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***USER INVOLVEMENT IN
NEW PRODUCT DEVELOPMENT:
AN EMPIRICAL INVESTIGATION***

By:

Eytan Lasry

**A thesis submitted to
The Faculty of Graduate Studies and Research
in partial fulfillment of
the requirements of the degree of
Master of Management Studies**

**School of Business
Carleton University
Ottawa, Ontario**

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**USER INVOLVEMENT IN NEW PRODUCT DEVELOPMENT:
AN EMPIRICAL INVESTIGATION**

**submitted by Eytan Lasry, B.A.A.
in partial fulfillment of the requirements for
the degree of Master of Management Studies**

Thesis Supervisor

Director, School of Business

Carleton University

January, 2000

ABSTRACT

Previous research has shown that firms need to understand user needs and incorporate them into the design of their new products in order for them to achieve commercial success. Other researchers point to the dangers of relying on customers for accurate data on new products when these products are based on radically new or 'disruptive' technologies. This study investigates the impact of end-user involvement in new product development activities on product success. Managers at 55 firms developing computer telephony integration (CTI) products were surveyed. The findings show that managers' perceptions of end-user involvement in new product development activities increase as a function of the level of technological newness of the product. However, increased perception of the involvement of end-users during trials and testing activities has a negative effect on product success for these technologically new products. On the other hand, for products targeting new markets, increased perception of end-user involvement during requirements definition and design specification activities results in greater product success. In other words, different dimensions of product newness (market and technology) affect the relationship between end-user involvement and product success in opposite directions.

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1.0 PROBLEM STATEMENT AND RESEARCH OBJECTIVES

The ability to successfully develop and market innovative new products is one of the most critical success factors for modern firms in a variety of technology-related businesses. A significant amount of research has therefore been conducted in order to discover the factors affecting the subsequent success, or failure, of a new product (Brown and Eisenhardt, 1995). Most of the research on product development agrees that one of the most critical factors leading to successful new product development (NPD) is understanding user needs and incorporating them into the new product's design (Rothwell, 1974; Cooper, 1979; Cooper and Kleinschmidt, 1987; Zirger and Maidique, 1990).

This has led technology driven firms to develop and implement organizational processes and infrastructures that facilitate the capture of customer requirement information and its integration into the new product's design. However, most of these processes and infrastructures are designed for products that are in the latter stages of their lifecycle or are incremental and continuous innovations (Eliashberg et al, 1997). Wind and Mahajan (1997), in their introduction to the special issue on NPD of the Journal of Marketing Research, point to the paucity of research on the topic of radical or discontinuous innovation and suggest several opportunities for research in this area. One refers to 'knowledge-based marketing research' as the processes for informing users on the capabilities of discontinuous new products in order to gather their requirements. They propose that further research be focused on these types of methods rather than on those that rely on traditional focus group interviews and survey research.

Although, the literature provides little guidance to managers involved in discontinuous or radical NPD, it appears evident that the development process, including the manner in which users are involved, differs markedly from the incremental new product development process (O'Connor, 1998). Therefore, the level of innovativeness or newness of a product may have a significant impact on its development process and on how user requirements are gathered.

A review of the product development literature leads to a certain degree of confusion regarding how and when users should be involved in the NPD process. While many authors have proposed that users are an important source of new product ideas (von Hippel, 1986), some researchers have argued that being too close to customers or being 'customer-led' may prove detrimental to innovation and firm performance (Macdonald, 1995). These and other studies (Christensen, 1997; Ciccantelli and Magidson, 1993; Neale and Corkindale, 1998) form the basis of an ongoing debate in the literature about whether customers and users inhibit or stimulate new product ideas (Slater and Narver, 1998), and if customer input leads only to incremental new products rather than breakthrough innovations.

This project aims to achieve two major objectives. The first one is to fill a gap in the literature on product development by providing insight into how product newness affects the manner in which developers solicit and integrate user input during various activities of the development process. This study attempts to test the assertions of previous researchers on the benefits and potential dangers of involving users in the development

process, and brings clarity to an ongoing debate in the literature. In addition, most of the existing research on the development of radical innovations is case-based and qualitative. Therefore, this project attempts to shed some light on previous findings with a larger sample quantitative study. The second main objective is to provide managers of new product development with guidelines on how and when to involve users in development processes according to the level of newness of the product.

The research questions that this project focuses on are:

- 1) What effect does the level of newness of a product have on the level of customer involvement in the product development process?
- 2) Do radically new product development projects tend to involve product end-users less or more than incrementally new product development projects?
- 3) What effect does the level of newness of a product have on the level of involvement of other customer personnel in the product development process?
- 4) Do the types of market research methods that firms use differ based on the extent of the product's newness?
- 5) Are projects with a high level of user involvement more successful?
- 6) How does product newness moderate the relationship between user involvement and success?

Three key variables are measured and analyzed: product newness; user involvement in the product development process; and commercial product success. By relating the level

of newness and of user involvement to measures of commercial success, we generate managerial guidelines for developers of new products.

The role of users in NPD is dynamic and complex and the challenge for high technology firms wanting to sustain competitive advantage lies in learning to rapidly and continuously create and dismantle the technological infrastructures required to serve a particular market. In other words, knowing when to actively seek out existing customer input, when to look toward a different set of users for input and how to shift from one value network (Christensen, 1995) to the next while remaining 'close to the customer' (Peters and Waterman, 1982), and when to ignore customers altogether and focus on technological development.

2.0 LITERATURE REVIEW AND HYPOTHESES

This review draws on research from the product development, marketing and strategic management literature. The product development literature emphasizes the processes and outcomes of radical new product development, compares them to incremental NPD processes and outcomes, and identifies implications for managers of new product development. Marketing scholars are more interested in methods of gathering customer requirements, while strategy researchers tend to focus on the effects of radical technological change on firm performance and industry structure.

von Hippel (1986) argues that, in fast-paced, high technology industries, traditional market research techniques will not provide adequate new product ideas. He provides evidence that familiarity with existing product attributes and uses interfere with an individual's ability to conceive of novel attributes --a concept referred to as 'functional fixedness'. In addition, customers may become so accustomed to current, sub-optimal conditions of use, that they will not think to ask for a new solution even if they have real needs.

Veryzer's (1998) research into the discontinuous NPD process found that new product ideas did not come from customers but rather originated from within the developing firm. Although he stresses the value of customer feedback for the development of really new products, he also suggests that customer input may not be relied upon as heavily to guide the development process of discontinuous products, as it is for incremental new products. According to O'Connor (1998), in radical innovation projects, customers do not know

what their needs are, given that the products require very different behavior patterns or open up whole new applications.

Song and Montoya-Weiss (1998) examine the new product development practices of 163 really new products and 169 incremental new products. They compare the critical activities found to be determinants of new product success: strategic planning, market analysis, technical development and product commercialization. While strategic planning is the second most important determinant of success for really new products, it has a negative effect on incremental new product success. Similarly, business and market opportunity analysis is the most important factor for incremental new product success, but it has a negative impact on really new product success.

Their results reveal striking differences in the relative importance of activities for really new versus incremental new products. Given that user needs are often ill-defined and the competitive environment not clearly delineated, detailed market studies will be extremely costly to undertake and will not provide valuable data under the breakthrough innovation scenario. On the other hand, incremental new products usually involve an existing market and proven technology, and therefore, business and market opportunity analyses will be critical to understanding market trends, user requirements and competitor capabilities.

The importance of these different activities imply varying degrees of user involvement in the new product development process for radical and incremental new products and lead to the formulation of the hypothesis that:

Hypothesis 1: The importance of the input provided by **end-users** in the product development process is a function of product newness.

We use the term end-users to designate those individuals at customer firms that use a given product on a day-to-day basis as part of their job descriptions. We included this specification because, in interviews with managers, a caveat to the general proposition that product newness impacts customer involvement has emerged. It may be that only the end-users of a given technology are too steeped in the present and fail to provide adequate market research data. Therefore, firms do seek out customer input but from a different source. Individuals at customer firms that are not end-users of the technology, but play an active role in either purchasing decisions or technical support, are the ones that developing firms rely on for a more accurate assessment of where the technology is headed, and what features the new product should include. Therefore, we propose that:

Hypothesis 2: The importance of the input provided by other individuals (IT or technical support personnel, key decision-makers, buyers...) in the product development process is a function of product newness.

Additional evidence suggests that traditional market research methods are clearly not appropriate when gathering customer requirements for radically new products.

Effectively describing radical product concepts can be particularly difficult when no comparisons can be made with current products. For products that are part of complex technological systems, it can be problematic for users to envision features of a product that will interact with other not-yet-developed technologies.

In their in-depth case analyses of four, well-known discontinuous innovations, Lynn *et al.* (1996) found that, not only was the information generated from conventional market research techniques not useful to radical innovation projects, it was often misleading. They propose that a 'probe and learn' process is more suited to highly uncertain, radically innovative environments. Companies developed their products "by probing potential markets with early versions of the products, learning from the probes, and probing again." This iterative process is inherently exploratory and experimental rather than analytical and the authors point to the need to develop entirely different product development processes for discontinuous products.

Veryzer (1998) suggests that, in the early phases, breakthrough innovation projects tend to use qualitative research techniques that allow them to explore and gain a deeper understanding of the likely users and the features of the product they will demand, rather than more formal, quantitative techniques such as focus groups and market studies used in somewhat less discontinuous projects. In a similar study, O'Connor (1998) concluded that the nature, timing and mechanisms used for market learning in radical innovation projects differed from those used in incremental NPD. She observes interesting differences in the types of market-related questions asked, and in the market learning mechanisms used in breakthrough innovation projects compared to incremental innovation projects.

Information acceleration (Hauser, Urban and Weinberg, 1993) and a slew of other virtual reality-based methods are being developed specifically for gathering customer data in

radically innovative environments. These techniques place users in the information-base of a future world and attempt to create a simulated environment, through multimedia or hypermedia technology, for presenting new product concepts to potential users and eliciting their reactions.

In addition, sampling can be a serious obstacle to effective market research in radically innovative environments. Who to sample and how to ensure that they will be representative of the rest of the market? Therefore, in designing user involvement structures, firms must be careful not to base their product strictly on the requirements of early adopters, whose needs are not the same as those of other segments in the marketplace. Moore refers to this phenomenon as a 'chasm' in the innovation diffusion process (1991, 1995).

These arguments lead to the hypothesis that:

Hypothesis 3: The types of market research methods used during the product development process are function of product newness.

Researchers exploring broader issues of corporate and technology strategy have examined the reasons why successful firms consistently fail when faced with certain types of technological change. Christensen *et al.*'s (1995, 1996) study of the disk drive industry shows that established, incumbent firms failed precisely because they were attentive to the needs of the customers in their 'value network', and failed to recognize that certain 'disruptive' technologies would eventually allow newer entrants to take over

their market. He emphasizes the influence of existing customers on the technological strategies chosen by firms. Because their existing customers demanded incremental improvements in the current generation of disk drives, established firms lagged new entrants in the introduction of the new generation of disk drives. It can thus be inferred that successful breakthrough products that create new markets and are not valued by a firm's current customers, are characterized by minimal end-user involvement in the development process.

Organizational routines (Nelson and Winter, 1982) and path dependencies prevent firms from venturing away from current markets and into unknown territories. The core competencies (Prahalad and Hamel, 1990) that enable a firm to serve and even dominate a particular market may become core rigidities (Leonard, 1992) following a technological discontinuity. The decision to continue satisfying existing and powerful customers may be optimal in the short term, considering the revenues to which a firm has grown accustomed and needs to sustain its operations. However, the fear of cannibalizing sales of existing products and investments in complementary and specialized assets (Teece, 1988) has led to the decline of many well-established and successful firms.

Chandy and Tellis' research (1998) suggests that a firm's *willingness to cannibalize*, driven by active internal markets, influential product champions, a greater focus on future markets, and less specialized investments in a current technology, is an important driver of radical innovation. It appears that the decline of leading incumbent firms may be the result of the very logic of technological evolution i.e. the forces driving the exploitation

of existing opportunities structurally impede the development of new ones (Burgelman and Sayles, 1986). These forms of organizational inertia can become powerful barriers to successful new product development.

Hamel and Prahalad (1994) suggest that "customers are notoriously lacking in foresight". Martin (1995) argues that firms should "ignore their customers". These assertions build on work by previous researchers who found that a marketing orientation "inhibits organizations from developing truly breakthrough innovations" (Kohli and Jaworski, 1990). On the other hand, Slater and Narver (1998) argue that the traditional marketing concept of being 'market-oriented' is still very much desirable and should not be confused with being 'customer-led'. There is evidence that being 'customer-led', or responding to explicit customer needs, impedes innovation. However, avoiding the "tyranny of current markets" (Leonard, 1995) should not come at the expense of a market-orientation, or "a long-term commitment to understanding customer needs -both expressed and latent" and to developing innovative solutions that produce superior customer value.

This evidence leads us to propose that, in order to develop successful radical or breakthrough innovations, firms need to restrain the amount of end-user input that they solicit and integrate during the new product development process, for fear of ending up with only marginally or incrementally new products. Or more formally, that:

Hypothesis 4: When product newness is high, high end-user involvement leads to lower commercial success.

In summary, this project tests the following four research hypotheses:

- Hypothesis 1:** The importance of the input provided by end-users in the product development process is a function of product newness.
- Hypothesis 2:** The importance of the input provided by other individuals (IT or technical support personnel, key decision-maker, buyer...) in the product development process is a function of product newness.
- Hypothesis 3:** The types of market research methods used during the product development process are a function of product newness.
- Hypothesis 4:** When product newness is high, high end-user involvement leads to lower commercial success.

Figure 1 provides a graphical illustration of the expected relationships between the variables.

Figure 1 - HYPOTHESIZED RELATIONSHIPS

* Hypothesis 4 proposes that an inverse relationship exists when product newness is high

3.0 RESEARCH DESIGN

3.1 Preliminary Interviews

This cross-sectional field study is quantitative in nature. Preliminary interviews were conducted with managers responsible for product development at three firms developing telecommunications and Computer Telephony Integration (CTI) products. These firms included one large multibillion-dollar company, a mid-sized vendor, and a smaller, relatively new firm. These initial interviews lasted between one hour and one hour and a half. One was conducted face-to-face and the other two over the telephone. These interviews allowed the researchers to gain some initial insight into the issues related to user involvement in new product development, and further refine the research problem and hypotheses.

3.2 Sampling Frame

The telecommunications and CTI industry was chosen as the sampling frame because innovation is occurring at a very rapid pace in this field. It can therefore supply an adequate number of innovative product development projects to study. In addition, the explosion and growth of the Internet has dramatically altered user requirements for telecommunications products as well as the competitive landscape of the telecom industry. As voice and data communications converge on Internet Protocol (IP) networks, traditional telephony vendors must now supply data communications capabilities, internet-enabled products and web integration to their customers. Most of these types of products, having been developed within the past two to three years, are first generation products, that incorporate new-to-the-world technology. The relative newness of the

internet, the speed at which it is growing, and the pace of technological evolution make the CTI industry fertile ground for the study of radical innovation.

The study's population consists of 537 computer telephony equipment manufacturers and software developers. The list was compiled from the CTI Magazine directory of firms for 1998-1999. A sample of 128 firms was randomly selected from the directory. Each firm in the population was assigned a number, random numbers were generated and the corresponding firm was selected.

3.3 Instrument

The unit of analysis is a computer telephony new product development project. The questionnaire (see appendix A) was pre-tested during face-to-face sessions with senior product development managers at three different telecom firms. Only one of these managers had previously participated in the preliminary interviews. Managers involved in the pre-test were asked how they interpreted specific questions, if they understood the meaning of different concepts, and if the questions were clear and unambiguous. The questions, scales and format were revised and changed following each individual session.

3.4 Data Collection

Senior managers responsible for new product development at the 128 firms were contacted by telephone and asked to participate in the study. If the researcher was unable to speak to the right contact person, a questionnaire was sent by fax or e-mail with a cover letter explaining the research project. 30 firms were disqualified either because

they refused to participate in the study or because they are subsidiaries of foreign companies and product development projects are managed in their home countries. The most common reasons for refusal were time constraints and reluctance to reveal what is perceived as proprietary information.

3.5 Response Rate

Managers agreeing to participate in the study were sent the questionnaire by fax or e-mail and a time was agreed upon when the researcher would call them back to conduct the survey over the telephone. In all, 98 questionnaires were sent. 23 respondents returned the questionnaires by fax or e-mail and another 32 surveys were conducted over the telephone for a total of 55 usable questionnaires. Therefore, the response rate was 55/128 or 43 percent. Given that our sample includes a very broad cross-section of firms in terms of size and product category as well as a wide range of different products based on cost and length of development, we can argue that the results are representative of the computer telephony industry in 1999.

3.6 Variables and Measurement

3.6.1 Product Newness

Two essential dimensions of product discontinuity or innovativeness have been identified in the literature: technology newness and market newness (McDermott, 1998). Therefore, product newness was measured with five questions relating to technological and market issues. Respondents answered the questions on a seven-point unipolar scale with Not New at all and Very New as the anchors and Moderately New as the midway-point. The

average of these five questions was used to form an **overall product newness** variable ($\alpha = .75$). The average of the first two questions in question 5 constitutes the **market newness** construct ($\alpha = .52$):

- How new (to your company) were the customers targeted by the new product?
- How new (to your company) were the user needs addressed by the new product?

The average of last three questions constitutes the **technological newness** construct ($\alpha = .82$):

- How new (to your company) was the technology embodied in the new product?
- How new (to your company) was the product architecture?
- How new (to your company) were the core components or software modules in the new product?

3.6.2 Customer Involvement

The product development process is broken down into five major activities: idea generation and screening, requirements definition and design specification, technical development, trials and testing, and product launch. Respondents' perceptions of the importance of **the involvement of potential end-users** of the product during each of the activities of the product development process was measured on a seven-point unipolar scale, where Not Important and Very Important are the anchors and Moderately Important is the midway-point:

- How important was the input provided by potential end-users of the product during *idea generation and screening* activities?

Similarly, respondents were asked to assess the importance of **the involvement of other customer personnel** during each of the five activities in the development process. These other individuals at potential customer firms were described to respondents as IT or technical support personnel, key decision-makers, buyers or influencers of the buying decision.

3.6.3 Market Research Methods

Respondents also provided data on the various market research methods used during each activity of the development process. This was used to measure the extent of the use of **customer-intensive market research methods (CIMRM)** during each of the five activities in the product development process. A list of the most common methods of market research was provided and participants placed an X in the cell that corresponded to the activity during which the method was used. Additional space was provided for participants to add any other methods they may have used. Scores were then assigned to the different methods based on the extent of customer involvement that they require. The following scores were assigned to the different methods:

- In-house demos = 0
- Technological forecasting = 0
- Customer surveys = 1
- Focus/Discussion groups = 2
- User group feedback = 2
- Alpha/Beta site testing = 3
- Customer site visits = 3

- Direct observation of users = 3
- Co-development = 4.

Total scores for each activity were then added up in order to derive a measure of the extent of the use of customer-intensive market research methods (CIMRM) during each of the five activities in the product development process.

Lead user analysis was left out due to the ambiguity of this concept for the respondents. Those who indicated that they used lead user analysis in product development were prompted to explain what they meant by lead users. Respondents provided very different explanations for what they meant by lead user analysis. von Hippel (1986, 1988) describes lead user analysis as a method for seeking out users that face needs well in advance of the general marketplace and using these users to generate ideas for new products. The majority of respondents think of lead user analysis as a method for testing new products with a group of early adopter customers. Therefore, it was decided not to include this item in the analysis due to the ambiguity of this concept for respondents and the consequent lack of consistency in the responses. Furthermore, very few respondents indicated that they used any other methods of market research and so these too were omitted from the analysis.

3.6.4 Product Success

Product success was assessed using measures proposed by Griffin and Page (1996) and respondents answered on a seven-point bipolar scale, with Well Below Goals and Exceeded Expectations as the anchors and On Target as the midway-point:

- To what extent has the product met revenue goals?
- To what extent has the product met profit goals?
- To what extent has the product met quality specifications?
- To what extent has the product provided a competitive advantage?

3.6.5 Additional Data

Data that may moderate the extent of customer involvement in the product development process, such as **project duration** and **budget**, were also captured. In addition, the questionnaire also included **open-ended questions** for participants to provide any supplementary information they deemed relevant and that could not be captured using the quantitative questions. Finally, respondents were asked to provide **general company information** such as product category and company size (number of employees, annual revenues).

3.7 Data Analysis

The quantitative data were analyzed using the following steps:

- 1) The raw data were coded and calculations were performed in order to derive measures for the variables used in this study.

- 2) Descriptive statistics were computed for all the variables, including frequencies, means, standard deviations and Spearman correlations.
- 3) In order to test the hypotheses that differences in managers' perceptions of end-user involvement (or other customer personnel involvement) are a function of product newness (Hypothesis 1 and 2), the sample was split into groups reflecting their scores on the various newness questions. Three different groupings were used. The sample was first divided based on scores for overall product newness, then on the basis of market newness, and finally based on technological newness. For each of the groupings, a score of five was used as the cutoff point given the means and that the groups would be sufficiently large to conduct the analyses. Products with newness scores greater than five were placed in the high newness group, while those with newness scores below or equal to five were placed in the low newness group. This was performed separately for all three newness dimensions: overall product, market, and technological. The means on the end-user and other customer personnel involvement measures for the different high and low newness groups were then compared using independent samples t-test. Therefore, differences in perceptions of user involvement were looked at from three different perspectives on product newness (overall, market, and technological).

Although most of the data used in our analyses have normal distributions, some of the variables present slight deviations from normality but no serious skewness or kurtosis. Given the distributions, two statistical tests were chosen for the following reasons: the two-group t-test is quite robust to deviations from normality; and the

Mann-Whitney U test will provide 95% efficiency with normal data. In order to corroborate the results from the t-tests, the analyses were also conducted using Mann-Whitney U non-parametric tests. The results of these tests are presented in Appendix B and consistently confirm the results obtained with the two group t-tests.

- 4) In order to verify the effect of product newness on the types of market research methods used during product development (Hypothesis 3), the mean scores for the use of CIMRM of the three different sets of high and low newness groups were compared using independent samples t-test (and the Mann-Whitney U non-parametric test).
- 5) In order to test the hypothesis that for really new products, more end-user involvement in new product development leads to lower success (Hypothesis 4), the high newness groups were also split on the basis of high and low perceptions of end-user involvement. Again, given the mean scores on the end-user involvement variables, five was also used as a cutoff point to divide the sample into high and low end-user involvement groups. The means of the success measures were then compared using independent samples t-test (and the Mann-Whitney U non-parametric test) in order to look for any significant differences between the groups.
- 6) Finally, product newness and user involvement (at different activities) were regressed (using ordinary least squares estimation) against various success measures to further test Hypothesis 4. The different models fitted on the data were all variations on the following:

$$\text{Success} = \alpha_0 + \beta_1 * (\text{product newness}) - \beta_2 * (\text{customer involvement})$$

4.0 RESULTS

4.1 Descriptive Statistics

Table 1 presents the range, means, modes, standard deviations, and number of observations for all the variables used in the study. Project duration ranges from 2.5 to 36 months with a mean of 12.75. Total budget ranges from \$10,000 to \$25 million with a mean of \$2.29 million. The means of the product newness measures range from 4.51 for new customers to 5.35 for new technology. *Figure 2* provides a graphical representation of the means for the product newness measures.

TABLE 1

Variable	N	Minimum	Maximum	Mode	Mean	Standard Deviation
Duration (in months)	55	2.5	36	12	12.7545	8.3199
Budget (in millions \$)	48	0.01	25	0.5	2.29	5.2022
New Customers	55	1	7	4	4.5182	1.818
New User Needs	55	1	7	7	5.2182	1.7207
New Technology	55	1	7	6	5.3545	1.5889
New Architecture	55	1	7	6	5.2	1.5414
New Components	55	1	7	6	4.8455	1.6326
Overall Newness	55	1.2	7	5	5.0273	1.1789
Market Newness	55	1	7	5.5	4.8682	1.4536
Tech Newness	55	1.33	7	6	5.1333	1.3606
End-Users in A	55	1	7	6	5.1091	1.7285
End-Users in B	55	1	7	5	4.7727	1.7816
End-Users in C	55	1	7	2	3.0091	1.6173
End-Users in D	55	1	7	6	5.1364	1.7911
End-Users in E	55	1	7	7	4.8364	1.8335
Avg. End-Users	55	1	7	4.8	4.5727	1.2508
Other in A	50	1	7	4	4.32	1.6343
Other in B	50	1	7	4	4.3	1.6933
Other in C	50	1	7	2	3.06	1.5572
Other in D	50	1	7	4	4.3	1.8871
Other in E	49	1	7	4	4.3367	1.7836
Avg. Other	50	1	7	1	4.066	1.286

TABLE 1 (CONTINUED)

Variable	N	Minimum	Maximum	Mode	Mean	Standard Deviation
CIMRM in A	52	0	15	1	4.7308	4.1967
CIMRM in B	52	0	15	0	4.4615	4.4345
CIMRM in C	52	0	17	0	3.0769	3.3888
CIMRM in D	52	0	14	9	6.6538	3.4804
CIMRM in E	52	0	11	0	4.0192	3.3343
Avg. CIMRM	52	0.6	10.8	3.6	4.5885	2.6231
Met Profit Goals	49	1	7	4	4.5612	1.6318
Met Revenue Goals	49	1	7	4	4.6224	1.4088
Met Quality Specs.	51	3	7	4	5.049	1.242
Competitive Adv.	51	2	7	7	5.6667	1.2596
Average Success	51	2.5	7	5	4.9779	1.0618

LEGEND:

- End-Users= Involvement of End-Users during New Product Development Activity __
- Other = Involvement of Other Customer Personnel during New Product Development Activity __
- CIMRM = Use of Customer Intensive Market Research Methods during New Product Development Activity __
- Activities: A = Idea Generation and Screening
 B = Requirements Definition and Design Specification
 C = Technical Development
 D = Trials and Testing
 E = Product Launch

The means for the measures of perceptions of end-user involvement in new product development range from 3.0 for involvement in technical development to 5.14 for involvement in trials and testing. Although, average involvement for end-users (4.57) is higher than average involvement for other customer personnel (4.07), the evolution of involvement across the five activities of the product development process follow similar patterns (see *figure 3*). Involvement starts out high during the idea generation and requirements definition activities drops significantly during technical development and picks up again during testing and product launch. Means of success measures range from 4.56 for met revenue goals to 5.67 for provided a competitive advantage. Average success ranges from 2.5 to 7 with a mean of 4.98.

Tables 2 through 5 present the correlations between the newness measures and the rest of the variables using the full sample. There are significant positive correlations between customer involvement measures - both end-user or other customer personnel - (table 2)

and product newness, mainly during three activities: requirements definition and design specification, trials and testing, and product launch. As product newness increases, so does the extent of the involvement of end-users and of other customer personnel in requirements definition, in trials and testing and in product launch activities. This initial finding leads us to focus our analysis on these activities in the subsequent statistical tests.

Table 3 also shows some significant correlations between newness measures and the use of customer-intensive market research methods (CIMRM) during various activities of product development. New customers are positively correlated with customer-intensive market research methods during technical development, and new user needs are positively correlated with CIMRM during requirements definition and technical development. New technology is positively correlated with CIMRM during idea generation, and new components are positively correlated with CIMRM during trials and testing and product launch.

The only success measure significantly correlated with product newness is competitive advantage (table 3). New customers, new technology, new product architecture, and new components are all positively correlated with the extent to which a product has provided the developing firm with a competitive advantage. In other words, the newer the product, the more competitive advantage a firm will benefit from. This result could be a function of the innovative environment of the computer telephony industry. The fast pace of change and of technological evolution in CTI rewards innovative firms and therefore, managers perceive product newness as a way to achieve competitive advantage.

There are no significant correlations between measures of perception of customer involvement and success measures (table 4). There seems to be no direct relationship between managers' perceptions of the involvement of end-users or other customer personnel in new product development activities and product success. There is however, a significantly negative correlation between the use of CIMRM during idea generation, requirements definition, and trials and testing activities and the achievement of product quality objectives (table 5). This implies that the more firms use the types of market research methods that require greater customer involvement, the less the new product meets quality specifications.

TABLE 2

	New Customers	New User Needs	New Technology	New Architecture	New Components	Overall Newness	Market Newness	Tech Newness
End-Users in A	.048 (.727) 55	.006 (.965) 55	.004 (.975) 55	.099 (.471) 55	.231* (.089) 55	.050 (.718) 55	-.009 (.947) 55	.144 (.293) 55
End-Users in B	.252 (.063) 55	.067 (.629) 55	.221 (.105) 55	.349*** (.009) 55	.430*** (.001) 55	.310** (.021) 55	.136 (.321) 55	.396*** (.003) 55
End-Users in C	-.049 (.722) 55	-.083 (.547) 55	.105 (.446) 55	.257* (.058) 55	.232* (.088) 55	.049 (.725) 55	-.098 (.476) 55	.217 (.112) 55
End-Users in D	.199 (.144) 55	.299** (.026) 55	.432*** (.001) 55	.341** (.011) 55	.357*** (.007) 55	.435*** (.001) 55	.309** (.022) 55	.419*** (.001) 55
End-Users in E	-.017 (.901) 55	.077 (.575) 55	.216 (.113) 55	.235* (.084) 55	.319** (.018) 55	.228* (.094) 55	.021 (.880) 55	.298** (.027) 55
Avg. End-Users	.090 (.512) 55	.098 (.477) 55	.282** (.037) 55	.398*** (.003) 55	.475*** (.000) 55	.315** (.019) 55	.078 (.570) 55	.447*** (.001) 55
Other in A	.110 (.447) 50	.188 (.190) 50	.044 (.762) 50	.057 (.695) 50	.146 (.310) 50	.139 (.334) 50	.115 (.427) 50	.091 (.529) 50
Other in B	.110 (.445) 50	.229 (.110) 50	.211 (.141) 50	.158 (.274) 50	.303** (.033) 50	.241* (.092) 50	.133 (.356) 50	.250* (.080) 50
Other in C	.150 (.299) 50	.156 (.278) 50	.124 (.391) 50	.064 (.657) 50	-.037 (.799) 50	.094 (.518) 50	.161 (.264) 50	.010 (.944) 50
Other in D	.290** (.041) 50	.344** (.014) 50	.214 (.136) 50	.172 (.231) 50	.107 (.458) 50	.348** (.013) 50	.376*** (.007) 50	.152 (.291) 50
Other in E	.199 (.169) 49	.179 (.220) 49	.270* (.061) 49	.289** (.044) 49	.173 (.235) 49	.325** (.023) 49	.248* (.086) 49	.269* (.062) 49
Avg. Other	.215 (.133) 50	.307** (.030) 50	.245* (.086) 50	.187 (.194) 50	.158 (.274) 50	.300** (.034) 50	.273* (.055) 50	.195 (.176) 50

Spearman's Rho Correlation Coefficients, (Significance in brackets), and Number of observations below

* = $p < .10$

** = $p < .05$

*** = $p < .01$

TABLE 3

	New Customers	New User Needs	New Technology	New Architecture	New Components	Overall Newness	Market Newness	Tech Newness
CIMRM in A	.204 (.147) 52	.091 (.522) 52	.354** (.010) 52	.161 (.255) 52	.072 (.613) 52	.217 (.123) 52	.173 (.221) 52	.184 (.192) 52
CIMRM in B	.155 (.273) 52	.341** (.013) 52	.151 (.286) 52	.190 (.177) 52	.057 (.690) 52	.239* (.088) 52	.261* (.061) 52	.124 (.380) 52
CIMRM in C	.309** (.026) 52	.348** (.011) 52	.108 (.448) 52	.012 (.935) 52	-.005 (.975) 52	.196 (.163) 52	.366*** (.008) 52	.005 (.970) 52
CIMRM in D	.124 (.381) 52	-.153 (.280) 52	.114 (.423) 52	.215 (.126) 52	.344** (.013) 52	.068 (.633) 52	-.047 (.739) 52	.275** (.048) 52
CIMRM in E	.045 (.753) 52	.008 (.954) 52	.066 (.644) 52	.177 (.210) 52	.294** (.034) 52	.072 (.611) 52	-.016 (.909) 52	.217 (.123) 52
Average CIMRM	.232* (.098) 52	.168 (.233) 52	.276** (.048) 52	.287** (.039) 52	.301** (.030) 52	.260* (.063) 52	.197 (.162) 52	.311** (.025) 52
Met Profit Goals	-.138 (.344) 49	-.078 (.593) 49	.100 (.495) 49	.021 (.888) 49	-.116 (.427) 49	-.087 (.553) 49	-.185 (.202) 49	-.028 (.848) 49
Met Revenue Goals	.016 (.912) 49	-.193 (.184) 49	.065 (.656) 49	.089 (.544) 49	-.019 (.99) 49	-.007 (.964) 49	-.095 (.517) 49	.054 (.714) 49
Met Quality Specs.	.152 (.287) 51	-.081 (.574) 51	-.171 (.231) 51	-.016 (.911) 51	-.188 (.188) 51	-.045 (.755) 51	.057 (.691) 51	-.168 (.239) 51
Provided a competitive Advantage	.280** (.047) 51	.179 (.208) 51	.303** (.031) 51	.363*** (.009) 51	.233* (.100) 51	.391*** (.005) 51	.242* (.087) 51	.343** (.014) 51
Average Success	.025 (.862) 51	-.084 (.559) 51	.080 (.579) 51	.128 (.371) 51	-.049 (.733) 51	.034 (.814) 51	-.061 (.672) 51	.040 (.778) 51

Spearman's Rho Correlation Coefficients, (Significance in brackets), and Number of observations below

* = $p < .10$

** = $p < .05$

*** = $p < .01$

TABLE 4

	Met Revenue Goals	Met Profit Goals	Met Quality Specs.	Provided a Competitive Advantage	Average Success
End-Users in A	-.006 (.969) 49	-.084 (.564) 49	-.081 (.572) 51	.072 (.616) 51	-.034 (.815) 51
End-Users in B	-.001 (.996) 49	.007 (.963) 49	-.083 (.562) 51	.134 (.348) 51	-.020 (.892) 51
End-Users in C	.006 (.967) 49	-.003 (.981) 49	-.103 (.471) 51	-.133 (.353) 51	-.069 (.629) 51
End-Users in D	.071 (.625) 49	-.042 (.772) 49	-.158 (.267) 51	.118 (.409) 51	-.010 (.943) 51
End-Users in E	.025 (.864) 49	-.067 (.649) 49	-.120 (.402) 51	.021 (.884) 51	-.010 (.943) 51
Average End-Users	.103 (.483) 49	-.011 (.941) 49	-.166 (.245) 51	.114 (.424) 51	.015 (.916) 51
Other in A	.048 (.752) 46	.157 (.299) 46	.127 (.394) 47	.123 (.410) 47	.126 (.397) 47
Other in B	.070 (.645) 46	-.023 (.879) 46	-.102 (.496) 47	.153 (.304) 47	.009 (.953) 47
Other in C	.100 (.2506) 46	.073 (.628) 46	-.092 (.537) 47	-.160 (.282) 47	-.024 (.871) 47
Other in D	.124 (.412) 46	.209 (.162) 46	.144 (.335) 47	.076 (.613) 47	.157 (.291) 47
Other in E	.050 (.746) 45	-.058 (.706) 45	-.110 (.465) 46	.146 (.334) 46	.006 (.966) 46
Average Other	.102 (.499) 46	.056 (.712) 46	-.012 (.934) 47	.091 (.543) 47	.064 (.671) 47

Spearman's Rho Correlation Coefficients, (Significance in brackets), and Number of observations below

* = $p < .10$

** = $p < .05$

TABLE 5

	Met Revenue Goals	Met Profit Goals	Met Quality Specs.	Provided a Competitive Advantage	Average Success
CIMRM in A	.126 (.398) 47	-.095 (.525) 47	-.244* (.091) 49	.067 (.650) 49	-.001 (.995) 49
CIMRM in B	-.086 (.565) 47	-.189 (.204) 47	-.291** (.043) 49	-.011 (.943) 49	-.161 (.268) 49
CIMRM in C	.085 (.569) 47	-.033 (.827) 47	-.076 (.604) 49	.208 (.153) 49	.072 (.625) 49
CIMRM in D	.023 (.880) 47	.068 (.650) 47	-.250* (.083) 49	.141 (.333) 49	-.010 (.944) 49
CIMRM in E	.118 (.430) 47	.094 (.529) 47	-.024 (.872) 49	.294** (.041) 49	.164 (.261) 49
Average CIMRM	.023 (.876) 47	-.021 (.888) 47	-.312** (.029) 49	.223 (.124) 49	-.013 (.927) 49

Spearman's Rho Correlation Coefficients, (Significance in brackets), and Number of observations below

* = $p < .10$

** = $p < .05$

*** = $p < .01$

4.2 Hypothesis 1: Newness and End-User Involvement

As outlined earlier, the sample was split in three different ways. Between high and low overall newness, high and low market newness, and high and low technological newness. We will now investigate the effect of these different dimensions of product newness on perceptions of the extent of end-user involvement in new product development activities. We therefore look at differences in the means of the end-user involvement measures between the high and the low newness groups.

Table 6 presents the results of the independent samples t-tests for mean differences between high and low overall newness products (See table 7 in appendix B for results of the Mann-Whitney U tests). The only significant difference in the means is for end-user involvement in trials and testing activities. For products with a higher degree of overall product newness managers tend to have higher perceptions of end-user involvement during trials and testing activities only. The same result was observed when the sample was split into high and low market newness groups (table 8 and table 9-appendix B). When targeting newer markets managers also tend to believe that they involve end-users more during trials and testing activities only.

**Table 6 – Two Group t-test: Mean differences in end-user involvement measures
between high and low *overall product* newness products**

End-User Involvement in:	t	Degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Idea Generation and Screening	-1.042	53	.302	-.4892	.4696
Requirements Definition and Design Specification	.830	53	.410	.4032	.4858
Technical Development	-.370	53	.713	-.1640	.4433
Trials and Testing	2.2325	53	.024**	1.0887	.4682
Product Launch	.877	53	.384	.4382	.4996
Overall Average	.748	53	.458	.2554	.3415

** = p < .05

**Table 8 – Two Group t-test: Mean differences in end-user involvement measures
between high and low *market* newness products**

End-User Involvement in:	t	Degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Idea Generation and Screening	-.580	53	.564	-.2733	.4710
Requirements Definition and Design Specification	.556	53	.581	.2700	.4856
Technical Development	-.204	53	.839	-9.0000E-02	.4419
Trials and Testing	1.953	53	.056*	.9233	.4729
Product Launch	-.574	53	.569	-.2867	.4996
Overall Average	.318	53	.752	.1087	.3416

* = p < .10

When looking at differences between the high and low technical newness products, significant differences in means of perceptions of end-user involvement were observed for all but one new product development activity (table 10). Thus, when developing

products with a higher level of technical newness managers perceive that they involve end-users more during the requirements definition, technical development, trials and testing, and product launch activities. (See table 11 in appendix B for Mann-Whitney U tests that confirm these results). These results provide strong support for Hypothesis 1 but only under the technological newness scenario. Managers' perceptions of the importance of the input provided by end-users in new product development is a function of the technological newness of the product. The newer the technology, the greater the perception that end-users are involved in new product development activities.

Table 10 – Two Group t-test: Mean differences in end-user involvement measures between high and low *technological* newness products

End-User Involvement in:	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Idea Generation and Screening	.710	53	.481	.3370	.4747
Requirements Definition and Design Specification	3.005	53	.004***	1.3655	.4544
Technical Development	1.850	53	.070*	.8003	.4325
Trials and Testing	2.500	53	.016**	1.1685	.4674
Product Launch	2.030	53	.047**	.9891	.4873
Overall Average	2.908	53	.005***	.9321	.3205

*** = $p < .01$

** = $p < .05$

* = $p < .10$

4.3 Hypothesis 2: Newness and Involvement of Other Customer Personnel

In order to test Hypothesis 2, we repeat the same procedure but now we look at differences in the means for the perceptions of the involvement of other customer personnel in new product development activities. When looking at differences between the high and low overall product newness groups (table 12 and table 13-appendix B), the results are similar to those observed for end-user involvement. The only significant difference in the means is for perceptions of the involvement of other customer personnel in trials and testing. Therefore, for products with a higher degree of overall newness managers tend to have higher perceptions of the involvement of other customer personnel during trials and testing activities. Once again, the same result was observed when the sample was split into high and low market newness groups (table 14 and table 15-appendix B). When targeting newer customers, with newer user needs, managers tend to believe that they involve other customer personnel more during trials and testing activities.

Table 12 – Two Group t-test: Mean differences in other customer personnel involvement measures between high and low *overall product* newness products

Other Customer Personnel Involvement during:	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Idea Generation and Screening	-.774	48	.443	-.3667	.4737
Requirements Definition and Design Specification	-.338	48	.737	-.1667	.4933
Technical Development	.515	48	.609	.2333	.4529
Trials and Testing	1.883	48	.066*	1.000	.5311
Product Launch	1.531	47	.132	.7828	.5113
Overall Average	.778	48	.440	2900	.3727

* = $p < .10$

Table 14 – Two Group t-test: Mean differences in other customer personnel involvement measures between high and low *market* newness products

Other Customer Personnel Involvement during:	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Idea Generation and Screening	.396	48	.694	.1872	.4724
Requirements Definition and Design Specification	.964	48	.340	.4680	.4855
Technical Development	1.440	48	.156	.6355	.4414
Trials and Testing	1.818	48	.075*	.9606	.5284
Product Launch	1.292	47	.203	.6607	.5113
Overall Average	1.587	48	.119	.5759	.3629

* = $p < .10$

However, the similarities between end-users and other customer personnel end here.

When it comes to differences between high and low technological newness products, no significant differences in means of perceptions of other customer personnel involvement were observed (table 16 and table 17-appendix B). This clearly contrasts with the prior results for measures of end-user involvement, which were significant in all but one new product development activity. In other words, when it comes to their perceptions of end-user involvement in new product development, managers take care to make distinctions between cases of new or less new technologies. However, new product developers seem to perceive that they involve other personnel from customer firms indiscriminately in new product development activities, irrespective of the level of newness of the product.

Table 16 – Two Group t-test: Mean differences in other customer personnel involvement measures between high and low *technological* newness products

Other Customer Personnel Involvement during:	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Idea Generation and Screening	.406	48	.686	.1900	.4677
Requirements Definition and Design Specification	1.334	48	.188	.6361	.4767
Technical Development	.430	48	.669	.1916	.4456
Trials and Testing	1.038	48	.304	.5556	.5350
Product Launch	1.115	47	.270	.5699	.5110
Overall Average	1.155	48	.254	.4201	.3637

One factor that may explain this difference is the investment in resources required to implement processes for involving end-users in new product development activities. Firms are prepared to make these commitments only when they feel that a product is very innovative technologically and therefore requires significantly more end-user input. On the other hand, involving other personnel such as IT managers, or buyers and decision-makers can be done without committing a great deal of resources to the task. These individuals may become involved and their input gathered on an ad-hoc basis without any formal processes being implemented. Therefore, the perception of the importance of their input will remain constant regardless of the level of newness of the product. This evidence provides weak support for Hypothesis 2, which proposes that the involvement of customer personnel other than end-users is a function of product newness, given that this relationship can only be established for involvement during trials and testing.

4.4 Hypothesis 3: Newness and CIMRM

With respect to hypothesis 3 and the use of customer-intensive market research methods (CIMRM), only one significant difference in means is observed (table 18 and table 19-appendix B). Products with a higher level of market newness use more CIMRM only during technical development activities. No significant differences in the means of CIMRM measures were found when comparing high and low overall product newness groups or when comparing high and low technologically new products. Therefore, the data does not support Hypothesis 3 given that the use CIMRM seems to increase only during the technical development of products addressing new markets.

**Table 18 – Two Group t-test: Mean differences in the use of CIMRM
between high and low *market* newness products**

Use of CIMRM during:	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Idea Generation and Screening	1.343	50	.185	1.5697	1.1688
Requirements Definition and Design Specification	1.133	50	.263	1.4061	1.2413
Technical Development	1.985	50	.053*	1.8364	.9249
Trials and Testing	.289	50	.774	.2848	.9858
Product Launch	-.453	50	.653	-.4273	.9433
Overall Average	1.276	50	.208	.9339	.7318

* = $p < .10$

In summary, our results provide weak support for Hypothesis 2 and Hypothesis 3 while Hypothesis 1 is confirmed when we take a technological view on product newness. In addition, our results indicate that there is no relationship between newness and success

(tables 20, 22, and 24 and tables 21, 23, and 25-appendix B). The only significant difference observed is between high and low technologically new products, where really new technologies provide more of a competitive advantage to the developing firm (table 24 and table 25-appendix B) than incrementally new technologies. However, our results may be confounded by the existence of a U-shaped or curvilinear relationship between newness and success that our statistical test cannot detect (see figure 4). In their study, Kleinschmidt and Cooper (1991) found that both low innovativeness and high innovativeness products were more successful than middle-of-the-road, moderately innovative products. Therefore, measuring differences in means between high and low newness products may fail to provide any significant results.

**Table 20 – Two Group t-test: Mean differences in product success measures
between high and low *overall product* newness products**

Product Success Measures	T	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	-.762	47	.450	-.3586	.4707
Met Profit Goals	.062	47	.951	2.525E-02	.4089
Met Quality Specifications	.196	49	.846	6.910E-02	.3529
Provided a Competitive Advantage	1.274	49	.209	.4488	.3523
Overall Average	.199	49	.843	5.998E-02	.317

**Table 22 – Two Group t-test: Mean differences in product success measures
between high and low *market* newness products**

Product Success Measures	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	-1.587	47	.119	-.7299	.4599
Met Profit Goals	-1.292	47	.203	-.5176	.4005
Met Quality Specifications	-.039	49	.969	-1.3889E-02	.3520
Provided a Competitive Advantage	.889	49	.378	.3148	.3541
Overall Average	-.715	49	.478	-.2141	.2993

**Table 24 – Two Group t-test: Mean differences in product success measures
between high and low *technological* newness products**

Product Success Measures	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	.225	47	.823	.1071	.4758
Met Profit Goals	.728	47	.470	.2976	.4087
Met Quality Specifications	-.547	49	.587	-.1936	.3536
Provided a Competitive Advantage	1.756	49	.085*	.6129	.3489
Overall Average	.699	49	.488	.2110	.3017

* = $p < .10$

4.5 Hypothesis 4: Really New Products, End-User Involvement and Success

The final hypothesis proposes that when products are really new, higher levels of end-user involvement in new product development leads to lower success. In order to test this proposition, we have taken the high newness groups and split them again on the basis of end-user involvement. Those with scores above or equal to 5 on different end-user involvement measures were placed in the high involvement group and those with scores below 5 were placed in the low involvement group. The means of the different success measures were then compared.

4.5.1 Overall Product Newness, End-User Involvement and Success

We begin our analysis by looking at the high overall product newness group. When comparing the high and low average perceptions of end-user involvement groups within the high overall product newness, no significant differences in success are observed. We then compared groups divided on the basis of high and low perceptions of end-user

involvement in idea generation, in requirements definition, in technical development, in trials and testing, and in product launch. Still no significant differences in success are found. We then performed the same analysis for the low overall product newness group, and again, no meaningful differences in success between groups of high and low perceptions of end-user involvement were observed.

4.5.2 Market Newness, End-User Involvement and Success

We now look at differences between groups of high and low perceptions of end-user involvement for the high market newness products. In this case, an interesting result emerges. Our analysis reveals a significant difference in the achievement of profit goals between products with managers having high perceptions of end-user involvement during requirements definition and specification activities compared to those with lower levels of perceptions of end-user involvement during requirements definition (table 26). In other words, products targeting newer markets seem to significantly benefit, in terms of achieving their profit goals, from increased perceptions of end-user involvement during requirements definition activities (See top half of figure 5).

Table 26 – Two Group t-test: Mean differences in product success measures between high and low end-user involvement in requirements definition and design specification activities for *high market* newness products

Product Success Measures	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	.343	21	.735	.2619	.7627
Met Profit Goals	2.061	21	.052*	1.2540	.6085
Met Quality Specifications	.493	22	.627	.2889	.5860
Provided a Competitive Advantage	.475	22	.639	.2667	.5609
Overall Average	.973	22	.341	.4833	.4969

* = $p < .10$

Figure 5 - Testing Hypothesis 4 for Market Newness

We now test this relationship for products with low market newness to further substantiate our finding. For low market newness products, products with managers having higher perceptions of end-user involvement during requirements definition generated less profits (table 27). Or, when targeting known markets, increased perceptions of end-user involvement during requirements definition activities results in fewer profits (See bottom half of figure 5).

Table 27 – Two Group t-test: Mean differences in product success measures between high and low end-user involvement in requirements definition and design specification activities for *low market* newness products

Product Success Measures	T	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	-.280	24	.782	-.1688	.6037
Met Profit Goals	-1.872	24	.073*	-.9188	.4909
Met Quality Specifications	-1.249	25	.223	-.5647	.4520
Provided a Competitive Advantage	.585	25	.564	.2882	.4927
Overall Average	-.842	25	.408	-.3235	.3843

* = $p < .10$

No significant differences in any other success measure (other than profit goals) were observed, and in any other new product development activity (other than requirements definition) for either high or low market newness products. (These results are also shown to be significant with the Mann-Whitney U tests in tables 28 and table 29-appendix B).

4.5.3 Technological Newness, End-User Involvement and Success

Let us now examine differences in success between groups with high and low perceptions of end-user involvement within the technologically newer products. In this case, it is differences in perceptions of end-user involvement during trials and testing activities that has the greatest effect on product success. The results show significant differences in the achievement of profit goals, of competitive advantage, and of overall success, between high and low end-user involvement groups (table 30). However, the direction of this relationship is the key finding of our research. For technically newer products, those with managers having perceptions of a higher degree of end-user involvement during trials and testing activities tend to be less successful (in terms of profit goals, competitive advantage, and overall) than those with lower perceptions of end-user involvement during trials and testing. In other words, involving end-users more during the trials and testing activities of really new technologies is detrimental to product success (See top half of figure 6).

**Table 30 – Two Group t-test: Mean differences in product success measures
between high and low end-user involvement in trials and testing activities
for *high technological newness* products**

Product Success Measures	T	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	-1.503	29	.144	-.9495	.6317
Met Profit Goals	-1.731	29	.094*	-.8131	.4698
Met Quality Specifications	-1.166	30	.253	-.5942	.5098
Provided a Competitive Advantage	-1.869	30	.071*	-.8599	.4602
Overall Average	-.2095	30	.045**	-.7899	.3770

** = $p < .05$

* = $p < .10$

Figure 6 - Testing Hypothesis 4 for Technological Newness

* Significant success measures include: Profit goals; Competitive advantage; and Overall product success

** Significant success measures include: Revenue goals; Profit goals; Competitive advantage; and Overall product success

On the other hand if we look at products in the low technical newness group, those with managers having higher perceptions of end-user involvement during trials and testing activities score significantly higher on almost all the success measures (revenue goals, profit goals, competitive advantage, and overall success) (table 31). Incrementally new technologies stand to significantly benefit from increased perceptions of end-user involvement during trials and testing activities (See bottom half of figure 6). (Again, these results are supported by the Mann-Whitney U tests. See table 32 and table 33 in appendix B).

Table 31 – Two Group t-test: Mean differences in product success measures between high and low end-user involvement in trials and testing activities for *low technological* newness products

Product Success Measures	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	2.201	16	.043**	1.6169	.7347
Met Profit Goals	1.767	16	.096*	1.3831	.7828
Met Quality Specifications	.829	17	.418	.4464	.5383
Provided a Competitive Advantage	1.870	17	.079*	1.0238	.5474
Overall Average	2.164	17	.045**	1.0967	.5069

** = $p < .05$; * = $p < .10$

End-user involvement during trials and testing is the only new product development activity where high or low perceptions of end-user involvement leads to differences in success for really new or incrementally new technologies. However, if we compare groups of high and low perceptions of end-user involvement split on the basis of the

average of all the end-user involvement measures, or overall perceptions of end-user involvement in new product development activities, we also find differences in success.

Technically newer products score significantly less on product quality when overall perceptions of end-user involvement are higher (table 34). On the other hand, when technical newness is lower, revenue, competitive advantage, and overall success is higher for the products with more overall perceptions of end-user involvement (table 35). So, overall perceptions of end-user involvement in new product development activities have a positive effect on the success of products with low technological newness (See figure 7). Therefore, the direction of the relationship between overall perceptions of end-user involvement and success provides added support to the findings described above for perceptions of end-user involvement in trials and testing. (See table 36 and table 37 in appendix B for the results of the Mann-Whitney U test for these cases).

Figure 7 - Testing Hypothesis 4 for Technological Newness

* Significant success measures include: Revenue goals, Competitive advantage, and Overall product success

Table 34 – Two Group t-test: Mean differences in product success measures
between high and low overall end-user involvement in new product development
activities for *high technological* newness products

Product Success Measures	t	degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	.577	29	.568	.3509	.6077
Met Profit Goals	-.673	29	.506	-.3070	.4563
Met Quality Specifications	-.2444	30	.021**	-1.0648	.4357
Provided a Competitive Advantage	-.530	30	.600	-.2348	.4430
Overall Average	-.905	30	.373	-.3300	.3646

** = $p < .05$

Table 35 – Two Group t-test: Mean differences in product success measures
between high and low overall end-user involvement in new product development
activities for *low technological* newness products

Product Success Measures	t	Degrees of freedom	Significance (2-tailed)	Mean Difference	Standard Error Difference
Met Revenue Goals	2.081	16	.054*	1.6846	.8097
Met Profit Goals	1.632	16	.122	1.4077	.8624
Met Quality Specifications	1.200	17	.247	.6929	.5775
Provided a Competitive Advantage	3.049	17	.007***	1.6143	.5295
Overall Average	2.492	17	.023**	1.3375	.5366

*** = $p < .01$

** = $p < .05$

* = $p < .10$

4.5.4 Regression Analysis

Our next step is to fit several ordinary least squares regression models to the data in order to further test Hypothesis 4 and the negative relationship between perceptions of end-user involvement and success for technically new products. Using only the products with high technological newness, we test the following model:

$$\text{Profit} = \alpha_0 + \beta_1 * (\text{technical newness}) - \beta_2 * (\text{end-user involvement in trials and testing})$$

Table 38 shows the parameter estimates and their significance. Both predictors are significant ($p < .05$) and the model fits reasonably well ($R\text{-Square} = .246$). The results of this regression analysis highlight our study's core finding: the existence of a negative relationship between perceptions of end-user involvement in trials and testing and the achievement of profit goals, for technically new products. All the major linear regression assumptions have been verified. (See Appendix C for details, tables and plots).

Table 38 – Linear regression model for high technological newness products

Dependent variable = Met profit goals

$R\text{-Square} = .246$

Total degrees of freedom = 30

Parameter	Standardized Coefficients - Beta	t	Significance
Constant		1.229	.229
End-User Involvement in Trials and Testing	-.407	-2.460	.020**
Technological Newness	.344	2.075	.047**

** = $p < .05$

We will now test other regression models in order to assess the robustness of this relationship (end-user involvement and success). The next model we fit uses the average of the measures of perception of end-user involvement during trials and testing and product launch (i.e. end-user involvement in the later activities of the product development process) as a predictor. Again, we only use the high technical newness group:

$$\text{Profit} = \alpha_0 + \beta_1 * (\text{technical newness}) - \beta_2 * (\text{average of end-user involvement in trials and testing and in product launch})$$

Table 40 presents the results of the regression analysis and both predictors are significant ($p < .05$). Although the model does not fit the data as well as the previous one ($R^2 = .218$), it lends further support to our conclusion.

Table 40 – Linear regression model for high technological newness products

Dependent variable = Met profit goals

R-Square = .218

Total degrees of freedom = 30

Parameter	Standardized Coefficients - Beta	t	Significance
Constant		1.016	.318
Average of End-User Involvement in Trials and Testing and Product Launch	-.377	-2.195	.038**
Technological Newness	.374	2.181	.037**

** = $p < .05$

We then test two other models that also provide added robustness to the hypothesis test. We insert overall perceptions of end-user involvement (the average of all the end-user involvement measures) as a predictor, rather than perceptions of end-user involvement only during trials and testing activities.

$$\text{Profit} = \alpha_0 + \beta_1 * (\text{technical newness}) - \beta_2 * (\text{overall end-user involvement})$$

Although the technical newness parameter is not significant, the sign of the coefficients (positive and negative) and the p-values (.063 and .198) illustrate the overall trend in the data: for technologically newer products, increases in perceptions of end-user involvement result in lower success (table 41).

Table 41 – Linear regression model for high technological newness products

Dependent variable = Met profit goals

R-Square = .137

Total degrees of freedom = 30

Parameter	Standardized Coefficients - Beta	t	Significance
Constant		.837	.410
Overall End-User Involvement	-.241	-1.319	.063*
Technological Newness	.354	1.939	.198

* = p < .10

We then use overall success (the average of all the product success measures) rather than profit goals as the dependent variable:

Overall success = $\alpha_0 + \beta_1 * (\text{technical newness}) - \beta_2 * (\text{end-user involvement in trials and testing})$

Once again, the technical newness parameter is not statistically significant, but the coefficients and p-values also allow us to draw similar conclusions about the existence of a negative relationship between managers' perceptions of end-user involvement and success for technologically new products (table 42).

Table 42 – Linear regression model for high technological newness products

Dependent variable = Overall Product Success

R-Square = .153

Total degrees of freedom = 30

Parameter	Standardized Coefficients - Beta	T	Significance
Constant		2.627	.014**
End-User Involvement in Trials and Testing	-.369	1.088	.285
Technological Newness	.188	-2.139	.041**

** = p < .05

We also tried to fit other models that support our previous results from the t-tests. For example, no regression equation that corroborates the previous finding that perceptions of

end-user involvement during requirements definition activities is positively associated with profit goals for products with high market newness, was statistically significant. Similarly, we were unable to build a significant regression model illustrating that, for low technical newness, increases in perceptions of end-user involvement during trials and testing leads to more profits.

None of these additional models resulted in any findings worth reporting. We also inserted various control variables in the regression equations that are believed to have an impact on product success or that may moderate the relationship between perceptions of end-user involvement and success. Variables such as project size, project length, percentage of hardware versus software in the product, company size (number of employees, annual revenues) were inserted in the equations and none of them improved the fit of the models or were statistically significant.

5.0 CONCLUSIONS AND DISCUSSION

5.1 Main Findings

The results of our data analysis point to three key findings. The first one relates to Hypothesis 1 and the relationship between product newness and perceptions of end-user involvement in new product development activities. When developing products with a higher level of technological newness managers tend to believe that they involve end-users more in new product development activities than when developing less technically new products. Figure 11 provides a graphical illustration of this relationship.

Hypothesis 4 proposes that a negative relationship exists between perceptions of end-user involvement in new product development activities and success when newness is high. Our second main finding relates to this relationship but in the opposite direction. This finding reveals that a positive relationship exists between perceptions of end-user involvement and success when the product's market is really new. It states that products addressing newer markets, and with higher perceptions of end-user involvement during

requirements definition and design specification activities, will achieve their profit goals better than products with lower perceptions of end-user involvement during requirements definition. Conversely, for products with low levels of market newness, perceptions of end-user involvement in requirements definition is detrimental to the achievement of profit goals (See figures 12 and 13).

Figure 12 - High Market Newness Products

Figure 13 - Low Market Newness Products

This study's third and most interesting result remains the confirmation of Hypothesis 4, for technologically new products, during a specific product development activity. Technologically new products, with increased perceptions of end-user involvement during trials and testing activities, do not achieve their profit goals to the same extent as the products with lower perceptions of end-user involvement during trials and testing. On the other hand, when technological newness is low, the achievement of profit goals is enhanced by higher perceptions of end-user involvement in trials and testing (See figures 14 and 15).

Figure 14 - High Technological Newness Products

Figure 15 - Low Technological Newness Products

In the following sections, we shall interpret these three results within the context of our study's sample as well as link them to the existing literature on new product development and technological innovation. We conclude with some managerial implications, the study's limitations, and directions for further research in this area.

5.2 The Impact of Product Newness on Customer Involvement

Our study's first objective was to explore the link between product newness and customer involvement in the product development process. Our first main finding indicates that a robust relationship between newness and perceptions of end-user involvement can be established only when we look at product newness from a technological perspective. The more technologically new a product, the more managers perceive end-users to be involved in new product development.

However, there is one new product development activity where both end-users and other customer personnel are perceived to be more involved as a function of newness: trials and testing. In addition, this result is consistent across all dimensions of newness: overall, market, and technological. This is probably due to the importance of this activity in technology-based industries. For most types of industrial products, where consumer market research methods cannot be applied, testing by potential end-users and customers is a crucial part of product development and firms would never dream of launching a new product without an adequate number of trials and sufficient testing. Therefore, managers

believe that increased customer involvement in trials and tests will reduce some of the uncertainty related to developing really new products. However, this strategy carries certain risks and consequences for product success in certain cases that are discussed later.

5.3 Product Success in New Markets

The second key finding we report is the difference in product success, when market newness is high, between products with high and low levels of perceptions of end-user involvement during requirements definition and design specification activities. When targeting a new market, increased perceptions of the involvement of end-users in requirements definition leads to greater achievement of profit goals. The reverse of this relationship was shown to be significant for low market newness products. For products addressing known markets, increased perceptions of end-user involvement in requirements definition leads to less profits.

When developing products for customers that are relatively unknown to their firm, with needs that are also not well known, it becomes critical to involve users in the development process in order to gather their requirements and develop a product that will respond to their needs. The requirements definition and design specification activities are essential steps in the new product development process. It is here that major decisions must be made with respect to the product's architecture and its design. Therefore, gathering adequate data from a market that is somewhat unknown becomes of utmost importance. In addition, when targeting a new set of customers, getting them involved in product development can play an important role in product marketing and help stimulate sales in this new market.

Requirements definition and design specification also represent activities that require the least amount of past experience and relationship with customers. Users participating in these types of activities can do so without needing to invest as much or to allocate as much resources to it relative to participation in other product development activities. By contrast, getting customers involved in technical development or trials and testing activities requires a prior relationship with the customers given the investment that participation in these types of activities demands (Matthews, 1996). It follows that firms are more likely to be successful in involving end-users (and in perceiving their involvement as being significantly higher) in requirements definition rather than in other activities when they have no prior relationship with them.

On the other hand, when dealing with well-known customers whose needs are also well defined, involving them to a great extent in requirements definition may prove counterproductive. Having to deal with end-users is a time-consuming process and can lead to delays in product development. High-technology markets confer great rewards to firms that possess a first-mover advantage. Capturing a larger share of the market early on can lead to considerable differences in future revenue and profit streams. Therefore, considering how critical time to market can be to profits, a slight delay in the launch of a new product can have a significantly adverse effect on profits. In addition, increased involvement of end-users can also lead to higher development costs and thus lower profits. Hence, managers' perceptions of lower end-user involvement for known markets.

In their comparison of the product development practices of really new and incremental new products, Song and Montoya-Weiss (1998) find that business and market opportunity analysis is the most important factor for incremental new product success, but it has a negative impact on really new product success. They argue that for incremental new products, that usually involve an existing market and proven technology, business and market opportunity analyses are critical to understanding market trends, user requirements and competitor capabilities. Although our findings do not directly contradict their arguments, we propose that the extent to which users are involved (and managers perceive them to be) in requirements definition and design specification activities is an important moderator of the relationship with success. Market studies are important when developing incremental new products but firms must beware of spending too much time and resources on gathering user requirements when the

market is well-known and time to market rather than technical excellence is a critical success factor.

5.4 Successfully Commercializing Really New Technologies

When the technology rather than the market is new, perceptions of involvement in trials and testing activities becomes a determining factor for reaching profit goals. Greater involvement of end-users in trials and testing of really new technology leads to products that are less successful overall. This finding proposes an important caveat to the conventional wisdom claiming that firms must understand user needs and incorporate them into a new product's design in order to be successful. The different dimensions of newness as well the specific activities where users are involved must be considered in order to ensure that success is in fact attained.

Possible explanations for this finding revolve around the quality and the accuracy of information generated by end-users who are unfamiliar with a new product's technology. End-users who are accustomed to a current product's features, capabilities, and usage patterns will have great difficulty providing adequate feedback and accurate market data

for a really new product that requires a radical change in thinking and behavior. In addition, gathering user input for technically new products may also lead to delays in the development process and thus to lower profits. In fact, conducting trials and tests of technology that is still uncertain or unstable can be a very challenging, time-consuming and capital-intensive process.

Our finding that perceptions of too much end-user involvement in new product development is not beneficial to product success seems to corroborate Christensen's (1997) view that leading firms in the rigid disk drive industry failed because of the influence that their existing customers exerted on the firms' product development activities. Existing customers were reluctant to adopt next generation 'disruptive' technologies because these technologies failed to respond to their needs that were being met by current generation 'sustaining' technologies. Existing customers asked their manufacturers for incremental improvements in current technologies rather than radically new technologies. Therefore, leading firms consistently lagged newer entrants when next generation technologies replaced the old ones. Not only are users 'blind' to the capabilities of new technologies that they are unfamiliar with, but they are understandably reluctant to adopt new technologies that require that they replace whole systems and infrastructures. Users who test really new products have no interest in seeing their current investment in a given technology rendered obsolete. Therefore, their feedback on trials and tests may not provide an accurate assessment of the market's true needs, and may come to reflect their status-quo bias, path dependencies, and aversion to radical change. In other words, excessive end-user involvement in trials and tests may

lead firms to develop products that are technologically new but end up as marketplace failures given that they incorporate the influence of end-users that have a vested interest in maintaining the current product architecture.

On the other hand, products with only marginally new technology benefit unconditionally from increased perceptions of end-user involvement in trials and testing. Again, this reinforces the argument that end-users are a valuable and useful source of feedback on products that they are familiar with, that provide improvements to the current technological regime, and that do not require radical changes in usage patterns or mandate wholesale shifts to new architectures.

5.5 Managerial Implications

Our findings lead to several implications for managers of high technology new product development. The two key insights that emerge are: managers need to pay close attention to the various newness attributes of the products they are developing; and they must also become preoccupied with changing levels of end-user involvement during the different activities of the new product development process.

In our sample of computer telephony products, technological newness was a determining factor affecting the extent of the perceptions of the involvement of end-users during trials and testing activities. However, products with high perceptions of end-user involvement during trials and testing also turned out to be less successful than their counterparts with lower perceptions of end-user involvement. Managers must be careful not to involve end-users indiscriminately in the product development activities of really new products.

Product newness is a multidimensional construct and therefore, managers must involve end-users very carefully according to the product's specific newness attributes (market or technological). Similarly, user involvement must evolve dynamically across all the different product development activities rather than remain static from idea generation to launch.

When developing incremental new technologies, firms should increase the extent to which end-users are involved in trials and testing. Conversely, firms should restrain end-user involvement during trials and testing when the product is based on a radically new technology. Therefore, end-user involvement in trials and testing activities needs to be moderated by the product's level of technical newness.

For products addressing new customers and new needs, the inverse relationship applies. The newer the market, the more end-users need to be involved in requirements definition and design specification. On the other hand, when a firm knows the customers and their needs, the product will be more profitable if the firm does not involve end-users in requirements definition as much. There appears to be a real danger in involving end-users systematically and consistently in all new product development activities and irrespective of the product's particular newness attributes.

5.6 Limitations of the Study

This study uses a single industry at a single point in time as the sampling frame.

Therefore, there will be severe limits to the generalizability of this research. Although it

can be argued that computer telephony product manufacturers and software developers in 1999 are not representative of the high technology industry at-large, we are justified in selecting this industry as our population because we are interested in studying products based on radically new technologies and the computer telephony industry in 1999 is an adequate setting given these research objectives. Nonetheless, our study may suffer from an industry-specific and a temporal bias that will make generalizations to other industries such as semiconductors or biotechnology, and to other time periods, difficult.

A multiple respondent approach would certainly have improved data reliability. Relying on respondents' recollection of specific events having occurred in the past yields results that can be inaccurate and subjective. However, time and cost considerations prevented us from using more than one respondent per firm and from gathering additional observations. In addition, the number of t-tests conducted on the set of variables raises concerns of an inflated type I error and the possibility that the significant results observed are in fact spurious.

Another possible concern with the results relates to the issue of reverse causality. Could the relationships between the variables be interpreted in the opposite direction? i.e. when technologically new products are unsuccessful, managers increase the extent of user involvement. This concern is addressed by invoking the three criteria required to establish causality: association, temporal precedence, and non-spuriousness of results. In this case, we have a certain degree of association between the variables. We also have temporal precedence given that product success is assessed at a point in time when

product development is complete. Therefore, success always comes after user involvement in new product development and reverse causality cannot be attributed to the relationships found in this study.

Finally, the findings must be interpreted carefully. Our hypotheses were supported in very specific cases and support for the more general propositions was not obtained with this data set. The study can be replicated in other high technology industries in order to put the hypotheses to a more stringent test. Similarly, the study can be replicated within the same industry at a later point in time to further test the stability of our conclusions.

5.7 Directions for Future Research

Given its findings well as its limitations, this study points to several avenues for further research. Researchers investigating radical new product development processes may wish to focus on the use of specific market research methods such as focus or user groups, as well as on customer involvement in pre-development activities as a function of product newness. A longitudinal design would also allow researchers to gain deeper insight into the evolution of user involvement during the various activities of the product development process as well a greater understanding of the specific methods of user involvement and the context in which they were used. Other possibilities for improving on the research design include using multiple respondents to cross-validate the responses and ensure greater reliability of the results. Similarly, a dyadic research design that matches developers and users would also improve reliability and provide a more accurate description of user involvement in new product development. A valuable contribution to

this area would be to develop a scale for assessing the extent of user involvement in new product development that relies less on managers' perceptions of their involvement but is rooted in specific activities and measures the extent and the strength of the interaction between producers and users at different stages and activities of the development process. Several sources of archival data can be mined for this type of information. Company announcements of limited product releases, beta sites, research agreements, joint product development...can be used as measures of user-producer interaction for the development of new products.

Another interesting research avenue would be to relate this research to Moore's (1995) technology lifecycle framework. Moore argues that firms must beware of "the chasm" (Moore, 1991) in the innovation diffusion process when marketing discontinuous new technologies. Radically new technologies tend to appeal to a select group of 'techies' and 'early adopters' and they are frequently the ones that firms rely on to test really new technologies. Involving these users too much may lead to products that are too complex and that fail to generate any mass-market appeal. Products may also end up incorporating particular, idiosyncratic features that only appeal to the users that were involved in the tests. Our study provides some initial support for Moore's hypotheses and additional research can further expand on these findings to determine how the model stands up to a more robust empirical test of the propositions. Our research found that new technologies that involved end-users more in trials and testing activities were less successful. If the end-users involved in new product development are in fact these 'techies' and early adopters, they are not representative of the larger market and the product may not appeal to the mainstream users and end up as a marketplace failure.

In addition, Moore (1995) argues that once a new technology is accepted by the mainstream market and customers start adopting it a very rapid rate, it enters the 'tornado' or the 'hypergrowth' phase. Therefore, firms must only be concerned with satisfying demand and need to disregard specific customer requirements in order to capture as much market share as possible before the 'tornado' is over and everyone has chosen a vendor. Our results show that when products target known markets, increased perceptions of end-user involvement are negatively associated with success. This finding also lends support to Moore's view by showing that in certain instances, being too focused on user-defined requirements may be detrimental to success.

There are several interesting ways of building on these results. One would be to assess the level of customer involvement in new product development according to the position of the product in the technology adoption lifecycle. This requires asking questions to determine the characteristics of the buyers of the product to see how they map on to the categories describes by Moore i.e. the level of technological understanding of the buyer, the primary motivation for buying, the extent of involvement in the buying or decision making process... Another would be to understand how a product's design changes as it evolves from one stage of the lifecycle to the next based on its level of technological development or sophistication. An important contribution of these types of studies would be the development of an empirically robust typology of product users and buyers as well as a typology of product categories that map on to Moore's categories i.e. core technology, customized solution, 'whole product', technological commodity...

6.0 REFERENCES

- Brown, S.L. and K.M. Eisenhardt (1995) Product Development: Past Research, Present Findings and Future Directions. *Academy of Management Review*, 20: 343-378.
- Burgelman, R.A. and L.R. Sayles (1986) *Inside Corporate Innovation: Strategy, Structure and Managerial Skills*. The Free Press, New York, NY.
- Chandy, R.K. and G.J. Tellis (1998) Organizing for Radical Product Innovation: The Overlooked Role of Willingness to Cannibalize. *Journal of Marketing Research*, 35: 474-487.
- Christensen, C.M. (1997) *The Innovator's Dilemma*. Harvard Business School Press, Boston, MA.
- Christensen, C.M. and R.S. Rosenbloom (1995) Explaining the Attacker's Advantage: Technological Paradigms, Organizational Dynamics, and the Value Network. *Research Policy*, 24: 233-257.
- Christensen, C.M. and J.L. Bower (1996) Customer Power, Strategic Investment, and the Failure of Leading Firms. *Strategic Management Journal*, 17: 197-218.
- Ciccantelli, S. and J. Magidson (1993) Consumer Idealized Design: Involving Consumers in the Product Development Process. *Journal of Product Innovation Management*, 10: 341-347.
- Cooper, R.G. (1979) The Dimensions of Industrial New Product Success and Failure. *Journal of Marketing*, 43: 93-103.
- Cooper, R.G. and E.J. Kleinschmidt (1987) New Products: What Separates Winners from Losers? *Journal of Product Innovation Management*, 4: 169-184.

- Eliashberg, J., G.L. Lilien and V.R. Rao (1997) Minimizing Technological Oversights: A Marketing Research Perspective in R. Garud, P.R. Nayyar and Z.B. Shapira (Eds.) *Technological Innovation: Oversights and Foresights*. Cambridge University Press, UK. pp. 214-230.
- Griffin, A. and A.L. Page (1996) PDMA Success Measurement Project: Recommended Measures for Product Development Success and Failure. *Journal of Product Innovation Management*, 13: 478-496.
- Hamel, G. and C.K. Prahalad (1994) *Competing for the Future*. Harvard Business School Press, Boston, MA.
- Kleinschmidt, E.J. and R.G. Cooper (1991) The Impact of Product Innovativeness on Performance. *Journal of Product Innovation Management*, 8: 240-253.
- Kohli, A.K. and B.J. Jaworski (1990) Market Orientation: The Construct, Research Propositions, and Managerial Implications. *Journal of Marketing*, 54: 1-18.
- Leonard, D. (1992) Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development. *Strategic Management Journal*, 13: (7), 111-125.
- Leonard, D. (1995) *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*. Harvard Business School Press, Boston, MA.
- Lynn, G.S., J.G. Morone and A.S. Paulson (1996) Marketing and Discontinuous Innovation: The Probe and Learn Process. *California Management Review*. 38: 3, 8-37
- Martin, J. (1995) Ignore Your Customer. *Fortune*, (May 1), 123-126.
- McDermott, C.M. (1998) "Discontinuous Innovation" in Dorf, R. (Ed.) *The Technology Management Handbook*. CRC Press. Boca Raton, FL.

- Macdonald, S. (1995) Too Close for Comfort?: The Strategic Implications of Getting Close to the Customer. *California Management Review*. 37: (4), 8-27.
- Matthews, J. M. (1996) *Customer Producer Interaction in Industrial Product Development: An Interorganizational Perspective*. Unpublished DBA Dissertation, Harvard Business School, Boston, MA.
- Moore, G. (1991) *Crossing the Chasm*. HarperBusiness. New York, NY.
- Moore, G. (1995) *Inside the Tornado*. HarperBusiness. New York, NY.
- Neale, M.R. and D.R. Corkindale (1998) Co-developing Products: Involving Customers Earlier and More Deeply. *Long Range Planning*, 31: (3), 418-425.
- Nelson, R. R. and S. G. Winter (1982) *An Evolutionary Theory of Economic Change*. Harvard University Press. Cambridge, MA.
- O'Connor, G.C. (1998) Market Learning and Radical Innovation: A Cross Case Comparison of Eight Radical Innovation Projects. *Journal of Product Innovation Management*, 15: 151-166.
- Peters, T.J. and R.H. Waterman, Jr. (1982) *In Search of Excellence: Lessons from America's Best Run Companies*. Harper & Row, New York, NY.
- Prahalad, C.K. and G. Hamel (1990) The Core Competence of the Corporation. *Harvard Business Review*. May-June: 79-91.
- Rothwell, R., C. Freeman, A. Horsley, V.T.P. Jervis, A.B. Robertson and J. Townsend (1974) SAPPHO Updated - Project SAPPHO Phase II, *Research Policy*, 3: 258-291.
- Slater, S.F. and J.C. Narver (1998) Customer-Led and Market-Oriented: Let's Not Confuse the Two. *Strategic Management Journal*, 19: 1001-1006.

- Song, X.M. and M.M. Montoya-Weiss (1998) Critical Development Activities for Really New versus Incremental Products. *Journal of Product Innovation Management*, 15: 124-135.
- Teece, D. J. (1988) Capturing Value from Technological Innovation: Integration, Strategic Partnering, and Licensing Decisions. *Interfaces*. 18: 3, 46-61.
- Urban, G.L., B.D. Weinberg and J.R. Hauser (1996) Premarket Forecasting of Really New Products. *Journal of Marketing*, 60: 47-60.
- Urban, G.L. and E. von Hippel (1988) Lead User Analysis for the Development of New Industrial Products. *Management Science*, 34: (5) 569-582.
- Veryzer, R.W.Jr. (1998) Key Factors affecting Customer Evaluation of Discontinuous New Products. *Journal of Product Innovation Management*, 15: 136-150.
- von Hippel, E. (1986) Lead Users: A Source of Novel Product Concepts. *Management Science*, July, 32: (7) 791-805
- Wind, J. and V. Mahajan (1997) Issues and Opportunities in New Product Development: An Introduction to the Special Issue. *Journal of Marketing Research*, 34: 1-12.
- Zirger, B.J. and M.A. Maidique (1990) A Model of New Product Development: An Empirical Test. *Management Science*, July, 36: (7), 867-883.

APPENDIX A: QUESTIONNAIRE

User Involvement in New Product Development

Objectives of the Research:

To understand the role that potential end-users and customers play in the development process of new telecom and CTI products, based on the level of newness of the product.

To provide clear managerial guidelines for developers of new telecom and CTI products.

Instructions:

Please answer the following questions based on a **recently completed** new product development project in which you were involved, and of which you have in-depth knowledge.

This questionnaire should take less than 15 minutes to complete. You may fax it back to the School of Business at Carleton University, to the attention of Eytan Lasry: 613-520-2532.

All responses will be kept **strictly confidential**.

Thank you for your time and cooperation.

Product Name: _____

1. From product conception to product launch, how long did this project take?

_____ months

2. When was the product released to the end user (month and year)?

3. What is, based on cost of development and integration, the proportion of hardware and software in the final product?

_____ % Hardware

_____ % Software

4. Approximately how much money did your organization invest in this project?

\$ _____

Section 1 - Newness of the Product

5. How new was this product compared to your company's other products? Circle the appropriate number for each of the following dimensions.

How new were / was the:	Not New at all		Moderately New			Very New	
Customers targeted by the new product	1	2	3	4	5	6	7
User needs addressed by the new product	1	2	3	4	5	6	7
Technology embodied in the new product	1	2	3	4	5	6	7
Product's architecture	1	2	3	4	5	6	7
Core components or software modules in the product	1	2	3	4	5	6	7

Section 2 - The Development Process

6. How important was the input provided by potential end-users of the product during each of the five activities of the development process? Circle the appropriate number.

Development Activities	Input from potential end-users						
	Not Important		Moderately Important			Very Important	
Idea generation and screening	1	2	3	4	5	6	7
Requirements definition and design specification	1	2	3	4	5	6	7
Technical development	1	2	3	4	5	6	7
Trials and testing	1	2	3	4	5	6	7
Product launch	1	2	3	4	5	6	7

7. Aside from end-users, **other individuals at potential customer firms** (i.e. *IT or technical support personnel, key decision-makers, buyers or influencers...*) may also provide input during the product development process. How important was the input provided by these **other individuals at potential customer firms** during each of the five activities of the development process? Circle the appropriate number.

Development Activities	Input from other individuals at potential customer firms						
	Not Important		Moderately Important			Very Important	
Idea generation and screening	1	2	3	4	5	6	7
Requirements definition and design specification	1	2	3	4	5	6	7
Technical development	1	2	3	4	5	6	7
Trials and testing	1	2	3	4	5	6	7
Product launch	1	2	3	4	5	6	7

8. Indicate with an "X" whether the following market research methods were used **during each of the five activities** of the development process. Specify any additional market research methods and indicate during which activities they were used.

Market Research Methods	Development Activities				
	Idea generation and screening	Requirements definition and design specification	Technical development	Trials and testing	Product Launch
Customer surveys					
Focus / Discussion groups					
User group feedback					
Alpha / Beta site testing					
In-house demos					
Customer site visits					
Direct observation of users					
Lead user analysis					
Technological forecasting					
Co-specification/development					
Other:					
Other:					
Other:					

Section 3 - Product Success Measures

9. Rate the degree to which the product met specific performance objectives. Circle the appropriate number.

To what extent has the product:	Well below Goals			On Target		Exceeded Expectations	
Met revenue goals	1	2	3	4	5	6	7
Met profit goals	1	2	3	4	5	6	7
Met quality specifications	1	2	3	4	5	6	7
Provided a competitive advantage	1	2	3	4	5	6	7

Section 4 - Supplementary Information

10. Where did the initial idea for this new product come from?

11. If end-users were not the main source of input during the product development process, what were the key sources of customer requirement information that your firm used?

12. With the benefit of hindsight, how would you change the manner in which user input was gathered during the development of this product ?

Section 5 - Company Information

13. Company name: _____

14. Main lines of business (check all that apply):

☐ Switching (PBX)	☐ Routing (ACD)	☐ IVR products
☐ Dialing equipment	☐ CTI applications	☐ Call center SW
☐ Hardware (chips, boards, cards...)	☐ Workforce management	☐ Help desk SW
☐ Recording and logging	☐ Internet telephony	☐ Wireless apps
☐ Other: _____		

15. Approximate number of employees in your division of the company: ☐ Under 100

☐ 101 - 500 ☐ 501 - 1000 ☐ 1001 - 5000 ☐ 5,001 - 10,000 ☐ 10,001 +

16. Approximate number of total employees in your company: ☐ Under 100

☐ 101 - 500 ☐ 501 - 1000 ☐ 1001 - 5000 ☐ 5,001 - 10,000 ☐ 10,001 +

17. Approximate annual revenues: ☐ Under \$1 million ☐ \$1 - \$10 million

☐ \$10 million - \$50 million ☐ \$50 million - \$100 million

☐ \$100 million - \$500 million ☐ \$500 million +

Should I require any additional information, I may need to contact you personally. Also, if you wish I will send you a copy of the research results. Please provide your:

Name: _____ Title: _____

Phone: (____) _____ Fax: (____) _____

Email: _____

Please check here _____ if you wish to receive a copy of the research results

Thank you again for your time and cooperation.

APPENDIX B: MANN-WHITNEY U TESTS

**Table 7 – Mann-Whitney U test: Mean differences in end-user involvement measures
between high and low *overall product* newness products**

End-User Involvement in:	Mann-Whitney U	Significance (2-tailed)
Idea Generation and Screening	294.00	.173
Requirements Definition and Design Specification	330.00	.469
Technical Development	348.50	.685
Trials and Testing	226.00	.011**
Product Launch	318.00	.350
Overall Average	327.00	.444

** = $p < .05$

**Table 9 – Mann Whitney U test: Mean differences in end-user involvement measures
between high and low *market* newness products**

End-User Involvement in:	Mann-Whitney U	Significance (2-tailed)
Idea Generation and Screening	342.00	.566
Requirements Definition and Design Specification	350.50	.674
Technical Development	361.50	.816
Trials and Testing	254.00	.036**
Product Launch	345.50	.611
Overall Average	368.00	.906

** = $p < .05$

Table 11 – Mann Whitney U test: Mean differences in end-user involvement measures
between high and low *technological* newness products

End-User Involvement in:	Mann-Whitney U	Significance (2-tailed)
Idea Generation and Screening	348.00	.726
Requirements Definition and Design Specification	209.50	.006***
Technical Development	269.00	.085*
Trials and Testing	228.50	.015**
Product Launch	265.00	.073*
Overall Average	209.500	.007***

*** = $p < .01$

** = $p < .05$

* = $p < .10$

Table 13 – Mann Whitney U test: Mean differences in other customer personnel
involvement measures between high and low *overall product* newness products

Other Customer Personnel Involvement during:	Mann-Whitney U	Significance (2-tailed)
Idea Generation and Screening	261.00	.427
Requirements Definition and Design Specification	288.00	.809
Technical Development	280.00	.685
Trials and Testing	208.50	.066*
Product Launch	221.00	.154
Overall Average	264.00	.475

* = $p < .10$

Table 15 – Mann Whitney U test: Mean differences in other customer personnel involvement measures between high and low *market* newness products

Other Customer Personnel Involvement during:	Mann-Whitney U	Significance (2-tailed)
Idea Generation and Screening	294.00	.832
Requirements Definition and Design Specification	263.50	.413
Technical Development	248.50	.259
Trials and Testing	214.00	.071*
Product Launch	234.50	.222
Overall Average	237.50	.187

* = $p < .10$

Table 17 – Mann Whitney U test: Mean differences in other customer personnel involvement measures between high and low *technological* newness products

Other Customer Personnel Involvement during:	Mann-Whitney U	Significance (2-tailed)
Idea Generation and Screening	291.00	.697
Requirements Definition and Design Specification	234.50	.133
Technical Development	287.50	.646
Trials and Testing	260.00	.318
Product Launch	240.50	.248
Overall Average	255.00	.279

Table 19 – Mann Whitney U test: Mean differences in the use of CIMRM
between high and low *market* newness products

Use of CIMRM during:	Mann-Whitney U	Significance (2-tailed)
Idea Generation and Screening	277.50	.328
Requirements Definition and Design Specification	268.00	.247
Technical Development	204.50	.018**
Trials and Testing	324.50	.918
Product Launch	319.00	.836
Overall Average	284.50	.359

** = $p < .05$

Table 21 – Mann Whitney U test: Mean differences in product success measures
between high and low *overall product* newness products

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	254.00	.376
Met Profit Goals	292.50	.926
Met Quality Specifications	316.50	.915
Provided a Competitive Advantage	244.00	.126
Overall Average	313.50	.872

**Table 23 – Mann Whitney U test: Mean differences in product success measures
between high and low *market* newness products**

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	223.50	.122
Met Profit Goals	250.00	.311
Met Quality Specifications	318.50	.915
Provided a Competitive Advantage	268.50	.278
Overall Average	280.50	.410

**Table 25 – Mann Whitney U test: Mean differences in product success measures
between high and low *technological* newness products**

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	287.50	.893
Met Profit Goals	276.50	.715
Met Quality Specifications	287.50	.539
Provided a Competitive Advantage	226.00	.067*
Overall Average	295.50	.654

* = $p < .10$

Table 28 – Mann Whitney U test: Mean differences in product success measures
between high and low end-user involvement in requirements definition
and design specification activities for *high market* newness products

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	58.00	.747
Met Profit Goals	32.00	.046**
Met Quality Specifications	59.00	.603
Provided a Competitive Advantage	56.50	.491
Overall Average	54.50	.437

** = $p < .05$

Table 29 – Mann Whitney U test: Mean differences in product success measures
between high and low end-user involvement in requirements definition
and design specification activities for *low market* newness products

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	78.50	.934
Met Profit Goals	48.50	.079*
Met Quality Specifications	59.50	.188
Provided a Competitive Advantage	71.00	.468
Overall Average	67.50	.376

* = $p < .10$

**Table 32 – Mann Whitney U test: Mean differences in product success measures
between high and low end-user involvement in trials and testing activities
for *high technological* newness products**

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	62.50	.102
Met Profit Goals	67.50	.153
Met Quality Specifications	75.50	.226
Provided a Competitive Advantage	60.00	.054*
Overall Average	54.00	.037**

** = $p < .05$; * = $p < .10$

**Table 33 – Mann Whitney U test: Mean differences in product success measures
between high and low end-user involvement in trials and testing activities
for *low technological* newness products**

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	19.00	.067*
Met Profit Goals	21.50	.113
Met Quality Specifications	32.00	.385
Provided a Competitive Advantage	22.50	.089*
Overall Average	20.50	.068*

** = $p < .05$

* = $p < .10$

Table 36 – Mann Whitney U test: Mean differences in product success measures between high and low overall end-user involvement in new product development activities for *high technological* newness products

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	95.50	.439
Met Profit Goals	97.50	.486
Met Quality Specifications	64.00	.019**
Provided a Competitive Advantage	101.50	.373
Overall Average	102.00	.408

** = $p < .05$

Table 37 – Mann Whitney U test: Mean differences in product success measures between high and low overall end-user involvement in new product development activities for *low technological* newness products

Product Success Measures	Mann-Whitney U	Significance (2-tailed)
Met Revenue Goals	14.50	.066*
Met Profit Goals	17.00	.115
Met Quality Specifications	22.00	.216
Provided a Competitive Advantage	9.00	.013**
Overall Average	11.50	.029**

*** = $p < .01$

** = $p < .05$

APPENDIX C: LINEAR REGRESSION ASSUMPTIONS

Collinearity statistics such as the variance inflation factors (VIF) are low and do not show any evidence of multicollinearity (table 39). A histogram (figure 8) and a normal probability plot of the residuals (figure 9) do not show any significant deviations from normality. A scatterplot (figure 10) of the residuals and predicted values shows no evidence of heteroskedasticity.

Table 39 – Collinearity Statistics

Parameter	Variance Inflation Factor (VIF)
Constant	
End-User Involvement in Trials and Testing	1.019
Technological Newness	1.019

Figure 8 - Histogram

Dependent Variable: Met Profit Goals

Figure 9 - Normal P-P Plot of
Regression Standardized Residual

Dependent Variable: Met Profit Goals

Figure 10 - Scatterplot

Dependent Variable: Met Profit Goals