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Product Innovativeness and Entry Strategy: Impact on Cycle Time and Break-even Time

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New product development time, or cycle time, has become a critical competitive variable, particularly for small high-tech manufacturing firms. The business press is filled with examples about large firms that have successfully reduced cycle time. This article investigates the relative impact of product innovation and entry strategy on cycle time and initial market performance of small firms. Using a sample of seventy-three small manufacturing firms, Abdul Ali, Robert Krapfel, Jr., and Douglas LaBahn find that faster product development is associated with shorter break-even time. Their results also indicate that these firms are achieving shorter cycle time not by sacrificing product quality, but by keeping the technical content of the product simple. Past research has not taken into account this relationship, and this may be one of the reasons why researchers have often suggested conflicting impact of entry strategy on market performance.

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J PROD INNOV MANAG 1995;12:54–69

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0737-6782/95/$9.50
SSDI 0737-6782(94)00027-D

J PROD INNOV MANAG 1995;12:54–69

Introduction

Today, product development managers face intense pressure to bring world-class products to market in record times. Many factors contribute to this pressure, including acceleration in the rate of technological development, improved mass communication, more intense competition due to maturing of markets and globalization, a fragmentation of the marketplace due to changing demographics, shorter product life cycles, and the escalating cost of R&D. Some observers of new product trends in the US expect that "Americans are looking at product lifetimes as low as 2 years in some industries" [43], and this accelerated rate of product obsolescence increases the need to develop new products quickly enough to ensure timely introduction during the product life cycle [11]. A survey done by United Research Co. reports that six out of 10 chief executive officers consider short product development cycles to be vital to their company. Seven out of ten CEOs expect to reduce time to market by 10%–20% in the next two years [44].

Getting new products to market quickly is critical for attaining competitive advantage in the battle for global markets [4,23,59,60,65]. Smith and Reinertsen suggest that shorter times to develop new products (cycle times) can increase sales through extended product lives, increase market share through pioneering, increase profitability through pricing freedom and economy of scale, and enhance a company's image as an innovation leader (e.g., Apple, Honda, and 3M) [58]. An economic model developed by McKinsey and Co. suggests that in a market with 20% annual growth rate and 12% price-drop per year, high-tech products that ship to market six months late but on budget will earn 33% less profit over five years. In contrast, coming out on time and 50% over budget cuts profits only 4% in the same market [14,15].

Companies like Hewlett-Packard Co. [25,61], Honeywell Inc. [30], Intel Corp. [67], and Xerox Corp. [46] have reported significant reductions (as high as 50% cut) in cycle time accompanied by lower development cost, improved product quality and increased market share. However, such dramatic results are yet to be realized in many companies. A recent study indicates that US companies have not yet grasped the full consequences of slow product development and do not seem willing to invest resources to speed up the new product development process as do their counterparts in Germany and Japan [22]. The question arises: are most companies better-off to speed up new product development processes? The mass media in recent times suggests that "US companies would be smart to slow down and think before they invest to speed up and innovate" [56]. It may not be worth the price to cut development time. Crawford reveals several "hidden costs" of accelerated development and suggests that a firm needs to consider carefully before pursuing an accelerated product development strategy [12]. This implies that speeding up new product development processes may not be effective for all firms and raises two important research questions: (1) What factors influence cycle time for developing new products and (2) what are the influences of cycle time on market performance? This article addresses these important questions.

The existing product development literature mainly examines the direct impact of environmental, situational, and controllable factors on market performance of new products. We suggest that cycle time is an important intermediate outcome of the new product development process, and managers can directly influence cycle time to a greater extent than other outcomes such as market share or sales. The primary objective of this study is to explore the relative impact of innovativeness (product innovation and technical content), and product advantage on cycle time. We also investigated the effect of cycle time and entry

BIOGRAPHICAL SKETCHES

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Douglas W. LaBahn is Associate Professor of Marketing at California State University Fullerton. Dr. LaBahn has a B.S. in Information and Computer Science from University of California Irvine, an M.B.A. from California State University Long Beach, and a Ph.D. from the University of Maryland. His research interests in improving the new product development process arose from his experience at directing product and service developments at a small company prior to attending the University of Maryland.

strategy (marketing mix) on initial market performance (total time from market launch to attaining break-even), because prior research indicated the influence of these factors on market performance of new products. This article investigates these issues based on a survey of a wide cross-section (nine different four-digit SIC groups) of seventy-three small (less than 100 employees) manufacturing firms. By analyzing various interrelated factors that influence cycle time and initial market performance, this article improves our understanding of timing as a source of competitive advantage and provides an empirical basis for further research.

Background

Past researchers have investigated what specific activities to undertake to improve the odds of new product success [9,54] and stressed the importance of order of entry [29,31,32,50,62]. Recently, some empirical studies have investigated the influence of factors on cycle time for product development [21,38,39,40].

Researchers have recommended several approaches or tactics to accelerate new product development. Such recommendations are mostly based on literature reviews and case studies. Sourcing of technology from outside [18], simplifying or eliminating steps in the product development process [41], and teaming [33] are said to influence new product introduction time. Empirical studies on cycle time, however, are meager but growing. Griffin finds that percentage change across product generations, complexity, and types of process used in new product development influence cycle time [21]. She also stresses the need for obtaining performance baselines for cycle time and suggests that a firm should use such baselines against which to compare results from its new product development process. McDonough and Barczak observed that leadership style influences speed of development, and the source of the technologies used in the project moderate the relationship between leadership style and speed of development [39]. In a follow-up study, McDonough and Barczak observed that technological familiarity moderates the relationship between speed of development and the cognitive problem-solving orientation of both project leaders and project teams [40]. Further, McDonough suggests that the technology (radical or routine project) and the characteristics of both project leaders and the project team affect the speed of product development [38].

Whereas the existing research on cycle time reviews approaches or tactics for accelerating new product development and suggests how to measure cycle time, not much empirical work has been done to find out how *small* firms are managing product development. The business press contains many examples concerning large firms that have successfully reduced cycle time. In contrast, we concentrate on small firms because smaller companies produce the greatest number of new products per million dollars of R&D [2]. Smaller firms have also been the greater contributor to economic and employment growth over the last decade. We also focus on *initial* market performance because several environmental and market variables, which are beyond the control of managers, influence long-run market performance and it would be difficult to isolate the effect of cycle time on longer-term market performance.

Factors Affecting Cycle Time

We define cycle time as the elapsed time from the beginning of idea generation when the firm decided to develop a new product to the end of product launch when the product is commercially available and managed in a routine manner (see [66]). Urban and Hauser define the cycle time for innovation as the time from project initiation to market [63]. Griffin reports that different definitions of "conception to production" time frame have created considerable variation in the measurement of cycle time [21]. Our definition is consistent with the notion of product development time [32], innovation time [35], total time [21], and lead time [7].

Innovativeness and Technical Content

Past researchers suggest that product innovation influences new product success [9,54]. In this article, we differentiate between a product's innovativeness and technical content of a product. We define innovativeness to be the uniqueness or novelty of the product to the market. In contrast, we define technical content as the technology required to produce a product. Broadly construed, technology consists of product technology, process technology, and management technology [6]. In our study, we focus on the product technology dimension and define a product's technical content to be the extent to which new knowledge, materials, or components are embodied in the product [6]. In other

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words, we consider innovativeness as a market-based construct and technical content as a product-based construct.

Innovative products give customers a new way to satisfy their wants; they open up the customer to new possibilities (e.g., a VCR). In contrast, rather mundane familiar products may have high technical content not visible to the user (e.g., a laser printer). However, innovativeness does not preclude the possibility of having a product with high level of technical content. For example, a fax machine is highly innovative and at the same time contains sophisticated technology. In contrast, the original video game "Pong" is high in innovativeness and low in technical content, whereas, a personal computer based on "Pentium®" chips is low in innovativeness and high in technical content.

Innovativeness. We define highly innovative products as "new-to-the-world" products that create an entirely new market [5]. These products are designed to find specific uses or markets for a promising new technology and are expected to take a relatively longer time to develop (see [36]). The idea of innovativeness in this article is similar to what Robertson calls "radical" or "discontinuous" innovation [47].

Kleinschmidt and Cooper suggest that the relationship between innovativeness and commercial success is U-shaped, that is, products that are very high, or low, in innovativeness are more successful than moderately innovative ones [28]. Moderately innovative products are not innovative enough to benefit from the impact of product advantage as highly innovative products do, and not close enough to the base business to gain from the effects of synergy and good marketing as noninnovative products do. In contrast, we postulate that the relationship between innovativeness and cycle time is convex. We suggest that firms focusing organizational resources on the pursuit of a unique and differentiated product may take longer time to develop such product and the product development time would increase at an increasing rate with the degree of innovativeness. Consequently, we propose the following:

P1: Increasing innovativeness tends to lengthen cycle time at an increasing rate.

Technical Content. In many applications, greater technical content may enhance ultimate product success [9], however several industry experts comment on the problems associated with incorporating high technology into a new product. Gupta and Wilemon identify technological uncertainties as a major reason for project delay [23]. Clark and Fujimoto define product complexity in two dimensions: (1) complexity of internal structure and (2) complexity of user interface [8]. Different combinations of internal and external complexity will influence product development. Griffin defines product complexity as the number of functions the product performs and hypothesized that the more functions a product performs, the longer is development [21]. Similarly, we suggest that increasing a product's technical content increases the development project's complexity, uncertainty, and ultimately development time. Further, the relationship between cycle time and technical content, as in the case of innovativeness, should be nonlinear because products with increasingly complex technical content should increase the development time at an increasing rate. We may then propose the following:

P2: Increasingly complex technical content tends to lengthen cycle time at an increasing rate.

Product Advantage

Himmelfarb suggest that shortening the new product development cycle, particularly if the project is conducted by a multifunctional team, most often results in fewer mistakes that will cause quality problems later on [24]. Concentration on speed forces a development team to focus on those elements of a product design that are most related to quality. In addition, firms that believe that their product has unique competitive advantages are less inclined to struggle with product definition, a likely cause of development delays. Cooper and Kleinschmidt investigated several factors that affect new product successes and identified product advantage as one of the important success factors [10]. The business press reports that companies like Xerox Corp. [46] and RCA (Thomson) Consumer Electronics [64] have not only managed to improve the quality of their new products, but they have also reduced product development time by more than half. We may summarize the discussions as follows:

P3: Improved product advantage is associated with shorter cycle time.

Factors Affecting Break-even Time

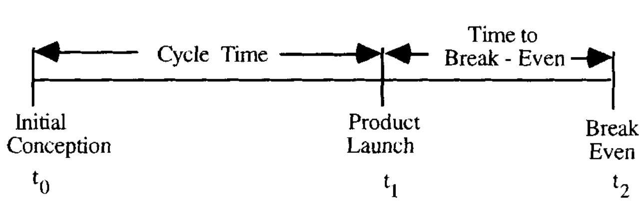
We define break-even time as the elapsed time from the end of product launch when the product is commercially available to the start of making profit when cumulative product contribution has repaid the development and start-up investments. One can measure initial market performance in many ways, including market share, sales, profits, and time to break-even. To estimate market share, a firm needs to know the size of the served market, which is difficult to measure, especially in the early stage of the product life cycle when the market is evolving. The level of sales achieved and profits are valid measures of initial market performance; however, we favor the time from product launch to break-even because it includes "market acceptance, cost of production and sales, selling price, time value of money, and start-up costs" [20]. Managers can use break-even time to evaluate projects across a wide variety of settings and circumstances. Thus, time to break-even is a universally accepted and understood yardstick of market performance. House and Price suggest that companies like Hewlett Packard use "time-to-market" and "break-even time after release" as important measures to make comparisons among projects and as a common reference point across different functional areas to make decisions that impact the development strategy [26]. The schematic diagram in Figure 1 displays the time order of occurrence of cycle time and break-even time.

Cycle Time

Economic models [15] and managerial discussions [23] suggest that shortening time to market improves market performance. Smith and Reinertsen suggest that shorter times to develop new products (cycle times) can improve market performance through extended product lives, pioneering, pricing freedom, economy of scale, and enhancement of company image as an innovation leader (e.g., Apple, Honda, and 3M) [58]. Similarly, Rosenau suggests that faster product development often means (1) no competition, which allows the company to charge a premium price, (2) more sales, which yield more profits, (3) lower development costs, and (4) less chance for an unfavorable market or technology change [52]. All these benefits of faster product development will shorten the break-even time. Therefore, we offer the following proposition:

> *P4:* Faster cycle time leads to shorter post-launch time to break-even.

Figure 1. Time order of occurrence of cycle time and break-even time.



Entry Strategy

Past research on the market timing or entry decision issue suggests that entry strategy affects the entrant's performance in the marketplace [32,50,55,62]. Gatignon et al. suggest that entry strategy encompasses the marketing mix variables, in particular the positioning of the new brand in relation to currently competing brands, and the marketing activities undertaken to support the entry [17]. Following Robinson [49], we consider four entry strategy variables. They are market pioneering, product advantage, relative promotional effort, and relative price. The general relationship between marketing mix variables (product quality, price, and promotional effort) and market performance has been supported by many researchers [32,48,50]. Urban et al. found significant rewards accruing to successful pioneering brands [62].

Past researchers, usually, have assessed the performance of a new brand in terms of market share to incorporate the competitive success concerning brand introduction [17]. As discussed earlier, we use time to break even as an indicator of initial market performance, because it includes market acceptance, cost, and sales [20]. We believe that entry strategy will influence break-even time. Higher product quality increases the demand for a new product and consequently shortens the break-even time. Further, we expect that advertising and promotional activities undertaken to support the entry may increase the fixed cost and consequently lengthen the break-even time. This is specially true for small high-tech firms that may neither have a formal marketing department nor necessary marketing expertise. At the same time, small firms need greater promotional activities because most often customers lack knowledge of the product or the company. Higher price reduces the appeal of the product to the price-sensitive segment of the market and thereby prolongs the break-even time. Market pioneers tend to have high market share through positioning advantage, ability to exploit economies of scale, brand consideration, and cognitive structure [63]. We expect that market pioneering will also be associated with shorter break-even time. These discussions indicate that we can propose:

P5: The higher the product advantage, the shorter the break-even time.
P6: The higher the relative promotional effort, the longer the break-even time.
P7: The higher the relative price, the longer the break-even time.
P8: Market pioneering is associated with shorter break-even time.

Research Setting and Data Collection

The sampling frame selected for this study consisted of a wide cross-section (nine different four-digit SIC groups) of small (less than 100 employees) manufacturing firms.[1] We chose these firms to represent a wide variety of small businesses engaged in product development, and as a result we were able to investigate broad patterns of new product development activities independent of industry-specific practices. The unit of analysis is the firm's most recently completed new product development project. We used entrepreneurs (e.g., president or owner) as single key informants because we presumed that they had vested interest and intimate knowledge of their firms' new product development processes. Our pretest interviews and discussions with industry experts confirmed the owner's knowledge and accessibility of the development process.

Data Collection

The data collection phase proceeded in four stages. First, we undertook unstructured personal interviews with several entrepreneurs and industry experts. The interviews focused on identifying the most important issues facing the key decision-maker. We developed multiple-items scales to measure all but two constructs identified for our research.[2] We further used ratio scales to measure easily quantifiable concepts (e.g., product development cost in dollars). These items, hence the composition of each construct, item to total correlation, reliability of measures (coefficient alpha), and the means and standard deviations of the constructs are shown in Table 1.

Second, we developed a questionnaire based on the personal interviews and the literature review. A second wave of personal interviews focused on refining the content and wording of the measurement indicators. Third, we sent out 3071 invitations to participate in the study. Of which, 592 (19.3%) executives agreed to participate. Because the unit of analysis is the firm's most recently completed new product development project, we considered only those firms that had recently completed, or were close to the completion of the product development project. We didn't find any regional bias among those who agreed to participate in our survey. This approach enabled us to construct a list of firms that had recently developed a new product.[3] In addition, this approach enabled us to identify the key decision-makers and to gain their commitment.

Fourth, we mailed questionnaires to those who had agreed to participate. Of the 592 questionnaires mailed, 286 (48%) were returned and 243 (41.0%) were largely completed. Information was provided by 129 (21.8%) firms about a recently completed project, whereas 114 (19.2%) provided information about an advanced ongoing product development project. For this study, we have focused on only those firms who have reported project completion.

Following outlier elimination ($\geqslant 4s$) and deletion of missing cases for data analysis, the number of usable questionnaires with complete data regarding project completion and cycle time numbered seventy-three for a response rate of 12.3%. We have done subsequent *t*-tests to identify any significant difference that may exist between those who completed projects and those who didn't. The *t*-tests revealed that no significant differences existed between the groups regarding in-

[1] The sampling frame was constructed from three sources. First, a random sample was drawn from a highly regarded commercial mailing list provider. Second, a complete census of the 1987 Small Business Innovation Research (SBIR) phase II award winners was obtained. Third, a list was compiled from names submitted by a census of the members of the leading association of small business incubator directors.

[2] In order to reduce the variability in reported cycle times arising from unclear end points, we ask the respondents to identify the tasks completed at each stage of the product development process as well as to check a timeline chart during which the tasks associated with each stage were performed. These questions were asked in the questionnaire immediately preceding the questions eliciting respondent's estimates of cycle times.

[3] Two reasons motivated this approach: first, new product development is an infrequent activity in many small firms; thus, at any one time many firms are not likely to have recently completed a project. This was evidenced by several hundred responses indicating the firm had not recently developed a new product. Second, the complexity of the new product development task was felt to be such that the quality of the response was likely to decay rapidly with time. Therefore, managers were asked to respond only if they could report on a recently developed project.

Table 1. Constructs: Composition, Internal Consistency, and Descriptive Statistics

Construct Name (Coefficient Alpha)	Construct Measures	Item—Total Correlation	Mean	SD
Cycle time (0.70)	Total project time from the beginning of idea generation to the end of the market launch in months	0.57	1.77	0.88
	Total project time from the beginning of idea generation to the end of the market launch in man-years	0.57		
Product advantage[a] (0.63)	Compared to competitors, the new product meets (will meet) customer needs better	0.47		
	The new product was (will be) of higher quality than any existing product.	0.42	6.12	1.02
	The new product had (will have) unique features/attributes from existing products.	0.42		
Relative promotional effort[a] (0.80)	Compared to competitors, the promotional budget of the new product was (will be): (higher/lower)	0.65		
	The promotional effort was (will be) much above the industry average.	0.65	3.05	1.60
	The promotional expenditures did (will) exceed those of existing products.	0.64		
Relative price[a] (0.76)	Compared to competitors, the new product was (will be) priced lower (reverse coded).	0.47		
	The new product was (will be) priced much higher than industry average.	0.61	3.30	1.89
	The price of the new product was (will be) higher than existing products.	0.74		
Product innovativeness[a] (0.77)	The innovativeness of the product to the market is: (lower/higher)	0.62		
	The new product has unique features for customers.	0.64	5.96	1.21
	The product technology is new to the customer.	0.61		
Technical content[a] (0.82)	The technical know-how contained in the product is: (low/high)	0.68		
	The technology of the product is state-of-the-art.	0.61	5.21	1.62
	The product contains highly sophisticated technology.	0.77		
Market pioneering	Was your company the first into the market with this type of product? (yes/no)		yes (53.4%) no (46.6%)	
Break-even time	Total time from market launch to attaining break-even? (months)		17.38	15.47
Up-front homework (0.84)	Project screening (activities performed to evaluate new product ideas)	0.62		
	Technical assessment (activities performed to evaluate technical aspects)	0.51		
	Market assessment (activities performed to evaluate market response)	0.77	0.45	0.22
	Detailed market research	0.71		
	Financial analysis	0.68		

[a] These variables measured on a seven-point scale with 1 low and 7 high.

novativeness, entry strategy, break-even time, firm size, new products recently launched, product substitutability, and life span of new technology. We, however, found significant differences regarding actual or expected cycle time and first-year sales.

The mean product development cost was $349,091, requiring 18.7 months and five person years to complete. The mean time to break-even after launch was 17.4 months. The mean respondent firm had a total staff size of 28.8 people with 5.2 people having some responsibility for researching and developing new products. Similarly, the mean number of products sold by these entrepreneurial businesses was 21. All but one of the companies are privately held.

Nonresponse

We assessed nonresponse bias by comparing early versus late respondents as suggested by Armstrong and Overton [3]. The time between when the questionnaire was mailed and when it was returned was used to form early (67%) and late (33%) respondent groups. Subsequent *t*-tests revealed that no significant differences existed between the groups regarding company age, staff size, new products recently launched, and number of products currently sold. Therefore, nonresponse does not appear to be a significant issue.[4]

Model Development

Equations 1 and 2 are used to test the hypotheses concerning the factors affecting cycle time and break-even time respectively. Equation 1 regresses cycle time on the innovativeness factors. Equation 2 regresses break-even time on entry strategy, innovativeness, and the on cycle time. Both equations also include all the environmental and firm specific control variables.

$$CT_i = \alpha_0 + \alpha_1 \, INNOV^2_i + \alpha_2 \, TECH^2_i + \alpha_3 \, PRDADV_i + \epsilon_{1i} \quad (1)$$

$$BET_i = \beta_0 + \beta_1 \, CT_i + \beta_2 \, PRDADV_i + \beta_3 \, RPROMO_i + \beta_4 RPRICE_i + \beta_5 \, PION_i + \epsilon_{2i} \quad (2)$$

where $i = 1,2, \ldots, n$. α_0 and β_0 are the intercept terms and ϵ_{1i} and ϵ_{2i} are the error terms. The variables in the equations are:

CT = cycle time,
BET = break-even time,
PRDADV = product advantage,
RPROMO = relative promotional effort,
RPRICE = relative price,
PION = market pioneering,
INNOV = innovativeness, and
TECH = technical content.

Model Specification

The literature on cycle time suggests that time to market, product advantage, product cost, and development cost are mutually interdependent and must be balanced with each other [53,58]. Therefore, to test the impact of cycle time on time to break-even, we need to include these variables. However, the data on product cost is not available. Due to measurement difficulty because of varying accounting practices among small firms and proprietary nature of cost data, it is hard to get a reliable measure of product cost. We used unit price as a proxy measure for product cost. We understand that price may not be a good proxy variable for unit cost, because two products with same product cost may sell at different prices. However, inclusion of price in our cycle time model only makes the estimates of the hypothesized effects of explanatory variables more conservative. In the break-even time model, we include unit price because it will affect demand for the product and hence break-even time.

Urban and Hauser suggest that up-front investment provides an opportunity to understand the market better and the firm is able to develop product that delivers benefits more effectively [63]. In other words, up-front activities help to develop a better quality product. Cooper and Kleinschmidt found that up-front activities were most proficiently undertaken in successful projects [10]. We include this variable in our model to test the relationship between product advantage and cycle time. Further, the marketing strategy literature suggests that the performance of a new entry depends on: (1) the competitive environment facing the entry, (2) the capabilities of the entrant, and (3) the market entry strategy [17]. Consequently, we include the following variables along with our theoretical constructs to reduce specification error:

[4] Sixty nonrespondents were also contacted by telephone in order to determine the reason for nonparticiation. The majority reported that they had not recently developed any new products.

Environmental: market growth rate, product substitutability, life span of new technology
Firm-specific: firm size, familiarity with new product development
Project-specific: product development cost, unit price of new product, up-front homework

Table 2 list specification variables included in our model and shows the variable definitions, means and standard deviations.

We have used exploratory factor analysis to confirm the underlying factor structure of our main constructs. The resulting factors correspond to multi-item constructs that are used as predictors in our regression model. All factors had eigenvalues greater than 1.0, and the factors explained 70.7% of the variance in the original twenty variables. Table 3 displays the labeled factors and factor loadings.

Table 2. Variable Definitions and Descriptive Statistics

Variables	Definition	Mean	SD
Firm size	What is the size of your organization in terms of total full time staff? ---- total staff	28.8	58.8
Product development cost	Total Project cost from the beginning of idea generation to the end of the market launch? ------ dollars	349,091	816,921
Unit price of new product	The estimated unit price of the product $ ___	23,404	53,576
Life span of new technology[a]	How long will the current technology be viable in the market? (few months, many months)	5.1	1.7
Market growth rate[a]	The short-term (3-yr.) market growth rate for your product is (low/high)	5.3	1.4
Product substi-tutability[a]	How easy is it for customers to substitute other products in place of yours? (easy/difficult)	3.4	2.2
Product development familiarity	Number of other new products launched in the last two years.	3.7	5.0

[a] These variables measured on a seven-point scale with 1 low and 7 high.

Model Estimation

We use ordinary least squares (OLS) to estimate the regression coefficients. Heteroskedasticity, the condition of the error variance not being constant over all observations, is a potential problem in cross-sectional data estimation. We didn't find any evidence of heteroskedasticity in the cycle time model. However, in the break-even time model, the scatterplot of the studentized residuals (e_i/std.dev (e_i)) against predicted values of break-even time shows that the spread of residuals increases with the magnitude of the predicted values, suggesting strongly that the variability of break-even time increases with the predicted values of break-even time. Thus, the regression coefficients obtained by the OLS procedure are still unbiased and consistent, but they are no longer minimum variance unbiased estimators. To correct the problem, we ran weighted least squares (WLS) estimation for the break-even time model with the weights being the reciprocals of the estimated error variance. The estimated error variances are obtained from the OLS procedure. The scatterplot of residuals against each independent variable, however, do not suggest any heteroskedasticity problem.

Given the sample size and the fit of the overall model [37], the values of variance inflation factors and tolerance limits in our cycle time model do not suggest that we have any multicollinearity problem. However, the explanatory variables in the break-even time model consist of cycle time as well as the predictor variables of the cycle time. Consequently, we expected and observed a multicollinearity problem in our break-even time model.

Ridge regression is one way to remedy the multicollinearity problem by modifying the method of least squares to allow biased estimators of the regression coefficients. The ridge regression estimator has only a small bias and is substantially more precise in the sense that it will have a larger probability of being close to the true parameters [42]. See also [34]. The ridge standardized regression estimators are obtained by introducing into the least square normal equation a biasing constant k ($k \geq 0$). We performed ridge regression for the break-even time model for eleven values of k ranging from 0 (i.e., OLS regression) to 1.0.

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Table 3. Constructs: Factor Loading Matrix[a]

Constructs	Items	PA	RPE	RP	PI	TC	UF
Product advantage (PA)	Compared to competitors, the new product meets (will meet) customer needs better	0.74					
	The new product was (will be) of higher quality than any existing product.	0.78					
	The new product had (will have) unique features/attributes from existing products.	0.67					
Relative promotional effort (RPE)	Compared to competitors, the promotional budget of the new product was (will be): (higher/lower)		0.84				
	The promotional effort was (will be) much above the industry average.		0.74				
	The promotional expenditures did (will) exceed those of existing products.		0.86				
Relative price (RP)	Compared to competitors, the new product was (will be) priced lower.			0.67			
	The new product was (will be) priced much higher than industry average.			0.84			
	The price of the new product was (will be) higher than existing products.			0.86			
Product innovativeness (PI)	The innovativeness of the product to the market is: (lower/higher)				0.84		
	The new product has unique features for customers.	0.47			0.63		
	The product technology is new to the customer.				0.80		
Technical content (TC)	The technical know-how contained in the product is: (low/high)					0.87	
	The technology of the product is state-of-the-art.					0.70	
	The product contains highly sophisticated technology.					0.88	
Up-front homework (UF)	Project screening (activities performed to evaluate new product ideas)						0.76
	Technical assessment (activities performed to evaluate technical aspects)						0.62
	Market assessment (activities performed to evaluate market response)						0.86
	Detailed market research						0.81
	Financial analysis						0.82

[a] Suppressed coefficients lower in absolute value than 0.4.

The ridge trace, a simultaneous plot of the values of the estimated ridge standardized regression coefficients for different values of k, shows that the coefficients tend to stabilize between k = 0.4 and k = 0.5. Figure 2 shows the ridge trace for the break-even model.

Results

Table 4 displays the standardized coefficient estimates, their *t* values, and the adjusted R^2 from the ordinary least squares estimation of the two regression models. We report both the OLS and WLS results for the break-even time model. Because of the heteroskedasticity problem, we emphasize the WLS results for our break-even time model. Because the ridge trace does not show a wide fluctuation of the coefficients as k changes (and only the development cost variable changes sign), the relative importance of our hypothesized variables from the WLS results remains valid (see Figure 1). Due to the scale differences of the parameters, we present the standardized coefficient

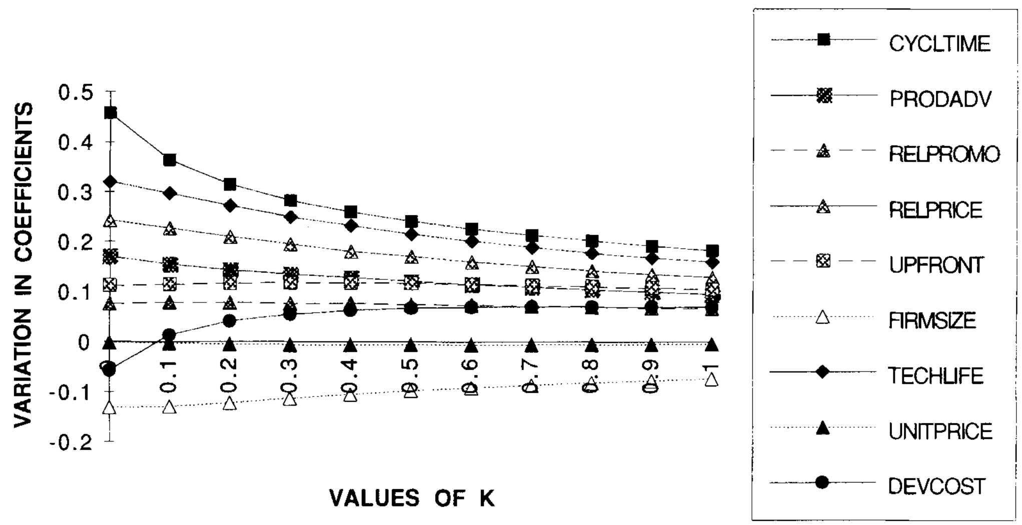

Figure 2. Ridge trace for nine variables.

estimates (betas) here. All but one of the coefficient estimates have the expected signs, and the adjusted R^2 values range from 0.35 to 0.41 which seem reasonable for cross-sectional data on early market performance of small firms (see [50]).

The main findings from Table 4 confirm our earlier discussion of the effects of specific factors on the cycle time and break-even time.

Cycle Time

Following are some highlights from Table 4 on the cycle time model:

- Greater innovativeness and higher level of technical complexity delay a new product's arrival into the marketplace.
- Better product advantage also comes with faster product development.

Innovativeness significantly prolongs the cycle time (estimated $\alpha_1 = 0.22$, $t = 2.00$). We show here that the relationship between innovativeness and cycle time is nonlinear. That is, increasing innovativeness will lengthen the cycle time at an increasing rate. As expected, higher levels of technical complexity produce longer cycle times (estimated $\alpha_2 = 0.39$, $t = 3.70$).

The result shows that better product advantage (estimated $\alpha_3 = -0.23$, $t = -2.26$) tends to speed up cycle time. It seems that firms that are reporting shorter cycle times are also claiming to produce relatively higher quality products. Whether customers can verify this is beyond the scope of this study. As discussed earlier, firms may be doing this by paying more attention at the outset of the product development process. The firms are not only better defining customers' wants at the early stage, but also cutting the "fuzzy front end" of the product development cycle. For example, we find that doing up-front homework leads to longer cycle times (estimated $\alpha_{UFH} = 0.28$, $t = 2.87$), no doubt due to the ambiguity of the elements at this stage. Simpler technology that goes into new products may also discourage "techno-nerds" from playing with the new product for a considerable time, thereby cutting cycle time.

Break-even Time

For the break-even time model, we consider only the WLS results. The main findings from Table 4 on break-even time model are as follows:

- Faster product development leads to shorter break-even time.
- Market pioneering, lower relative price and firm size help in achieving shorter break-even time.
- Product advantage, however, prolongs the break-even time.

The most significant variable explaining break-even time is cycle time (estimated $\beta_1 = 0.34$, $t = 2.14$). As proposed in P4, faster cycle time is associated with shorter break-even time. One might argue that short

Table 4. Standardized Regression Coefficient Estimates[a]

Independent Variables and Expected Sign	Cycle Time Eqn. (1) OLS	Time to Break-even Eqn. (2) OLS	Time to Break-even Eqn. (2) WLS
Entry strategy			
Product advantage (−)	−0.23 (−2.26)**	0.18 (1.86)*	0.17 (1.74)*
Relative promotional effort[b] (+)		0.07 (0.72)	0.06 (0.62)
Relative price[b] (+)		0.26 (2.61)***	0.28 (2.74)***
Market pioneering[b] (−)		−0.10 (−1.08)	−0.16 (−1.67)*
Product innovativeness			
Product innovation[c] (+)	0.22 (2.00)**		
Technical content[c] (+)	0.39 (3.70)***		
Cycle time (+)		0.42 (2.43)**	0.34 (2.14)**
Control variables			
Life span of new technology (+)	0.02 (0.19)	0.42 (2.43)**	0.32 (3.07)***
Up-front homework (+)	0.28 (2.87)***	0.12 (1.16)	0.14 (1.25)
Firm size (−)	−0.09 (−0.81)	−0.13 (−1.24)	−0.16 (−1.64)*
Product development cost (+)		−0.02 (−0.09)	0.04 (0.22)
Unit price of new product (+/−)	0.23 (1.98)**	−0.01 (−0.06)	−0.00 (−0.00)
Adjusted R^2	0.35	0.41	0.41
Sample size (n)	73	73	73

[a] The values in parentheses are t-statistics. All tests are two-tailed with * = 10%, ** = 5%, and *** = 1% significance. Due to small sample size, all nonsignificant variables are dropped from the reduced model presented above. The significant results, however, remain unchanged from the full regression model.
[b] Only hypothesized for break-even time.
[c] Squared term.

cycle time projects are cheaper, hence cheaper projects will yield faster break-even time. Because we considered product advantage, product development cost, and unit price of the product in the break-even time model, we believe that these variables will not influence the relationship between cycle time and break-even time. The data not only support this proposition, but they also suggest that cycle time, among the variables considered in this article, is the strongest indicator of break-even time. This clearly shows the need for understanding the role of cycle time in explaining the initial market performance of new products.

Market pioneering (estimated $\beta_4 = -0.16$, $t = -1.67$), and lower relative price (estimated $\beta_3 = 0.28$, $t = 2.74$) tend to speed up the break-even time. These results confirm some of the earlier findings in the marketing strategy literature [48]. P5 posits that higher product advantage will shorten the break-even time. The standardized coefficient estimate for product advantage, however, is positive (estimated $\beta_1 = 0.17$), but only marginally significant ($p = 0.09$), thus directly contradicting P5. Severe multicollinearity often causes a sign reversal. However, the ridge trace shows consistently positive coefficient estimates for the product advantage variable over the entire range of the biasing constant (see Figure 1) and so in this instance multicollinearity does not appear to be the issue. Potential explanation for this unanticipated result is that product advantage is defined here from the manufacturer's perspective and customers may not share the same perception. As defined, product advantage may produce some incompatibility with customers' existing way of doing things (see [49]), or may increase technological risk for the buyers [57]. The result is puzzling and merits further investigation.

On a separate note, we would like to point out that we found a negative relationship between firm size and break-even time (estimated $\beta_{FS} = -0.16$, $t = -1.64$). As firm size increases, firms tend to have shorter break-even times. This result is obtained although we concentrate on relatively smaller firms (less than 100 employees) and the result nicely confirms the media reports about the success of big firms in reducing cycle time and achieving better market performances.

Discussion

The article empirically examines the issues related to cycle time reduction and investigates the relationship between faster new product development and initial market performance for small firms. We find that faster product development leads to shorter break-even time. The results also indicate that firms are achieving shorter cycle time not by sacrificing product quality, but by keeping the technical content and innovativeness of the product simple. We also show that market pioneering, lower relative price, and large firm size improve a firm's market performance. Past research has not taken into account these relationships and this may be one of the reasons why researchers have often suggested conflicting impact of entry strategy on market performance. These findings support six of our eight hypotheses. However, we didn't find any support for our hypothesis on relative promotional effort and found the wrong sign for the moderately significant effect of product advantage on break-even time. One possible explanation for the later result is that we need to define product advantage from customers' perspective instead of firms' perspective as we did here.

Returning to the issues first raised in the introduction, we desired to identify factors under management control that can or should influence the success of new product development. The entry-strategy problem of being the pioneer or the follower as well as the entry-time problem of when to enter the market, have both been addressed in the literature [32]. Although earlier researchers have found a positive association between market pioneering and improved performance of the firms [48,62], current theoretical work suggests that mere order of entry has no relevance to market share in the long-run [16], and market pioneering is not a strategic behavior conducive to superior performance open to all firms [27]. Rather, firms' resources and skills do matter. Initial market pioneer skills and resources differ from, but are not superior to, later entrants [51]. These findings are based on Abell's hypothesis that market evolution changes success requirements [1]. That, a "strategic window" for entry occurs when the best fit arises between a market's key success requirements and specific firm competencies.

The notion of "strategic window" highlights the importance of cycle time. The choice of market-entry time to improve new product success is contingent upon the completion of the product development process. Only when a product is developed, can a firm think of exploiting the "strategic window." Thus, cycle time will be an important determinant of new product success and our finding of significant impact of cycle time on break-even time confirms this proposition. Past research has not taken into account this relationship and this may be one of the reasons why researchers have often found conflicting impacts of entry strategy on market performance (see [19] for a historical analysis of the market share performance of pioneering brands).

Technical content has the strongest delaying affect on cycle time for developing new products. Thus, the use of technology which may increase product acceptance [9] may also create serious risks of arriving too late to market if excess technical content is pursued. For example, Czinkota and Kotabe suggest that US manufacturers are seeking technological steps that are too large in each development project [13]. Incorporating high technology into a new product takes time; however, we find that greater development frequency shortens cycle time.[5] Thus product development experience may offset some, but not all, of the cycle time required for technological content decisions.

Implications for Managers

Although the theory of what factors influence the product development time is of academic interest, it is also important to marketing managers, as is evident from the fact that firms are increasingly relying on cycle time for competitive advantage. We suggest that a firm that wants to speed up the product development process should be vigilant against overengineering. Putting sophisticated state-of-the art technology into a new product may provide professional pride to technical or R&D managers, but it may seriously delay entry into the market. Managers should also seriously consider developing new products that are highly innovative to customers. Our results show that innovativeness has negative impact on cycle time if we held the product advantage constant. Further, product advantage should be defined from the customers' perspective. Unless the product offers some unique benefits, it may not pay off to develop highly innovative products. Czinkota and Kotabe suggest that Japanese firms have taken an incrementalist product development approach and consequently, they have been able to increase the speed of new product introductions,

[5] The seemingly appropriate use of technical content for creating a competitive advantage has several undesirable residual consequences. Our findings suggest that managers must consider the urgency of the market need and ease of competitive response. One could infer from our results that managers trying to leapfrog competitors by using complex technologies run a real risk of being too late to market.

meet the competitive demands of a rapidly changing marketplace, and capture market share [13]. However, speeding up of product development process by taking an incremental approach doesn't mean that a firm should come up with trivial innovation. As Crawford suggested, firms should keep asking for evidence that speeding up offers genuine benefits to the customer [12]. Thus, there are two important messages for managers:

1. Incorporation of the state-of-the art technical know-how into a product needs special consideration.
2. Speed up product development by developing an incremental innovation only when it offers genuine advantage to customers. Given the nature of our sample, this caution may be particularly appropriate for small manufacturers.

Directions for Future Research

Our research suggests that shorter cycle time is an important indicator of improved market performance. However, this finding does not suggest that firms should keep on reducing the development time of new products. This is because one need to test the robustness of this relationship against other measures of market performance (e.g., market share, sales, ROI). The consideration of break-even time in our model reflects the trade-off involved between the benefit and the cost of reducing cycle time. But, to improve profitability, a firm needs to balance its efforts toward four key objectives—development speed, product cost, product performance, and development program expenses [58]. How does one make trade-offs between these four possible objectives? How do environmental and situational factors influence these trade-offs? There is a need for a theory that can explain these issues for decreasing product development time.

A factor, which should play an important role in determining the cycle time that we have not considered, is the effect of the existing products on a firm's choice of development strategy. For example, a firm may slow down the development of a new technology if it affects the sales of its existing products. Intel's slow introduction of Pentium chips against its still highly profitable 486 chips may highlight this point [45]. Examination of competitive effects also seems to be in order here. A firm in an intensely competitive market may have an added incentive to shorten the product development time.

We investigate the effect of innovativeness and entry strategy on cycle time for small firms. There is a need to replicate our findings for large firms. Further, we need to investigate the effect of factors such as process control variables on cycle time. Managers can influence cycle time by exercising controls on development process. For example, a firm can go to outsiders to expedite new product development. Should a firm achieve faster product development by using internal R&D efforts or should it hire a contract-research firm to do product development? Should it develop new products in a phased manner or simultaneously if possible? Clearly, there is an opportunity for further theoretical and empirical work in this area to improve our understanding of product development time.

Conclusion

Bringing new products faster to the marketplace is becoming an increasingly popular way to improve competitive position in the business world. The business press is replete with stories extolling the benefits of faster product development. However, accelerated product development has not yet been subjected to serious critique by academic researchers [12]. Part of this delay may be attributable to the lack of a conceptual framework for investigating implementation time as a source of competitive advantage. Part may be due to the growing doubt whether faster development will always be better. For example, the relentless push for accelerated product cycle times, Sony Corp. Chairman Akio Morita proclaims, is simultaneously exhausting consumers and corroding profit margins [56]. To overcome this deficiency, we drew on established theories to understand and explain the role and impact of innovativeness and entry strategy on cycle time. Our empirical study of small high-tech firms is particularly relevant, because smaller firms are developing more new products per dollar of research money [2]. Thus far the business press has largely ignored smaller firms in their discussions of product development productivity.

The premise that shorter cycle time is desirable, however, should be only cautiously accepted. Faster product development should be judged against product performance and development cost. This study has introduced break-even time as an important indicator of market performance and illustrated the crucial role of cycle time as a mediator between managerial actions and market performance.

The authors gratefully acknowledge the support provided by the Michael E. Dingman Center for Entrepreneurship at the University of Maryland at College Park. The authors would like to thank Abbie Griffin, Tom Hustad, Bill Robinson, and two anonymous reviewers for their helpful comments and suggestions on the earlier version of this manuscript.

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