas being engaged."
  - "There was no marketing buy-in. At the same time, pretty much all of the firm's R&D community bought into it. So, it became a technology infrastructure implementation without any supporting product concepts. Eventually it failed as there were turf wars, and no clear benefit of the technology."
  - "Management did not commit consistent marketing resources to the product, but the product was more of a marketing/business challenge than an R&D challenge."
- No customer/market testing prior to launching the product; need to meet the business requirements.
  - "Spent a lot of time doing business analysis, and were backed into price point (profitability, and price determination). Project had extensive market research, but quantitative analysis didn't show any price sensitivity, and we didn't check. … Product resulted in a sticker shock."

Would the project be successful today?

- Business environment has changed: there is more pressure for revenue and quicker return on investment.

- "… Don't know if you get buy in today… The big change since 1999-2000 is the economy is lousy, and everyone is watching the bottom line, and competition is who would generate the revenue first, ..."
- "Business was also good at the time, so there were no money and headcount issues."

IMPLICATIONS OF RESULTS

A practical implication of this study concerns the determination of the product's technology newness from the developing division's perspective. The study has shown definite influences of technology newness as a moderator variable on the organizational predictive variables indicating the divisions need to adjust their development processes and practices accordingly. However, the study showed that there is some negative relationship between technology newness and the social networking and interaction components (R&D/marketing intercooperation and organizational networking).

The social networking and interaction components of the study (R&D/marketing intercooperation and organizational networking) for development success showed a greater contingency effect with technology newness than initially predicted. This potentially demonstrates that the high level of R&D/marketing intercooperation and organizational networking for familiar technologies (low technology newness) could inhibit development success (Graph 4 and Graph 5). Furthermore, as it stands this finding disagrees with current recommendations that suggest more networking and R&D/marketing intercooperation to achieve development success, and thereby the findings of this study need to be replicated.

The analysis of the correlation coefficients (Table 2) shows that the R&D/marketing intercooperation and organizational networking is strongly correlated ($r=.52$, $p\leq.01$). The organizational networking and project execution also shows high association ($r=.42$, $p\leq.05$) potentially suggesting a causal relationship between these variables. It also suggests that putting the spot light on the project execution could positively influence the other organizational predictive variables. However, the relationship between project execution and other variables needs to be studied further.

CONCLUSION & FUTURE RESEARCH

The main purpose of this study was to investigate the role of a product's technology and market newness, R&D/marketing intercooperation, organizational networking, top management support and project execution in the success of new product development, and whether the product's technology and market newness influence the success of the innovation indirectly. As part of the study a model for testing the technology success over commercial success and the contingency model for technology and market newness were introduced. The results show that the product's market newness, top management support and project execution have direct influence in the innovation's success, while technology newness indirectly influences the organizational predictive variables.

The major insight yielded by this study is that the new product development success factors studied in this research are contingent upon the technology newness of the product. Previous studies also discussed the influence of technological uncertainty and its influence on the managerial variables, suggesting that high-uncertainty projects demand special attention for project definition, project milestones and customer participation (Shenhar *et al.* 2002). This strong contingency effect found for technology newness vs. social networking and interaction components of the study was quite surprising and could invalidate recommendations for how projects are managed, and would further require the organizations to alter their social interaction models based on the technology newness of the product under development. In summary, the findings suggest that a high degree of social networking (R&D/marketing intercooperation and organizational networking) could inhibit development success with familiar technologies (low technology newness).

The study did not support the main effects of R&D/marketing intercooperation and organizational networking to new product development success. This finding is quite puzzling as literature highlights the importance of the R&D/marketing relationship and organizational communication on innovation success (Moenaert *et al.* 1994, Ebadi and Utterback 1984, Millson and Wilemon 2002). However, this could be partially explained by the strong effects seen by the two (high/low) subgroups for technology newness that have completely opposite interactions to each other. This results in little or no support for the main effect for both R&D/marketing intercooperation and organizational networking.

LIMITATIONS OF THE STUDY

These findings, their interpretation and subsequent discussion must be considered in the context of the study's limitations.

One practical limitation is the sample size used in this study. A larger sample size would provide more statistical power to prove the main and interaction effects of the propositions. Although a consistent pattern is found in this study, typically MMR subgroups have difficulty detecting relationship with smaller sample size (Stone 1988). Future study recommends larger sample size to provide statistical power to better describe relationship between variables. A larger multi-case study would also provide more interesting comparisons and would provide results more suitable to generalization.

Subject variability in this study would also cause subjectivity in response, participant observation errors, and self-assessment biases. This mono-measurement bias is due to a single subject providing data for both the dependent and independent variables. Future studies should provide control for those effects by having more than one study subject, and evaluating the correlation and interrelation of responses. The potential biases with regards to success could be eliminated by also testing for objective measures of success in conjunction with the perceptual rating of success.

IMPLICATIONS FOR MANAGEMENT

The findings of this study suggest several management implications. First management should recognize the influence of top management support and project execution in getting products to commercialization. Management should establish a new product process model, i.e. new product development lifecycle, to ensure the activities that must be undertaken during the new product development process. More importantly, the management should encourage, if not require, quality project execution proficiency from their development teams; initial screening, preliminary market assessment, preliminary technical assessment, business/financial analysis, product development and customer tests of the product are recommended project management activities. However, it is important to note that although these activities strongly support new product commercialization, they do not guarantee commercialization success. As such, project screening activities are important to separate low potential projects from high potential projects.

Another major insight yielded by this study is that the new product development success factors studied in this research are contingent upon the technology newness of the product. This indicates that the management needs to recognize the innovation characteristics and adjust the organizational processes accordingly. This supports Shenhar's (*et al.* 2002) findings. However, the study showed that there is some negative relationship between the technology newness and the social networking and interaction components (R&D/marketing intercooperation and organizational networking). Furthermore, the strong contingency effect found for technology newness vs. social networking and interaction components of the study indicates that the organizations need to alter their social interaction models based on the technology newness. The findings suggest that high degree of social networking could inhibit development success with familiar technologies.

The qualitative data also indicated that the management must provide necessary resources for the new product development activities. Product concept testing with customers was an important point that came up during the interviews. Another key message that came from the qualitative data was the need to re-adjust the business requirements to foster the new product development. This contingency effect of the changing business environment with financial expectations to the new product development success was also highlighted by Tidd (2001).

DIRECTIONS FOR FURTHER RESEARCH

In addition to the questions this study answers, the results suggest several new directions for future research. Aside from collecting larger sample data, a more comprehensive model to test the development success variables (commercial and technology success) should be developed. The findings could be then tested further using the chi-square analysis to determine the degree of confidence in accepting or rejecting a given hypothesis.

The study results (Table 2) also show the potential cause and effect relationship among variables, such as putting a large emphasis on the project execution could potentially positively influences other organizational predictors. This was not tested in this study since the ability to assign causality depends on the creation of an experiment specifically designed to provide this kind of inference. However, this relationship and its impact on development success should be further studied.

Based on the findings of this research, a more comprehensive study is recommended to test the relationship between organizational networking, development success and technology newness. Shenhar's (et al. 2002) findings also highlighted the need to manage the high-technological uncertainty projects differently from the low-technological uncertainty projects. This future research should build a model that is a combination of this study and Shenhar's (et al. 2002). Another aspect of organizational networking can be studied by establishing a broader definition for organizational

networking to include networking with alliances. This model would test if the project newness can be overcome by acquiring the needed competencies from external partners.

The literature review has also highlighted set of studies targeted at understanding the environmental and organizational contingencies that influence new product development success (Tidd 2001, Damanpour 1996). This study has revealed several contingencies that should be targeted for further study: business environment, market and technology newness.

APPENDICES

APPENDIX A – SURVEY INSTRUMENT

Survey Objectives

There is no one recipe that highlights the factors that ensure successful commercialization. Purpose of this survey is to identify organizational (divisional) factors that influence the successful commercialization of new products.

Survey Use

This study is being conducted to fulfill the requirements of a Master of Science degree in Management of Technology. The final report will be published in accordance with the policies of the National Technological University MOT program. All participants in the study are welcome to a copy of the final report and presentation to be completed in the summer of 2002.

Confidentiality

All information submitted via this survey will be held in strict confidence. This survey does not require any confidential or detailed competitive information. The survey author requests each participant's name and address so that contact may be made if clarification is needed and for delivery of a copy of the final report.

No one other than the author will have access to this data. This data will not be published with any identification of individuals or organizations surveyed. Only composite statistics will be produced. Concluding reports may quote responses of anonymous participants.

Instructions

Please answer all of the survey questions. Since I will be attempting to identify and correlate relationships from this data, it is essential that all questions are answered. On multiple choice questions please choose only one answer.

If you have a comment, or need to explain an answer, please use the space provided at the end of the form.

Return and Contact Information

Contact: Binnur Al-Kazily

Part 1: Interview Information

This section records relevant background information about the interview.

1. Interview Location: In-person Interview	2. Interview Date:
3. Interview Start Time:	4. Interview End Time:

Part 2: Personal Information

This section records relevant personal information about you, the survey participant.

1. Name:	2. Business phone:
3. E-mail address:	4. Your title/Position:
5. Discipline: ☐ R&D ☐ Marketing ☐ Manufacturing ☐ Other	
6. Mark the box @ right if you would like a copy of the final report: ☐	

Part 3: Project Background

6. Project name:
7. Division that initiated the project:
8. Was the project commercialized? ☐ Yes ☐ No ☐ Yes, pilot only ☐ In-progress a. If NO, which stage was it killed? ☐ Proposal ☐ Investigation ☐ Development ☐ Testing & Validation ☐ Launch ☐ Not available/unclear b. If YES, was the product discontinued sometime after commercialization (<3 years) due to being recognized as a commercial failure? ☐ No ☐ Yes; specify
9. Indicate the project timeline a. When was the project initiated? b. When was it completed, killed or expected completion time; i.e. market-launch?

	Within the Division	Within the Firm	Outside of the Firm	New to the world, Did not Exist
10. At the timed that the project was initiated, where did the needed technology competencies reside? Check all that apply.	☐	☐	☐	☐
11. At the timed that the project was initiated, where did the needed market competencies reside? Check all that apply.	☐	☐	☐	☐
12. Identify the location of the sales force and channel that was used or will be used.	☐	☐	☐	☐

	No Comparable Reference	Few Employees w/ Experiences in this Area	Leverageable Experience	2nd Generation Product	Mature Product Line
13. How would you rate the level of technology experience for this product from the division's perspective?	☐	☐	☐	☐	☐
14. How would you rate the level of market experience for this product from the division's perspective?	☐	☐	☐	☐	☐

Part 4: Establishing Project Newness & Synergy

Newness captures how 'new and unfamiliar' the project is to the company, taking the firm into new markets, new technologies, new product categories, etc.

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
15. Assessing the market newness: Degree to which the product/project was new to the division in terms of:					
a. Product faced new competitors	☐	☐	☐	☐	☐
b. Product required new sales force or channels	☐	☐	☐	☐	☐
c. Product created a new product category for the division	☐	☐	☐	☐	☐
d. Product created a new market for the division	☐	☐	☐	☐	☐
e. Product fit within the market area defined by the division as an area of strategic focus	☐	☐	☐	☐	☐
16. Assessing the technology newness: Degree to which the product/project was new to the division in terms of:					
a. Product required new technologies	☐	☐	☐	☐	☐
b. Product required new engineering skills	☐	☐	☐	☐	☐
c. Product required new management skills	☐	☐	☐	☐	☐
d. Product fit within the technology area defined by the division as an area of strategic focus	☐	☐	☐	☐	☐
e. Product's technology requirements fit with the division's existing R&D skills/competencies	☐	☐	☐	☐	☐

Part 5: Establishing Project's Success

Success is difficult to measure. In this section the focus will be on both commercial success as well as other aspects.

	Fell far short of min acceptable level	Fell short of our min acceptable level	Met our min acceptable level	Exceeded our min acceptable level	Far exceeded our min acceptable level
17. ***Skip part a & b*** *if product was not commercialized or still in-progress.* Assessing the project commercialization success.					
a. How would you characterize the overall project profitability?	☐	☐	☐	☐	☐
b. How would you characterize the market share (domestic & foreign) achieved?	☐	☐	☐	☐	☐
18. ***Skip part b & c*** *if product was not commercialized, or is still in-progress.* Assess degree of innovation's success.	Complete Dud	Enhanced Existing Tech.	Gained Some Tech.	Learned a Lot	Out of This World!
a. How would you characterize the innovation's success	☐	☐	☐	☐	☐
	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
b. Gained acceptance as dominant design?	☐	☐	☐	☐	☐
c. Became a competitive advantage for the firm?	☐	☐	☐	☐	☐

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
19. Did the learnings gathered from the project facilitate commercial success of the follow on products?	☐	☐	☐	☐	☐
a. Please specify					

Part 6: Division's Culture, Management Support & Networking

Test the division's ability to bridge competency gaps by further understanding its culture, support and its ability to network with other divisions, or establish alliances and partnerships with external companies.

20. Assess the R&D and marketing interfunctional cooperation	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
a. During this project marketing and R&D regularly communicated for new product development	☐	☐	☐	☐	☐
b. During this project, marketing and R&D fully cooperated in establishing new product development goals and priorities	☐	☐	☐	☐	☐
c. Project team met with customers or reviewed customer feedback regularly	☐	☐	☐	☐	☐
d. Project team was regularly informed about what the competition was doing	☐	☐	☐	☐	☐
21. Assess the project team and division's ability to network	Not at All	Once or Twice	Regularly	Frequently	Very Frequently
a. How frequently did team members contact others within the division with technical questions?	☐	☐	☐	☐	☐
b. How frequently did team members contact others within the division with market related questions?	☐	☐	☐	☐	☐
c. How frequently did team members contact others in other divisions with technical questions?	☐	☐	☐	☐	☐
d. How frequently did team members contact others in other divisions with market related questions?	☐	☐	☐	☐	☐
e. How frequently did team members contact others outside the firm with technical questions?	☐	☐	☐	☐	☐
f. How frequently did team members contact others outside the firm with market related questions?	☐	☐	☐	☐	☐
	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
g. Team was good at coordinating work with other teams doing related work	☐	☐	☐	☐	☐
h. Team was well-informed about activities of other teams doing related work	☐	☐	☐	☐	☐
i. Project team had a leader that established cross-functional/cross-firm ties	☐	☐	☐	☐	☐

22. Assess the top management support	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
a. Team had division's total support	☐	☐	☐	☐	☐
b. Upper management maintained a visible presence to reinforce the project importance	☐	☐	☐	☐	☐
c. Management provided the necessary resources for the project team (ex. R&D, marketing)	☐	☐	☐	☐	☐
d. Senior management had a central role in project review process & investment decisions	☐	☐	☐	☐	☐
e. Project team had a leader that persuaded the division's members and management of the value of the innovation	☐	☐	☐	☐	☐
f. At what management level(s) was the project support, sponsorship and endorsement made? (check all that apply)	☐ Project Manager ☐ R&D Manager ☐ Marketing Manager ☐ Other; specify		☐ Section Manager ☐ General Manager		

Part 7: Project Management Execution

Test how well the project management activities were performed.

23. Assessing project management execution. Identify to what extent the following project management activities were performed.	N/A	Activity Was Not Performed	Activity Was Somewhat Performed	Activity Was Performed	Activity Was Performed Fully and Presented to Mgmt
a. Initial screening: *The initial assessment for project investment decision to the proposed new product idea*	☐	☐	☐	☐	☐
b. Preliminary market assessment: *A preliminary, but nonscientific, market assessment; a quick look at the market*	☐	☐	☐	☐	☐
c. Preliminary technical assessment: *A preliminary appraisal of the technical merits and difficulties of the project*	☐	☐	☐	☐	☐
d. Detailed market study/market research: *Marketing research, involving a reasonable sample of respondents, a formal design, and a consistent data collection procedure*	☐	☐	☐	☐	☐
e. Business/financial analysis: *A financial or business analysis leading to a go/no go decision prior to product development*	☐	☐	☐	☐	☐
f. Product development: *The design and development of the product, resulting in a prototype or sample product*	☐	☐	☐	☐	☐
g. In-house product testing: *Product testing in the lab (as opposed to in the field or with customers)*	☐	☐	☐	☐	☐
h. Customer tests of product: *Testing the product under real-life conditions, e.g., with customers and/or in the field*	☐	☐	☐	☐	☐
i. Test market/trial sell: *Trying to sell the product but to a limited or test set of customers*	☐	☐	☐	☐	☐
j. Trial production: *A trial production run to test the production facilities*	☐	☐	☐	☐	☐

k. Precommercialization business analysis: *A financial or business analysis prior to full-scale launch*	☐	☐	☐	☐	☐
l. Production start-up: *The start-up of full scale or commercial production*	☐	☐	☐	☐	☐
m. Market launch: *The launch of the product, on a full-scale and/or commercial basis*	☐	☐	☐	☐	☐

Part 8: General Comments

Record any interesting points from the interview:

Discuss why the project was successful; what led to problems; or any other comments

APPENDIX B – STATISTICAL METHODS

Relationship among variables using Spearman's Correlation Coefficient is captured in Table 8. Table 9 shows the results of the partial correlation test while controlling for months since initiation.

Table 8 – Spearman's Correlation Matrix and Reliability Coefficients

Variables	1	2	3	4	5	6	7	8	9	10
1.Success-dichotomous	- -									
2.Commercial Success	.68**	(.97)								
3.Technology Success	.61**	.56**	- -							
4.Market Newness	-.22	-.38*	-.35+	(.77)						
5.Technology Newness	.01	.06	.06	.26	(.75)					
6.R&D/Market Interrelationship	-.18	-.06	-.03	.03	-.25	(.86)				
7.Organizational Networking	.09	-.07	.05	.14	-.09	.53**	(.72)			
8.Top Management Support	.55**	.38+	.40*	-.02	.19	.22	.24	(.76)		
9.Project Execution	.62**	.36+	.26	.00	-.11	.27	.41*	.69**	(.87)	
10. Months since Project Initiation	.32+	.51**	.31+	-.38*	-.05	-.20	-.11	.01	.14	- -

n = 30
** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
+ Correlation is significant at the 0.10 level (2-tailed).
( ) Reliability coefficient alpha.
- - Single item scale.

Table 9 - Partial correlation test controlling for months since initiation

Variables	1	2	3	4	5	6	7	8	9
1.Success-dichotomous	- -								
2.Commercial Success	.59**	(.97)							
3.Technology Success	.55**	.50**	- -						
4.Market Newness	-.18	-.26	-.26	(.77)					
5.Technology Newness	-.02	.12	.01	-.00	(.75)				
6.R&D/Market Interrelationship	.03	.10	.27	.00	-.25	(.86)			
7.Organizational Networking	.11	-.04	.10	.16	-.20	.52**	(.72)		
8.Top Management Support	.57**	.36*	.42*	-.05	.26	.22	.24	(.76)	
9.Project Execution	.63**	.33+	.29	.11	-.16	.38*	.42*	.62**	(.87)

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
+ Correlation is significant at the 0.10 level (2-tailed).
( ) Reliability coefficient alpha.
- - Single item scale.

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