Title: Exploring Factors that Improve the Probability of New Product Success

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Abstract: This report reviews factors that may influence the success or failure of new products in the high technology field. The failure rate for new products is high, what things could be done to improve the new product success rate?

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New Product Development

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Table of Contents

Introduction

This report reviews factors that may influence the success or failure of new products in the high technology field. The failure rate for new products is high, Cooper and Crawford estimate that one-third of newly introduced product fails [11]. Others estimate failure rates of more than 70%. What things could be done to improve the new product success rate?

My incentive for this project began in 1990. I reflected on new product development/introductions I had been experienced. Some were successful, some failures and some vanilla. Some that were expected to be a success were stunning failures. Other products introduced even though we expected them to be failures, became successes. One product was expected to be a failure became the second highest revenue generating product for Hewlett-Packard for three years. (Not bad for a failure).

Increasing the new product success rate is vitally important. As Cooper says, "A unique product that is first to market does not always mean success" [9]]. A truly successful new product is one that is introduced early and accepted by the market place.

Improving the New Product Success Rate

Anecdotal Research

The first writings on improving the New Product Success Rate are anecdotal, that is, it is not substantiated by disciplined scientific research. A case study is an example of anecdotal research. The concept of a case study is to study a businesses' practices and determine what practices are responsible for success or failure. This reinforces the idea that there is a simple cause and effect relationship where certain factors always result in success.

Examples of this are the numerous case studies (first introduced at Harvard Business School). Peters and Waterman's book *In Search of Excellence* is an

example of anecdotal research[18]. Peters and Waterman analyzed the practices of many successful firms. Success was defined at the time of writing, but would these firms be successful later on? They distilled what they thought were best practices and published them. Some of the firms that Peters and Waterman considered successes are no longer independent companies. Wang Laboratories is one example of a firm praised as excellent by Peters and Waterman and no longer exists as an independent business.

Anecdotal research has helped improve business practices however it has a shortcoming. Anecdotal research does not scientifically analyze if a practice that is considered important in improving the success rate will, if not used, decrease the chances of new product success. The same practice may be present in both successful new products and failures.

Scientific Research

Project SAPPHO

Project SAPPHO, conducted in the United Kingdom in the 1970s analyzed the New Product Success Rate of products by studying both successful and unsuccessful products [19]. The researchers used pair-wise comparison analysis to compare successes and failures. Thus by comparing the characteristics of each, they can identify the characteristics associated with successful projects and those characteristics that are associated with unsuccessful projects. Project SAPPHO's inspiration came from a discomfort with typical studies of innovation where the outcome was a single factor that was claimed to account for success. The SAPPHO researchers believed that new product development is a complex process where many factors interact.

Maidique and Zirger

Funded by the Stanford Innovation Project, Mitch Maidique and B. J. Zirger did a rigorous study of the characteristics of successful and unsuccessful products. They focused on pairs of high-technology products--successful ones

and unsuccessful ones. They surveyed general managers of high-technology firms who defined whether a product was a success or a failure.

Maidique and Zirger's research is divided into three parts, first analyzing the results of questionnaires from the general managers, second, conducting detailed interviews on a subset of the organizations above, and third, developing and testing a model of new product development.

Maidique and Zirger--First Research

In their article, "A Study of Success and Failure in Product Innovation: The Case of The U.S. Electronics Industry," published in IEEE Transactions on Engineering Management in 1984, Maidique and Zirger reported their findings [16].

Maidique and Zirger used the following research methodology: An open-ended survey was administrated to 120 participants of the Stanford-AEA Executive Institute, a summer executive education program. The participants were high-ranking executives of U.S. electronics companies. Out of 120 participants, 79 completed the survey.

The 79 participants were given a more detailed survey. Of these, 59 were complete. This provided information on 158 new products, 79 successes and 79 failures. Detailed case studies were completed at 20 sites, with interviews of people involved in both the successes and failures.

Survey 1 provided demographic information on the respondents and inputs into developing the second survey. The information about the new products was unstructured, thus avoiding biases from the questionnaire.

Survey 2 is a 69-question instrument that was analyzed using pair-wise, MANOVA, and Factor analysis statistical techniques [21].

First, a cumulative binomial statistic calculated if the variable was statistically significant in differentiating between new product success or failure. The results of the analysis on the 60 variables are shown in Table 1.

Table 1

Binomial Value	Number of Variables
x <= 1%	18
1% > x <= 5%	9
5% > x<= 10%	10
x> 10%	23

Of the sixty variables, 23 were not significant, 10 mildly significant, 27 were significant and 18 variables were very significant with <1% binomial value. Of these 18 variables, 14 related to product successes and 4 to product failures. The 14 product success variables are as follows:

1. Priced with higher profit margins
2. Allowed greater pricing flexibility
3. Better matched to customer needs
4. Market forecast more accurately
5. Development team more fully understood user needs
6. Developed with better coupled functional divisions
7. Developed with a clearer market strategy
8. Formalized on paper sooner
9. More significant with respect to benefit to cost ratio
10. More actively publicized and advertised

11. Supported more by senior management
12. Closer to main business area of firm
13. Promoted by a larger sales force
14. Aided by more in-house basic research

The following four factors were related to in a negative way with product failures at the very significant level.

1. Accepted more quickly by users
2. Developed with fewer personnel changes on project team
3. Required fewer new marketing channels
4. Less plagued with after sales problems

Second, cluster analysis was used to generate a systematic grouping of variables. To test the validity of the responses from one general manager for each product pair, in-depth interviews were conducted at 20 sites for 20 pairs. On the average, five people were interviewed at each site. The outcome was that there was no statistically significant difference between the findings from the single manager and a larger number of managers.

Maidique and Zirger concluded that a new product is more likely to be a success when:

1. The developing organization, through in-depth understanding of the customers and the market place, introduces a product with a high performance-to-cost ratio.
2. The developing organization is proficient in marketing and commits a significant amount of its resources to selling and promoting the product.
3. The product provides a high contribution margin to the firm.
4. The R&D process is well planned and executed.

5. The create, make and market functions are well interfaced and coordinated.
6. The product is introduced into the market early.
7. The markets and technologies of the new product benefit significantly from the existing strengths of the developing business unit.
8. There is a high level of management support for the product from the development stage through its launch to the market place.

Maidique and Zirger--Second Research

Published in Research Policy, December 1985 under the title *The New Product Learning Cycle*, this paper is a follow on to the personal interviews with members of 40 new product development teams, representing 20 product successes and 20 product failures [15].

The methodology was in-depth interviews with managers and technologists and write reports with transcripts or summaries, background information, the competitive environment and the product development process. In all, 101 managers and technologists were interviewed in 148 hours of interviews.

One of their learnings was that successful product teams used concrete not abstract terms to describe their customers. In most cases where the interviewee associated success with a better understanding of user needs, they supported this by describing specific actions or events. They told stories of how they worked directly with customers. They knew a handful of customers as friends.

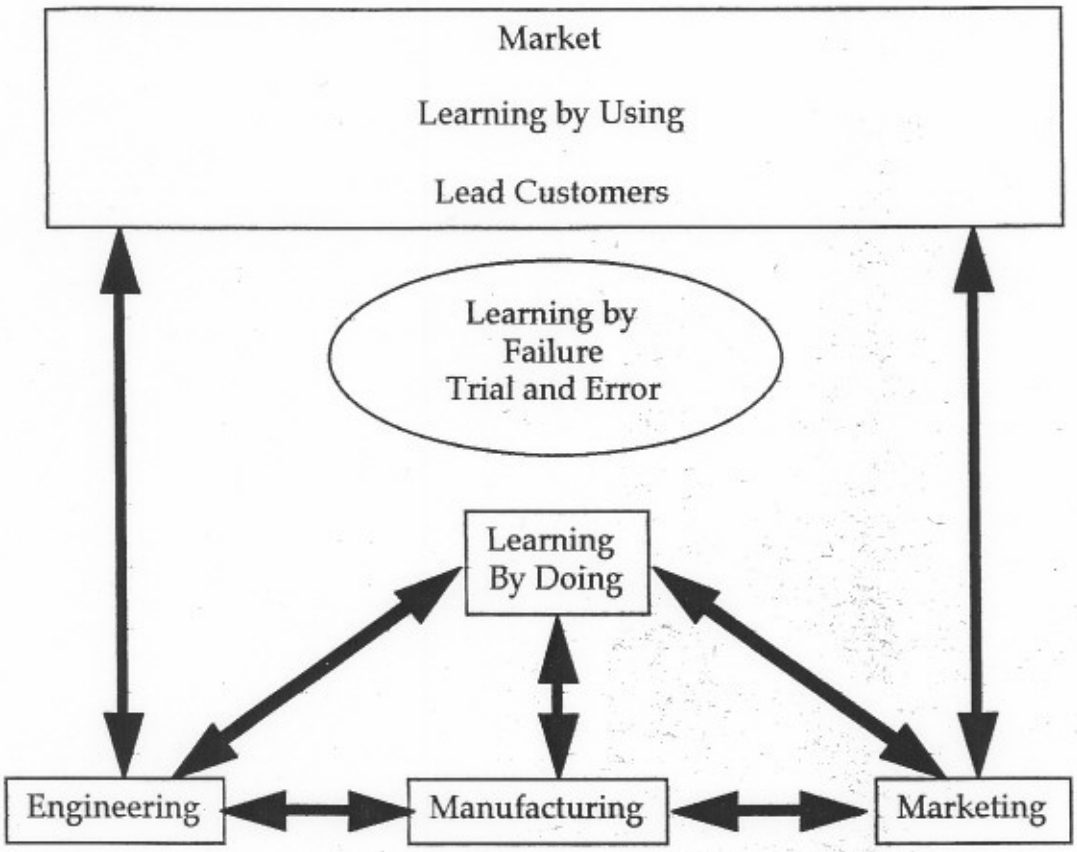
The actions to understand specific customer needs were in two types. First, the firm has such a complete understanding of the industry that they are able to develop successful products without having direct contact with customers. When Hewlett Packard was a scientific instrumentation company, they employed a form of this technique with their "next bench" approach. An

engineer would have an idea and discuss it with an engineer at the next bench to test and improve the idea. Because HP engineers were representative of the instrumentation customer base, next bench method was very successful. "Next bench" became part of the HP lore.

As HP expanded into computers, the next bench method failed. HP learned that asking another engineer what they thought of a computer idea was ineffective. They learned they had to transform the next bench process to contact computer users and managers.

This leads to the second method for understanding user needs. For successful products the interviewee described the company as "having more openly, frequently, carefully and continuously solicited and obtained customer reactions before, after and during the initiation of the development and launch process" [14]. Maidique and Zirger cited one company that conducted design reviews for new products at the customer's plant. The entire team heard the customer's suggestions directly and in the customer's environment. Today HP directly involves people from engineering, manufacturing and marketing in focus groups, trade shows and customer visits. HP knows that they don't know what customers need; hence they get out and learn what they need.

Maidique and Zirger developed the following model of the critical elements of new product development process.



Maidique and Zirger point out that mere listening is not enough. The successfully product teams listen deeply, without preconceived expectations of what the customer will say. You have to work hard to absorb information. You have to go from a "talk" mode to a "listen and feel" mode.

Scott McNeally, president of Sun Microsystems says his hero is "Detective Columbo" because of his constant listening and repeatedly asking simple questions. A Detective Columbo approach works very well to learn about customer. However, it is not a natural habit, especially for "talk only" Americans. Training is needed to develop good listening skills.

Robert G. Cooper

Cooper reports that there appears to be a high incidence of accepting projects that became failures [10]. He found that many new products that fail could have been screened earlier in the process and killed. Statistically

speaking, Cooper found that there were too many Type II failures. The solution was to develop a screening process and apply the discipline to follow it. The problem with screening better is that a product that would have been a success is not introduced. However, the new products introduced have a much higher probability of being successful than if the screening was not done.

True state →	Success	Failure
Predict Success	Success	Failure Type II error
Predict Failure	Success Type I error	Failure

Cooper describes four approaches to initial screening:

1. Benefit measurement models. Informed people provide subjective inputs about the project. Systematic solicitation and integration of benefit data. Scoring models are an extension.
2. Economic models. Decision treated as an investment decision. Use traditional analysis such as NPV, IRR, and Payback period. Sometimes Monte-Carlo simulation used. They require specific financial data which are seldom available in the beginning of a project.
3. Portfolio selection models. View the decision as part of a total resource calculation.
4. Market research approaches. Generally limited to simple consumer products.
5. Cooper states the accuracy of this model is 84% [7].

Cooper developed a set of action guides for product innovation managers to consider [8]. Based on a study of 122 industrial products firms, he found that

the strategy that a firm selects for its new product program is closely linked to the performance results that the firm achieves. He found that strategies that lead to high performance in one direction are quite different from strategies leading to high performance by other measures.

Cooper, in his article, "Selecting Winning New Product Projects: Using the NewProd System," views product screening as an effective way to increase the new product success rate [10]. Based on extensive industry study, he developed a model, NewProd for product screening.

Cooper uses a detailed questionnaire for key people in the development organization to develop a prediciton of new product success. The questions are divided into three parts [10].

1. New product project analysis
2. The new product process: general practices
3. Performance and suggestions

Following up on Cooper's NewProd report, Cooper and Kleinschmidt conducted a benchmarking study [6]. They propose that new product performance depends on five elements: the organization of the NPD program; the firm's NPD strategy; the firm's culture and climate for innovation; and senior management commitment to NPD. They describe 10 performance measures of a company's new product program: success rate, percent of sales, profitability relative to spending, technical success rating, sales impact, profit impact, success in meeting sales objectives, success in meeting profit objectives, profitability relative to competitors, and overall success. The 10 metrics are reduced to two program profitability and program impact.

Others

Calantone, Droge, and Vikery] state that there is no one best way to do New Product Development, and it is unlikely that a deterministic formula will be developed [4]. They found that success depends on a CEO's recognizing strategic value to assure appropriate resources are invested and coordination between design, engineering and manufacturing.

In the early, exploratory stage of studying new product development, Meyers and Marquis claim that most respondents respond with an example for a successful project [17]. The problem with this analysis is that it does not provide comparison data between successful and unsuccessful new product development efforts.

Bailetti and Litva point out that even when best efforts are made, the result may be introducing a new product that customers reject [2]. When the transfer of information from marketing to design is weak, design engineers overcome this by creating and applying their ideas about customer requirements. This creates inconsistency of customer requirements.

Bruce studied the risks in collaborative product development, pointing out the challenge of collaboration between different functions [3]. In his study, Bruce found that the main benefit of collaboration was satisfying customer requirements. To do this requires frequent communications among all parties.

The need for frequent communications relates to co-location of team members. This is reinforced in a graph presented in Smith and Reinertsen's book, Developing Products in Half the Time [20] . Allen reports that technical communications falls of rapidly with distance. A team separated by five meters has a 20% probability of meeting once per week, while a team separated by 20 meters has a 5% probability of meeting once per week [1].

In other words if team members are in different buildings or even on different floors of the same building, face to face communications will be significantly less than if they were collocated in a cramped area.

Chafin and Hughes describe effective product development as, trying to hit a moving target from atop a runaway train [5]. They add cyclical, continuous learning focusing on customer value to the new product development process.

They describe a transformation called value proposition process that involves continuous learning, identifying the certainty of knowledge for decision-making, building consensus, and focusing on adding value.

Datar, Jordan, Kekre, Rajiv and Kannan provide a contrary finding. They claim that two much of listening to customers can reduce time-to-market [12]. They found that too much listening creates confusion and duplication of effort.

They characterized new product development into two separate areas concentrated and distributed where concentrated has all the design team in one building and distributed has them.

Conclusions

Developing new products is a gamble. The only certainty is that a year after introduction, people will tell you, "I knew it all along." Unfortunately, when at introduction, they can not tell you if it will be a success or a failure.

Product development is an organic, unpredictable system not a simple cause and effect deterministic system. To believe that the product development process is deterministic is naive. One can never control complex systems. One can, however, influence the behavior of a complex system by knowing where critical pressure points are and applying appropriate actions. It is important to remember that this does not improve the system 100% of the time, rather it raises the probability of good results occurring.

The first conclusion is that new product success depends on much more than one variable. Viewing product success and failure as a one step, simple process is misleading. Some successful products are built on the learnings from product failures. Hewlett-Packard's first ink jet printer was a flop. Rather than give up on the concept, they studied what customers wanted and two years later introduced the successful line of ink jet printers [13].

After a failure, the firm would study what happened and why, and as a result they would get valuable ideas to help the follow on product succeed. On the other hand, the success of a product sets up an environment for future failures as people are promoted out of the team, and the success breeds an arrogance where "they know" what to do. As a result, the pattern for a failure following success is established [14].

Product success leads to failure because of arrogance. The team feels they know all the answers and don't have to do the research they did before. The Apple I, a failure was followed by the Apple II, a success, then Apple III, a failure, followed by Apple Ie a success then Lisa, another failure then Macintosh, a success. By achieving success one often lays the groundwork for future failures.

Diagram 1 below is my representation of a new product development process that will increase the probability of new product success. I believe that eliminating part of the actions in the diagaram will reduce the probability of new product success.

From left to right, here are the actions implied in the diagram.

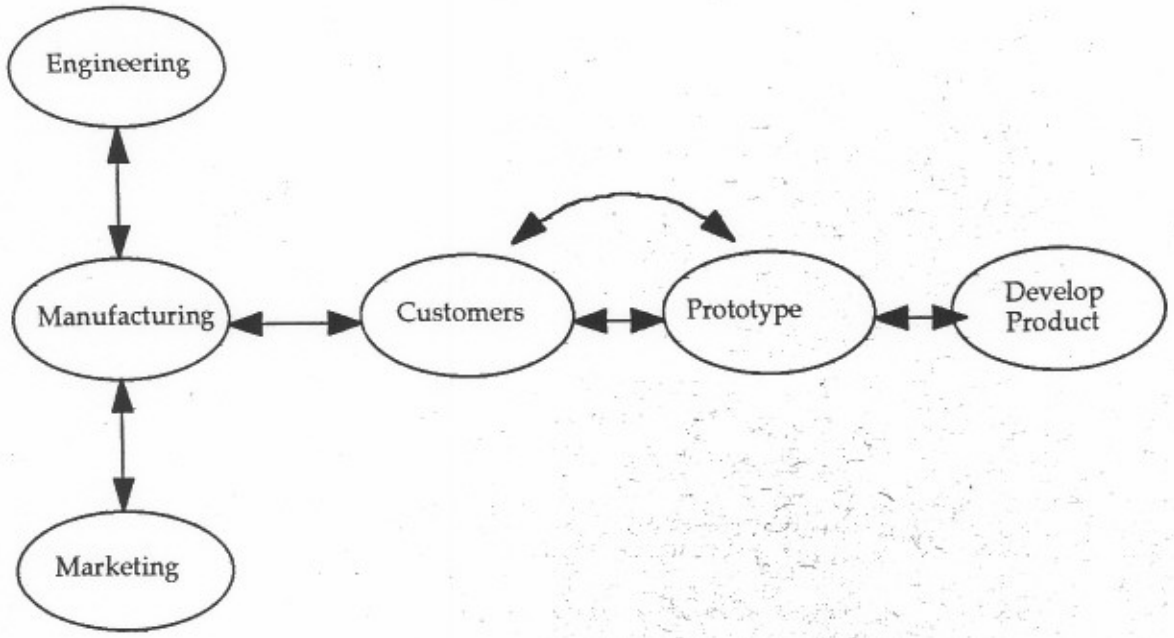
1. Collocate the engineering, manufacturing and marketing representatives of the new product development team. Keep them very close together so that they can overhear each other's conversations.

2. Make key customers an active part of the new product development team. Key customers are "enthusiastic volunteers" if you are trying to persuade them to work with you, don't make them part of your new product development team. Use the key customers to give feedback on the product, help make trade off decisions and communicate with them often. Team members should have the work and home phone number of key customers. They should be familiar with their personal life. They should consider them friends.

3. When a prototype is developed, formally present it to key customers. Present the prototype at the key customers' location where possible. Have observers at the presentation to video and audio tape the presentation and customer comments. Have a note taker as back up the video and audio tape. Have a designated facilitator to lead the presentation and discussion. Listen and watch body language as well as written and spoken comments.

4. Develop the product. Pronto. Do not spend time "improving" the product, (other than suggestions from key customers). Rather, make a wish list of features for future generations. Microsoft does this with their software. They introduce a "minimally acceptable" product and follow on with a series of improved products. The evolution of Windows exemplifies this: Windows I, Windows II, Windows III, Windows 95 and soon, Windows 97/98.

Diagram 1


Engineering
Manufacturing
Customers
Prototype
Develop Product
Marketing

Bibliography

[1] Allen, "Managing the Flow of Technology," *The MIT Press*, pp. 239.

[2] Bailetti, A. J. and Litva, P. F., "Integrating Customer Requirements into Product Designs," *JPM*, vol. 12, pp. 3-15, 1995.

[3] Bruce, M., "Factors Affecting the Process of Collaborative Product Development: A Study of UK Manufacturers of Information and Communications Technology Products," *JPIM*, vol. 12, pp. 16-32, 1995.

[4] Calantone, R. J., Di Benedetto, C. A., and Haggblom, T., "Principles of New Product Management: Exploring the Beliefs of Product Practitioners," *JPIM*, vol. 12, pp. 235-247, 1995.

[5] Chafin, D. C. and Hughes , G. D., "Turning New Product Development into a Continuous Learning Process," *JPIM*, vol. 13, pp. 89-104, 1996.

[6] Cooper, R. and Kleinschmidt, E., "Benchmarking the Firm's Critical Success Factors in New Product Development," *JPIM*, vol. 12, pp. 374-391, 1995.

[7] Cooper, R. G., "An Empirically Derived New Product Project Selection Model," *IEEE Transactions on Engineering Management*, vol. 28, pp. 54-61, 1981.

[8] Cooper, R. G., "How New Product Strategies Impact on Performance," *JPIM*, vol. 1, pp. 5-18, 1984.

[9] Cooper, R. G., "The Performance Impact of Product Innovation Strategies," *European Journal of Marketing*, vol. 18, pp. 5-54, 1984.

[10] Cooper, R. G., "Selecting Winning New Product Projects: Using the NewProd System," *Journal Product Innovation Management*, vol. 2, pp. 34-44, 1985.

[11] Crawford, C. M., "New Product Success Rate--Facts and Fallacies," *Research Management*, vol. Sept 1979, pp. 9-13, 1979.

[12] Datar, S., Jordan, C., Kekre, S., Rajiv, S., and Kannan, S., "New Product Development Structures: The Effect of Customer Overload on Post-Concept Time to Market," *JPIM*, vol. 13, pp. 325-333, 1996.

[13] Desmond, B., "Personal Experience of Bert Desmond at Hewlett-Packard," , 1985.

[14] Maidique, M. A., "New Product Success and Failure," presented at Tektronix Engineering Excellence Seminar, 1987.

[15] Maidique, M. A. and Zirger, B. J., "The new product learning cycle," *Research Policy*, vol. 14, pp. 299-313, 1985.

[16] Maidique, M. A. and Zirger, B. J., "A Study of Success and Failure in Product Innovation: The Case of the U.S. Electronics Industry," *IEEE Transactions on Engineering Management*, vol. EM-31, pp. 192-203, 1984.

[17] Myers, S. and Marquis, D. G., "Successful industrial innovations," *National Science Foundation*, vol. 69-17, pp. 11, 1969.

[18] Peters, T. J. and Waterman Jr., R. H., *In Search of Excellence*. New York: Harper & Row, 1982.

[19] Rothwell, R., Freeman, C., Horsley, A., Jervis, V. T. P., Robertson, A. B., and Townsend, J., "SAPPHO Updated--Project SAPPHO, Phase II," *Research Policy*, vol. 3, pp. 258-291, 1974.

[20] Smith, P. G. and Reinertsen, D. G., *Developing Products in Half the Time*, 2 ed. New York: Van Nostrand Reinhold, 1991.

[21] Zirger, B. J. and Maidique, M. A., "A Model of New Product Development an Empirical Test," *Management Science*, vol. 36, pp. 867-883, 1990.