ACCELERATING TRANSFORMATION: PROCESS INNOVATIONS IN THE GLOBAL INFORMATION TECHNOLOGY INDUSTRY

BEHNAM TABRIZI

Based on an Influential Research at Stanford University by the Author

"…. Pioneering work …."
Management Guru, Tom Peters, in Chicago Tribune.

Accelerating Transformation:
Process Innovation in the Global Information Technology Industry

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PREFACE

This book is based on the research that I did for nearly three years at Stanford University. Contrary to common advice, that researchers should not get involved in projects working with consulting firms, I chose to take the risk and started collaborating with a world-class management consulting firm. I was fortunate that I was able to partner with the crown-jewel of consulting firms, McKinsey & Company, to develop this study and gain unlimited access to most of the distinguished companies in the Information Technology industry. The research required travel to various locations across the United States. I was the principal investigator and engaged myself in all phases of the study, from designing the surveys, and performing the interviews, through the final analysis of the data. The results of the study are based on both qualitative and quantitative work involving detailed analysis of data and notes taken from interviews. The students at the University of Augsburg, Germany, acquired the European data, and the Stanford Japan Center obtained data from the Asian companies in my survey. McKinsey & Company and the Sloan Foundation provided generous research fellowship for this study.

An article I wrote in 1995 with Kathleen Eisenhardt, based on this research, was the winner of the prestigious Administrative Science Quarterly 2001 Award for Scholarly Contribution for a paper published five years earlier that had the greatest influence on subsequent theory and research in the field of management. In a letter to us, the editor noted, "not only is your article one of the most frequently cited of all papers (in the fields of strategy, marketing, organization and operation management) we published in 1995, but its influence has been broad-ranging and definitive in shaping the theory of adaptation and our understanding of product innovation."

I have been extremely fortunate in that my research has gained recognition not only in the academia but has also been adopted by a large number of companies. The response from the world of business on the impact of this research has been overwhelming. I am highly indebted to Tom Peters, who discovered the result of our study and wrote about it in his syndicated columns across nearly 60 newspapers around the world, including Chicago Tribune, Forbes ASAP, Dallas Business Journal, San

Jose Mercury, and many newspapers in Europe, Asia, and even New Zealand.

Working in a small office on campus, I was nicely surprised by the hundreds of calls that came from companies world-wide who were seeking to adopt the findings of the research. Now, for nearly ten years, I have applied the findings of the research in many companies and have seen the great results that have been achieved. It is from this background that I share in this book useful information for others.

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ACKNOWLEDGMENTS

Although the apparent function of the acknowledgments section is to thank those who made the research possible, I believe its real purpose is to make us realize that what we have written is hardly a product of just oneself. Writing has certainly had its solitary moments, and ultimately I am responsible for the shortcomings in these pages, but without an able team of supporters, this research would not have been possible.

I have been blessed with exceptional support from many of Life's "organizations" including family, colleagues, and those many hybrid forms that are partly friend and partly peers. My gratitude goes first to my wife, Nazanin, and my daughter, Sheila, for giving me their unconditional love and constant support. The energy I needed to complete this research, they supplied in generous and timely amounts. I am indeed fortunate for their presence in my life. My Father, Hamid, my mother, Nahid, my stepfather, Lou, and my brother, Shahin, played a key role in encouraging me to pursue this work, a fact I sometimes believed I would never forgive them for! But I am, ultimately, thankful for their belief in me. Further, my uncle, Dr. Firooz Tabrizi, and my childhood friend, Karan Vafadari, have both encouraged me to turn my works into books.

I am indebted to my mentor, Kathy Eisenhardt, for her excitement on this work and her due diligence and excellent rapport with me. She has been a catalyst in crucial moments and a source of insights always. I also thank Bob Keeley for his indispensable support in the early phase of this research, and to Jim Jucker for his never ending care for researchers such as me.

I also thank my research assistants, Asha Jain and Javad Nasiri, for their excellent assistance in preparing this manuscript for publishers. Finally, the thousands of students that I have either taught, or advised at Stanford University have enlightened and inspired me more than I could ever reciprocate.

ABSTRACT

The purpose of this book is to explore the processes that lead to the speed of new product development. Product development is a major source of transformation and innovation, especially in the Information Technology industry. Although speed has become a pivotal strategic competence for many firms, it is a neglected topic in the academic literature. Thus, I attempted to develop two theoretical approaches to speed: compression and experiential approaches. I examine this research question using data from approximately 72 product development projects in the fast-paced, global computer industry. The sample includes projects from major firms from Europe, Asia, and the U.S.

I posited a model for speed through compression. Product development was assumed to be a complex process, but nonetheless one that could be planned, rationalized and compressed by involving suppliers, using CAD[1] to cut step size, overlapping the steps, and rewarding for schedule attainment. The surprise of this study is that not only did these tactics not work, they actually slowed the development process. Contrary to the compression model, more extensive planning, more supplier involvement, and greater use of CAD were associated with longer development times. Only the use of multifunctional teams was related to fast product development. Overall, despite the extensive support from previous literature for a number of these tactics, most of the compression tactics led to slower product development.

In contrast, I also posited an experiential model for speed. Here the assumption was that product development was an uncertain path through foggy and shifting markets and technologies. Thus, fast developers would employ a highly interactive and experiential approach. Consistent with my hypotheses, fast developers did emphasize testing rather than planning, frequent iterations, and frequent milestones. Further, a powerful project leader was also important for fast product development. Such a leader seemed to get the resources necessary to keep product development from slowing down. Thus, the experiential tactics shortened product development time.

[1] Computer Aided Design

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Chapter 1

Introduction

When the rate of change outside exceeds the rate of change inside, the end is in sight.
Jack Welsh, Former CEO of General Electric

Product development has become a central path by which organizations diversify, adapt, and even transform themselves in fast changing and evolving environments. Although some have argued that organizational change is difficult or even impossible to achieve, in fact it is through new products that many firms are actually able to reposition. While acquisition and mergers may accelerate such repositioning processes, fundamental change occurs as firm employees shift their time and attention to the core organizational processes of designing and making new products. For example, Hewlett-Packard was transformed from an instruments company to a computer-based one through new product development. Similarly, Nike was changed from a running shoe company to a full-line sports apparel firm through product development. Thus, in the face of intense international competition, rapid technology evolution, and customers' maturing expectations, new product development is a primary way in which firms adapt.

In recent years, there has been a growing recognition of the importance of not just adaptation, but rather rapid adaptation as a strategic competence (e.g., Eisenhardt, 1989; Stalk and Hout, 1990). This same theme of fast pace echoes in product development. As a number of authors have observed, the product life cycle of new products in many industries is dropping. Enhanced competition is one reason as firm members rush to meet or surpass competitors (e.g., Schoonhoven, Eisenhardt, and Lyman, 1990). Rapid technical and market change is another as such shifts create gaps and opportunities for new products. The implication of these shortening life cycles is that, while there are certainly pitfalls to rapid product development (e.g., von Braun, 1990), organizations that do not successfully adopt rapid product development techniques will eventually fall behind the competition (Gomory and Schmitt, 1988).

The evidence for the importance of rapid product development is compelling. For example, McKinsey & Company's study of high-technology products showed that those products that were six months late in entering the market, but were within budget, earned 33% less over a five year period than they would have otherwise. Instead, entering the market on time, even 50% over budget, reduced a firm's profitability by only 4% for that product. Moreover, fast product development is usually more productive and lower cost (Stalk and Hout, 1990; Clark and Fujimoto, 1991) because lengthy time in product development tends to waste resources on peripheral activities and mistakes. Thus, firms that reduce time-to-market without adding people and equipment tend to increase productivity and reduce costs. Further, a shorter development cycle time improves strategic flexibility by giving firms the option of becoming either early innovators or followers (Gilman, 1982). And fast product development is less risky since the time between beginning the product and product launch is smaller. The likelihood of poor forecasting of market position is substantially reduced as development is begun closer to the time of introduction. Thus, rapid product development is a key to successful adaptation, and ultimately to the survival and success of firms.

While it is clear that rapid product development is often advantageous, it is not so clear how firm members can actually accelerate the pace of product development. Reflective of the static nature of most organizational and strategic theories, research on the speed of any organizational process is very limited. Consistent with this observation, there has been some armchair theorizing on fast product development, but little systematic research. Moreover, the few research results that are reported are often based on industries with long cycle times and large capital costs such as the automobile (Clark, Chew and Fujimoto, 1987; Womack, Jones, and Roos, 1990), semiconductor (e.g., Schoonhoven, Eisenhardt, and Lyman, 1990) and mainframe computer industries (Iansiti, 1992). It is unclear whether speed is a priority in these industries and whether the results of these studies generalize to other industries. In addition, the auto and mainframe computer studies involve relatively few firms, minimal theory, and modest multivariate modeling. And they frequently rely on Japanese models of product development (e.g., Imai et al, 1985; Clark and Fujimoto, 1991) which may or may not translate to other cultures. It is difficult to ascertain whether these practices themselves are effective or whether other factors, peculiar to the Japanese, are at work.

Given these observations, the purpose of this research is to explore the speed of new product development. Specifically, I ask how firms

accelerate the pace of product development projects. I examine this research question using data from approximately 72 product development projects from 36 firms operating in the fast-paced, global computer industry. The sample includes major firms from Europe, Asia, and the U.S. The computer industry is characterized by rapid product life cycles, intense and international competition, an evolving scientific base, and a lack of Japanese domination. It is a high-velocity industry where speed matters (Bourgeois and Eisenhardt, 1988).

A key theoretical contribution of this research posits two models for acceleration: the compression and the experiential model. The compression model assumes that product development is a complex process, but nonetheless one that could be planned, rationalized and compressed. On the other hand, the experiential model assumes that product development is more a response to uncertainty than complexity, more iterative than linear, and more experienced-based than planned.

The results of this research indicate that fast product development is associated with a more experiential model than compression. Specifically, fast developers were multifunctional teams that created many iterations, stayed close to real time information through testing and milestones, and were managed by powerful project leaders.

Some of the results of the systematic product development research such as powerful project leaders and multifunctional teams are replicated in this research. On the other hand, the previous work supported planning and emphasized the importance of overlap, whereas this research did not. Further contributions to the product development research are findings that fast developers emphasize test, not planning, frequent iterations, and frequent milestones.

Another contribution of this research is a multivariate test of the above models using a relatively large number of new product development projects drawn from a sample of international firms. The projects are drawn from the computer industry, where speed of product development is crucial to a firm's success. Finally, given the volatile nature of this industry, since projects are completed in the past three years, the results gained from this research offer valuable advice to the practitioners in the field.

The remainder of this research will be organized into six chapters. Chapter two begins with a review of the literature on factors that firms use to successfully speed up product development. This is followed by a review of the research on successful product development that does not emphasize speed of development. Finally, in chapter two, the organizational learning literature is linked with the research on product development.

In chapter three, several reasons that lead to the speeding up or slowing down of processes are explored. This is followed by proposing two strategies for creating accelerated pace that are relevant to product development, namely, the compression and the experiential strategies. Finally, a set of hypotheses that eclectically expounds each strategy is introduced.

Chapter four examines the details of methods that are employed to test the hypotheses. The methods include the description of the sample, measure of each construct, which is supplemented by specific questions, the structural position of the respondents, and the control variables.

In chapter five, results including discussion of means, standard deviations, and correlations between all the variables in the research are presented. This is followed by the results of ordinary least regression analyses. Finally, in chapter five, the outcomes of analytical techniques, subgroup analyses, and plots of independent versus dependent variables are discussed.

Chapter six is the summary of results, and chapter seven begins with a discussion of results -- the outcomes of the analytical techniques for the two proposed speed-up strategies are compared and contrasted. This is followed by examining the strengths and weaknesses of the measures and methods employed in the research. Next, the overall results are compared with related literature, and the future direction of the research is discussed.

Finally, chapter eight concludes with a review of the importance of the research question and a summary of the research, including contributions to theory, method, and managerial practice.

Chapter 2

Literature Review

Studies that elaborate on reducing product cycle time and its relationship to successful products remain scarce. On the other hand, there are a number of studies of successful product developments that do not cover the shortening of the product cycle time. Finally, the research on organizational learning can provide useful insights for observing the product development process as an organizational learning phenomenon. Thus, to capture all the above literature, this chapter is divided into three sections. Section one is a review of the literature on techniques that firms use to successfully reduce product development time. Section two is a review of the research on successful product development that does not emphasize speed of development. Finally, section three links the organizational learning literature with the research on product development and explains why learning is critical in product development.

2.1. RESEARCH ON SPEED OF PRODUCT DEVELOPMENT

There are several streams of research that are related to the speed of product development. Some of this work is a synthesis of practical experiences of the authors or of executives who were questioned by the authors. A second stream consists of in-depth studies of industries, often on a global basis, while an emergent set of work using dynamic, event history takes a more environmental, competitive view of the process. These studies often provide rich data, but there are also some important methodological and theoretical shortcomings.

2.1.1. Exploratory, Practitioner Writings

One stream of writings emphasizes the experiences of the authors, often people with decades of experience in product development (e.g., Vesey, 1991). They tend to have captivating anecdotes and many ideas. For example, Gold (1987) draws on his experience with product development in the past two decades to describe actions that accelerate product development. These include using external sources of technology (e.g., licensing or buying technologies from others and buying firms with

strategically important technologies), creating competition among projects, overlapping product development stages, and paying attention to rewards.

There are other examples as well. Rosenau (1988) enumerated about 10 factors which are organized around the key idea of cutting the size of each step in the development process. He included better teamwork, greater use of CAD[1], and extensive planning and scheduling among his suggestions. Cordero (1991) emphasized the use of CAD as well as careful planning and appropriate rewards. Perhaps best known is the work of Stalk and Hout (1990). These authors likened product development time to manufacturing inventory. Based on their experiences, they observe the importance of cutting the time of each development step and the time between each development step. They also advocated small, empowered cross-functional teams, high communication, and an incremental technology strategy.

Several other studies also rely on impressionistic data, but gather that data from managers who are engaged in product development (e.g., Gupta, et al 1986, Mabert, Muth, and Schmenner, 1992; McDonough, 1993). For example, Gupta, et al (1986) studied 12 large, technology-based firms in which they surveyed 80 managers and interviewed 32. They asked these managers to describe the factors which slowed down and speeded up product development. They found that managers believed that senior management support and early multifunctional involvement are keys to faster product development. These managers also noted that fast product development was related to detailed product requirements planning. This work was extended by Millson, Raj, and Wilemon (1992). The authors offered a very rational blueprint for accelerating new product development: 1) simplify, 2) eliminate delay, 3) eliminate steps, 4) speed up operations, and 5) perform parallel processes.

Simplify refers to generating explicit R&D goals and linking them to other functions, which is different from Imai et al's (1985) notion of broad and ambiguous goals. *Eliminate delays* points to integrating R&D goals with manufacturing, which is designing for producibility, and training for teamwork and group processes, which eliminates barriers to communication. *Eliminate steps* refers to reducing the number of parts and getting early feedback from lead users. *Speed-up operation* underscores the importance of Computer Aided Design/Computer Aided Manufacturing

[1] Computer Aided Design

(CAD/CAM) in accelerating new product development; the advantages of locating engineering, manufacturing, and marketing near each other (Gupta, Raj, Wilemon, 1986); and the value of using smaller groups to screen and generate product ideas. Finally, *parallel processing* constitutes integrating design with manufacturing (Dean and Sussman, 1989) and involving suppliers early in the design process.

Overall, this research stream has some engaging ideas. But, the writings rely on anecdotes and impressionistic information with little theoretical foundation, systematic data, or multivariate analysis. What emerges is a relatively rational view of product development pace which relies on planning and process compression.

2.1.2. In-depth Case Research

This research stream is characterized by a more empirically-based and systematic approach (e.g., Quinn, 1985; Imai, Nonaka, and Takeuchi, 1985; Clark, Chew, and Fujimoto, 1987; Womack, Jones, and Roos, 1990; Iansiti, 1992). The studies involve in-depth, case studies or small-sample studies conducted in global industries, frequently with an emphasis on Japanese management practice. Thus, this research overcomes some of the disadvantages of the previous work with often impressively rich data.

Early ground work was laid by Imai, Nonaka, and Takeuchi (1985) who examined how Japanese firms successfully achieve speed and flexibility in product development. The authors conducted an inductive case study of five innovative and successful Japanese products, each representing a different technology-based industry. The authors argued that an involved supplier network had the strongest effect on the speed of development. For example, the authors reported that 90 percent of the parts used in the medium-sized copier built by Fuji-Xerox were manufactured by the suppliers that were included in the project team. This action resulted in a shortening of the copier's delivery time by at least 50 percent.

Imai et al (1985) also noted that overlapping the development phases and multifunctional teams led to sharing responsibility, cooperation, and sharpened problem-solving orientation. An example of overlapping problem solving and multifunctional teams was the overlapping of engineering and production phases in the development of a successful (and fast time-to-market) copier developed by Fuji-Xerox. This overlapping