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Assessing the Impact of Dedicated New Product Development Resources on Firm Return on Investment

David H. Henard, M. Ann McFadyen, and Keven C. Malkewitz

This longitudinal study demonstrates that investing resources in new product development offers strong returns to the firm. It also suggests that patience and persistence pay off: dedication of human resources may take two years to produce positive results.

Report Summary

Although most managers intuitively believe that dedicating human and financial resources to new product development (NPD) initiatives leads to positive return on investment (ROI), there has been little direct empirical evidence to support such intuition. Indeed, considering the large costs associated with NPD activities, it is surprising how few investigations have focused directly on the relationship between the dedication of company resources and ROI. Henard, McFadyen, and Malkewitz turn their attention to this under-researched area of NPD strategy to establish whether there is support for the hypotheses that the greater the dedication of human resources and financial resources to NPD initiatives, the greater the return on investment.

Recognizing that dedicating human and financial resources may not result in instantaneous financial returns and that ROI over time is of interest, the researchers adopted a longitudinal approach, incorporating into their model the suitable lag time between each resource investment and subsequent return on that investment. Data were collected for 22 firms over seven years.

Analysis of the data provided support for both hypotheses: The greater the investment in human and financial resources, the greater the ROI. However, while dedication of financial resources resulted in immediate returns, the returns for dedication of human resources showed a two-year lag. Another interesting finding was that dedicating resources to NPD initiatives resulted in a statistically significant return on investment distinct from that of other R&D activities—despite the fact that NPD initiatives are clear R&D components. The researchers explain this in terms of persistence in investment: While the firms in the study made persistent investments in NPD initiatives, they did not make persistent investments in overall R&D.

An important implication of this research for managers is that returns from the dedication of resources to NPD projects should be evaluated over time, and that the dedication of human resources takes time to develop fully and to produce positive results. Additionally, persistence in resource dedication appears to be beneficial. ■

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Introduction

We are convinced that long-term success in the new millennium will come only to those companies that value innovation and learn how to harness its power for growth.

Ralph Larson
CEO, Johnson & Johnson

Many managers view investments in innovation and new product development (NPD) initiatives in marketing as strategically effective activities that are instrumental in contributing to firm profitability. Determining which NPD activities will lead to marketplace success has long been a focus of managerial and researcher interest (see Cooper 1980; Cooper and Kleinschmidt 1987; Henard and Szymanski 2001; Montoya-Weiss and Calantone 1994; Rothwell et al. 1974). Discovering and assessing a quantifiable link between core marketing activities and firm-level financial metrics is of primary importance to contemporary marketing professionals as well (Marketing Science Institute 2002).

Recently, Henard and Szymanski (2001) classified NPD activities into four broad categories focused on the product, the strategy, the process, and the marketplace. One important and relatively under-researched area is the category of NPD strategy, which addresses how managers should invest resources in NPD initiatives. The strategies managers select are closely associated with and have an impact on their firm's marketplace performance (Booz-Allen and Hamilton 1982; Cooper 1984a; Griffin and Page 1996). Extant investigations of NPD resource investments primarily focus on variables that are readily amenable to management action (Cooper 1984b), such as the degree of synergy between firm resources and market demands, order-of-entry decisions, or the dedication of resources to a new product initiative (Henard and Szymanski 2001; Montoya-Weiss and Calantone 1994).

In this research, we investigate the managerial decision to dedicate both human and financial

resources to NPD activities; we then assess the lagged performance impact of the dedication of each resource and explore the resulting return on investment (ROI) over time. We contribute to the literature by taking a theoretical approach to these questions and by using multivariate empirical analyses to build upon and enhance the existing knowledge base, which is largely atheoretical and bivariate. We further contribute by capturing precise measurements of human and financial NPD resource investments, by analyzing their relationship to ROI over time, and by explicitly modeling temporal adjustments.

We define the dedication of human resources as a firm's focused commitment of personnel dedicated to NPD initiatives. Such individuals focus solely on new product development initiatives and often hold doctorates in their respective fields. Whether new product development success comes from the efforts of a group of individuals or from a single product champion, the impact of dedicated human resources on the success of NPD initiatives is widely believed to be positive (e.g., Barczak 1995; Voss 1985). We similarly define the dedication of financial resources as the focused commitment of funds to NPD initiatives. As with dedicated human resources, we propose that dedicated financial resources will have a positive impact on firm-level performance (see Li and Calantone 1998; Morbey 1988).

Despite both the perceived importance of dedicated resources for firm performance and the large costs associated with NPD activities, there have been comparatively few investigations directly focused on the relationship between the dedication of company resources and return on investment (see Henard and Szymanski 2001). Additionally, empirical assessments of the lag between NPD resource investments and subsequent performance returns are relatively rare, despite the obvious practical importance of such information. Because there are few studies that offer empirical measurement of resource investments and the resulting ROI over an extended time frame, a more thorough exami-

nation of these relationships is warranted. In the following section, we detail the theoretical perspective that drives our investigation. We then discuss the methods used to test the hypothesized relationships and follow that with a discussion of the results.

Conceptual Background

An appropriate conceptual framework for our analysis is one that accounts for imperfect information, resource heterogeneity, and a nondeterministic competitive environment. The resource-based view of the firm (Amit and Schoemaker 1993; Barney 1986, 1991; Penrose 1959; Peteraf 1993; Prahalad and Hamel 1990; Wernerfelt 1984) asserts that utilization of a firm's unique resources brings marketplace success. In line with existing conceptions (e.g., Barney 1991; Daft 1986; Penrose 1959), we interpret firm resources to be either tangible (including raw materials, equipment, and R&D expenditures) or intangible (including reputation, brand equity, and tacit employee skills) and propose that the proper dedication and utilization of either type of resource can lead to long-term, positive returns.

The resource-based view of the firm is a relatively new theory, but it builds upon existing theories (see Conner 1991) and has emerged in the past decade as a leading contemporary approach to strategy (Foss 1997). One of the assumptions of the resource-based view is that firms possess heterogeneous assets. Many companies allocate new product development personnel and appropriate funds for NPD, but the degree of competence, commitment, and investment varies from company to company. Thus, even when firms possess seemingly similar resources, their utilization of these resources over an extended period of time makes the resources heterogeneous and unique (Penrose 1959; Srivastava, Fahey, and Christensen 2001). Under the resource-based view, resources are seen in terms of their imitability and mobility. In other words, how

difficult is it for competitors to reproduce and utilize the same resources? The resource-based view understands firms to be value creators: Companies can manipulate their resources in such a way that customers find value in their products. Hence, marketing managers' strategic decisions concerning resource investments play a large role in determining whether or not resources ultimately contribute to sustained positive financial returns.

Obviously, not all resources guarantee firms a sustainable return. Under the resource-based view, resources must possess four key attributes in order to achieve sustainability: They must be valuable, in the sense that they exploit competitive opportunities and diminish competitive threats; they must be rare within the firm's competitive environment; they must be imperfectly imitable, such that competitors cannot easily duplicate them; and there cannot be a strategically equivalent substitute that could replace them (Barney 1991). The dedication of human and financial NPD resources may not appear, on first examination, to qualify as such a resource given the preceding criteria. After all, many firms allocate both personnel and funds to NPD initiatives. However, while several firms may claim conceptually similar resources, not all have the wherewithal to fully develop or utilize those resources in a manner that leads to long-term profitability (Dierickx and Cool 1989). Srivastava, Fahey, and Christensen (2001) note that a marketing perspective on the resource-based view shifts the consideration of key resources from an emphasis on which firms possess valuable resources to an emphasis on how well firms utilize those resources.

When firms dedicate personnel to NPD initiatives, they are making an explicit attempt to leverage their intangible resources to exploit opportunities in the marketplace. Likewise, dedication of funds to NPD initiatives is a strategic attempt to leverage a tangible firm resource. By determining how strategic resources are utilized, marketing managers play a key role in the fundamental process of trans-

forming resources into products that provide value to customers (Srivastava, Fahey, and Christensen 2001). Consistent with the view of Hitt and Ireland (1985), we propose that through dedication and prudent utilization of resources, firms will develop competencies that allow them to produce products that provide a positive return on investment. Cohen and Levinthal (1990) demonstrate that firms that invest in NPD initiatives are more likely than their competitors to exploit marketplace opportunities successfully when they arise. They further note that while such tangible and intangible resources take time to develop, a firm's exploitive capabilities increase over time with continual investment. We propose that the dedication of human and financial resources to NPD initiatives increases firms' exploitive capabilities through the development of firm-specific core competencies.

Theoretically, dedicating individuals to NPD initiatives will lead to an increased level of individual and organizational expertise, resulting in marketplace success (Cohen and Levinthal 1990). One explanation for this is that dedicated individuals are better able to deflect internal resistance and successfully navigate organizational channels than are less involved individuals (Maidique 1980). A second explanation is that organizational routines and other individual- or team-based experiences may be so complex and involve so much idiosyncratic knowledge that competitors are unable to duplicate them (Dierickx and Cool 1989; Nelson and Winter 1982; Reed and DeFillippi 1990). Building on the above research and previously published positive empirical relationships between dedicated resources and marketplace performance (see Henard and Szymanski 2001), it follows that greater NPD resource dedication may result in greater realized customer value and enhanced financial performance. Reed and DeFillippi (1990) aptly note that the internal relationships, skills, and resource deployments arising from dedicated resources can be ambiguous to competitors, thereby raising barriers to imitation. This causal ambiguity arising from such trans-

action-specific, dedicated investments can lead to firm competencies that are both competitively rare and imperfectly imitable (Dierickx and Cool 1989; Reed and DeFillippi 1990; Williamson 1975).

The final criterion for determining if a resource has the potential to provide sustainable returns is whether it has a strategically equivalent substitute. Again, in a marketing perspective on the resource-based view of firms, it is the utilization and not the possession of resources that is of interest. In line with previously presented logic, while competitors may duplicate the resources of interest (personnel and funds) on a definitional level, it is the leveraging of these resources via the capabilities and competencies that develop thanks to the resources' dedication to the NPD task that make the resources strategically unavailable to competitors on a practical level (Hitt and Ireland 1985; Reed and DeFillippi 1990; Srivastava, Fahey, and Christensen 2001). Privately held knowledge is a basic source of competitive advantage (Conner and Prahalad 1996), and the base of knowledge gained through resource dedication is likely to expand over time (Cohen and Levinthal 1990; Dierickx and Cool 1989; Sinkula 1994). Just as skill sets define the competence of employees, the capabilities of a firm are shaped by the organizing principles through which it structures, coordinates, and communicates expertise (Cohen and Levinthal 1990; Penrose 1959; Zander and Kogut 1995). Firms that dedicate focused resources to NPD initiatives create an environment in which employees can develop a base of knowledge and a set of skills that are likely to produce internal tacit skills that are difficult for competitors to mimic and that lead to marketplace success.

In sum, the resource-based view of the firm proposes that firms possess resources that managers can leverage to achieve strong and consistent marketplace returns. Two of the most visible resources available to marketing managers are human and financial. The resource-based view suggests that long-term

utilization of these resources on NPD initiatives should lead to firm-specific core competencies that provide companies with more knowledgeable workers, heightened process efficiencies, imperfectly imitable competitive capabilities, and, most importantly, positive performance returns. Building upon our conceptual discussion, we forward the following hypotheses:

H1: The greater a firm's dedication of human resources to NPD initiatives, the greater the firm's ROI.

H2: The greater a firm's dedication of financial resources to NPD initiatives, the greater the firm's ROI.

In the following section, we discuss the methodology used to test our hypotheses. We describe the database development and define each of the variables used in the empirical analysis. A presentation of the results and a discussion of our findings follow this.

Methodology

In the literature on the resource-based view of the firm, one finds a couple of recurring concerns regarding empirical analyses. One is the difficult methodological task of quantifying intangible resources (such as human resources or brand equity) for empirical analysis. By contrast, capturing financial expenditures is rather straightforward. Traditionally, strategy researchers use proxies to test intangible relationships of interest. While this practice is potentially subject to criticisms of construct validity, we subscribe to the view of Godfrey and Hill (1995) that researchers should focus on observable variables that collectively shed light on the unobservable variables of research interest. With that in mind, we captured data that most closely approximate the intangible human resource dedication and captured financial resource investments directly. We measured performance at a level that reflects financial returns to the company as a whole. (We

describe our measures in detail in the following section.)

A second methodological concern centers on the time period of analysis. The resource-based view of the firm considers persistent resource investment to be important for marketplace success, which implies the need for longitudinal analysis rather than the more traditional static investigations. In accordance with this thinking, we tested our hypotheses with appropriate methodological tools, assessing and incorporating into our model the suitable lag time between each resource investment and subsequent return on that investment.

We conducted a multivariate, longitudinal analysis with an explicit dynamic specification to capture the lagged impact that dedicating NPD resources has on a firm's ROI. To this end, we collected both survey and archival panel data. Our source of archival data was Standard & Poor's COMPUSTAT database, which consists of over 35 years of time series financial data on approximately 7,300 active U.S. companies, 5,000 inactive U.S. companies, 500 Canadian companies, and 250 American Depository Receipts (foreign companies that file with the Securities and Exchange Commission). We obtained survey data from a joint initiative of the Industrial Research Institute (IRI) and the Center for Innovation Management Studies (CIMS). These data were collected over a seven-year period (from 1992 to 1998) from 106 firms that are recognized as innovation leaders. The IRI/CIMS annual surveys were designed to collect detailed data pertaining to participating firms' sourcing and allocation of resources for numerous NPD activities. The goal of the joint initiative was to build a longitudinal, comprehensive database on unique NPD antecedents and outcomes. The IRI/CIMS database is the only source, to our knowledge, that provides such detailed information on dedicated NPD resource investments. Importantly, the firms participating in the IRI/CIMS surveys provided detailed and unique information on human and financial NPD resource commitments.¹

The questions and definitions used in the IRI/CIMS surveys presented to participants remained constant throughout the seven-year survey period. Over this period, an average of 85% of the firms responded to the survey each year. In order to analyze a consistent and comprehensive longitudinal sample, we eliminated firms from our database that did not respond to the survey for two or more of the seven years. Firms that either responded to all years or had only one year of data partially missing were retained in the database. We replaced any single-year missing values using a regression imputation procedure to calculate replacement values. Regression imputation incorporates all of the reported values in a regression model to determine an appropriate replacement value for any missing data. While both regression imputation and mean substitution techniques produce effectively similar results, regression imputation is a more statistically rigorous and accurate methodological approach (Little and Rubin 1987). Of the total participating IRI/CIMS firms, 22 (20.7%) provided sufficient data over the survey time frame. The final database contained seven years of IRI/CIMS and COMPUSTAT data for 22 companies from 5 SIC industry groupings. The sample includes firms from the following product classifications: energy production, consumer products, organic chemicals, plastics and resins, and industrial equipment.

Measures

Our model had several independent measures, a dependent measure, and control measures.

Independent Measures. We defined dedicated human resources as personnel that the firm committed solely to NPD activities. Participating IRI/CIMS firms provided us with the total number of personnel within the company that were solely dedicated to NPD activities. Each of these individuals held an advanced educational degree. Any part-time employees with advanced degrees that were dedicated to NPD initiatives were also included in the total number. Support services personnel

such as secretaries and nonproject administrative personnel were not included. To construct this predictor variable and to create an empirically appropriate and relative measure across the firms in our sample, we divided the number of dedicated NPD personnel by the total number of employees for each firm. Data on the total number of employees in each firm were obtained from the IRI/CIMS database.

We defined dedicated financial resources as funds that the firm allocated solely to NPD activities. Participating firms provided us with the total dollars that were allocated solely to the development of new products. These expenditures were committed to specific technical, nonroutine activities that were targeted at transforming research findings into the production and commercialization of new products. They also included dollars that were allocated to any design or engineering tasks required to commercialize a new technology for product launch. This total expenditure does not include previously commercialized technology or financial commitments to routine technical activities. To create an appropriate and relative across-firm measure, we divided the total funds dedicated solely to NPD initiatives by capital expenditures. Data for this variable were also obtained from the IRI/CIMS database.

Dependent Measure. We operationalized the financial performance variable as a firm's ROI. COMPUSTAT defines this measure as a firm's net income before taxes divided by its invested capital. ROI is a firm-level financial performance metric that is commonly used by corporate executives to evaluate firm performance and has been used when examining the impact of product development expenditures on firm performance (e.g., Erickson and Jacobson 1992; Horwitch and Thietart 1987).

Control Measures. We recognize that unobservable factors other than our explanatory variables of interest can influence a firm's ROI. Therefore, we specified our model to control for potential extraneous effects. Dependent vari-

Table 1
Results of the Two-Sample Kolmogorov-Smirnov Difference Tests

Panel A. Across-Firm Results by Year: *p*-values

Variable	1992	1993	1994	1995	1996	1997	1998
Employees	.55	.79	.51	.92	.91	.68	.70
Sales	.16	.17	.14	.21	.29	.17	.52
R&D expenditures	.88	.86	.77	.58	.67	.77	.98

Panel B. Across-Year Results for Firms: *p*-values

Variable	1995/1996	1992/1995	1993/1996	1994/1997	1995/1998
Employees	1.00	.97	.99	1.00	.95
Sales	1.00	.50	.23	.37	.93
R&D expenditures	1.00	.52	.89	.58	.64

ables that are used as outcomes in one year may be correlated with outcomes in subsequent years and may exert a statistical influence on the data. Our use of a panel data method controls for this influence. We also included a lagged dependent variable in our model, which accounts for any statistical influence from the previous year. Firm size and investments in research and development programs may also influence performance, so to control for any effects that expenditures in total research and development (R&D) might have on ROI, we included a size-adjusted measure of R&D intensity to capture the relative impact that R&D investment across the firm has on subsequent firm performance.² Given that both dedicated human and financial resources investments are a specific subset of total R&D resource investments, it is important to control for the performance impact of other R&D activities when interpreting the relationships of interest in this study. To create an appropriate and relative across-firm measure and to be consistent with extant research measures (e.g., Baysinger and Hoskisson 1989; Coff 2003; Etilie 1998; Helfat 1994), we divided total R&D expenditures by sales. Data for this variable were obtained from the COMPUSTAT and IRI/CIMS databases.³

Procedure

The IRI/CIMS survey data were collected by self-reports from company managers, and our statistical model is therefore subject to criticisms of common-method variance (Campbell and Fiske 1959). To address that shortcoming, we verified the accuracy of the IRI/CIMS data by comparing it with independent third-party COMPUSTAT archival data (see Podsakoff and Organ 1986). The correlation of reported information between the IRI/CIMS and COMPUSTAT databases was remarkably high (all *r*-values greater than or equal to .93) across all model variables and all years tested. To ensure that our data did not contain a systematic bias due to our having eliminated certain firms and having retained others, we compared the responses of the retained IRI/CIMS firms with data for the eliminated firms using both IRI/CIMS and COMPUSTAT data. For both sets of companies, we examined gross sales, number of employees, and R&D expenditures over a seven-year period. These were pertinent variables that were commonly reported across both databases. We conducted a Kolmogorov-Smirnov two-sample test (Siegel and Castellan 1988) to determine if any differences existed

Table 2
First-Differenced Dynamic Panel Data Model Results

Explanatory Variable	Base Model	Full Model
Intercept	.14 (.57) ^o	.02 (.16)
Lagged ROI	-.03 (2.54)	-.62 (.78)
R&D intensity	.17 (.39)	.18 (.18)
Lagged R&D intensity	.22 (.61)	.08 (.28)
2nd lagged R&D intensity	.21 (.49)	.00 (.23)
Dedicated human resources	----	-66.75 (43.67)
Lagged dedicated human resources	----	45.11 (51.91)
2nd lagged dedicated human resources	----	90.24 (46.40) *
Dedicated financial resources	----	6.76 (.77) **
Lagged dedicated financial resources	----	-.61 (5.47)
2nd lagged dedicated financial resources	----	-3.50 (2.55)
Model Wald χ^2	.34	209.82 **
Model R^2	.08	.58 *
Wald χ^2 test of difference between models		203.07 **

^o Standard errors are in parentheses

* $p \leq .05$

** $p \leq .01$

between retained and eliminated firms in the distribution of responses for the noted variables.

Panel A in Table 1 details the results of our analysis across firms. The large and statistically nonsignificant p -values ($p > .10$) for each of the variables across the seven-year period consistently indicate that there is no statistical difference in reported results between firms retained in our database and those that were eliminated. We further tested for any potential differences in the distribution of firms responding across years. In each case, the p -values for the variables exceeded .23 (see Table 1 Panel B), indicating that there are no statistically significant differences in the distributions and that sample variance across years is not an issue. Given the results of these tests, we are confident that both the

retained and eliminated firms are from similar populations and that selection bias is not present.

As noted previously, the resource-based view of the firm proposes that the value of resources increases with cumulative investment in them. The returns on these investments are also likely to vary over time; in order to develop an accurate model, it is important to calculate the appropriate lag time between resource investment and return on that investment. Since theory suggests that the dedication of human and financial resources may not necessarily have an immediate impact on ROI, we used a dynamic panel data model to explicitly capture the temporal adjustments. More specifically, we used a two-stage least squares first-differenced panel data model with a lagged dependent

Table 3

Descriptive Statistics and Intercorrelations for the Model Variables

	Mean	S.D.	1	2	3	4
1. ROI	.90	1.98	1.00			
2. Dedicated human resources	.01	.01	.04	1.00		
3. Dedicated financial resources	.21	.32	.61*	.10	1.00	
4. R&D intensity	.21	.53	-.03	-.01	-.03	1.00

* $p \leq .05$ ** $p \leq .01$

variable (Anderson and Hsiao 1981, 1982). The model we tested takes the format $R_{it} = \beta_0 + \beta_1 R_{i,t-1} + \beta_2 I_{it} + \beta_3 I_{i,t-1} + \beta_4 I_{i,t-2} + \beta_5 H_{it} + \beta_6 H_{i,t-1} + \beta_7 H_{i,t-2} + \beta_8 F_{it} + \beta_9 F_{i,t-1} + \beta_{10} F_{i,t-2} + \varepsilon_{it}$ where R , I , H , and F are ROI, research intensity, dedicated human resources, and dedicated financial resources, respectively. We used $R_{i,t-2}$ and $R_{i,t-3}$ to obtain an instrumental variable estimate of $\Delta R_{i,t-1}$.

In Table 2, we report both base model and full model results. The base model serves as the point of statistical comparison for the subsequent full model. The full model incorporates the dedicated human and financial NPD resource variables and examines the impact of contemporaneous and previous two-year resource investment on ROI. A statistically significant χ^2 result when testing the difference between the base model and the full model indicates that the explanatory variables included in the full model demonstrate predictive value over and above those in the base model. A positive and statistically significant coefficient for the predictor variables in the full model indicates empirical substantiation for our respective hypotheses.

Results

Table 2 shows the results of our hypotheses testing. Hypothesis 1 stated that the greater a firm's dedication of human resources (relative to

its total number of employees) to NPD initiatives, the greater the firm's ROI. Hypothesis 2 stated that the greater a firm's dedication of financial resources (relative to its capital expenditures) to NPD initiatives, the greater the firm's ROI. Both hypotheses are supported by these data. The significant χ^2 for the test of difference between models ($\chi^2 = 203.07, p \leq .01$) indicates that dedicated NPD resources have a statistically significant impact on firm ROI over and above that of the control variables. The results from our analysis further indicate that the lag time between investment and return differs for each dedicated resource. Table 2 provides evidence that financial resources dedicated to NPD have a more immediate and positive impact on ROI, while their effect in later lagged values is less substantial. It is evident that the greatest performance impact occurs closest to the time of financial investment.

By contrast, the impact of human resources dedicated to NPD appears more complex. The parameter on the immediate value of dedicated human resources is not significant, nor is the parameter on the first lagged value. It is not until the second lagged value that we detect a positive and significant relationship between the dedication of human resources to NPD and ROI. This suggests that human resource investments in NPD initiatives take relatively more time than financial investments to produce performance returns. The values for R&D intensity are not significant, which may result

from a lack of persistence in either R&D expenditures or firm sales across the study years (Bhargava 1994; Helfat 1994). Firms that either earn or expect a high level of ROI in one year have more discretionary funds and may increase R&D expenditures; the opposite also holds (Erickson and Jacobson 1992; Helfat 1994).

The model detailed in Table 2 offers a rigorous and parsimonious evaluation of the relationships of interest. While our relatively small firm sample size is somewhat limiting, we were able to control for phenomena that previous research highlighted as having potential influence on ROI. Table 3 provides summary and descriptive statistics for all variables included in the longitudinal study. The correlation matrix in Table 3 largely reveals modest to no intercorrelation between the model variables and indicates that there is a low probability of multicollinearity effects influencing the results. The statistical software (STATA 8SE) used in this research automatically checks for multicollinearity problems and will not calculate a model in the presence of problematic collinearity. The software detected no problems. As an additional measure, we manually checked for any multicollinearity before fitting the model.⁴ No indicators of collinearity were observed.

Discussion

The results support our hypotheses that the greater a firm's relative dedication of human and financial resources to NPD initiatives, the greater its return on investment. Yet an interesting question arises from our results. Why does dedicating resources to NPD initiatives—which are clear R&D components—result in a statistically significant return on investment distinct from that of other R&D activities? Recall from our conceptual discussion that the resource-based view of the firm posits that a firm's performance is enhanced by its persistent investment in resources (e.g., Cohen and Levinthal 1990). Our R&D intensity variable is composed of R&D expenditures and firm sales.

A post hoc analysis of our data indicated that neither R&D expenditures nor sales were persistent across the study years.⁵ Likewise, ROI was not persistent during the sample time frame. By contrast, we found persistent dedicated human and financial resource investment in NPD initiatives. This difference in persistent investment may offer some explanation. With greater relative dedication of resources to NPD initiatives, marketing managers create an environment in which firms are better able to develop tacit skills internally and exploit marketplace opportunities.

On another level, R&D expenditures capture an array of activities at varying stages of development—encompassing both basic and applied research—with varying probabilities of ultimate market introduction or profitable returns. By contrast, NPD resource dedication, as defined here, is a more short-term activity in relationship to performance returns and is captured closer to the point of performance measurement. While the precision of our predictor variable measurements may partially explain the results, the fact that human and financial resource dedication is closely associated with the production and commercialization of new products (i.e., applied research) may also impact the relative strength of the parameter estimates. Some research provides evidence that if managers do not expect a contemporaneous impact on ROI from discretionary expenditures, then they will not expect an impact on market value and will instead focus on activities that lead to short-term gains (Hayes and Abernathy 1980). Thus, both the persistent dedicated resource investment in NPD as well as the nonpersistent intensity of R&D investment that we observed may be logical business reactions to the noted inconsistency in ROI during the study years.

The premise of this study was that the dedication of NPD resources would lead to positive firm-level performance. Even after controlling for prior performance and other R&D activities, dedicating relative human and financial resources to NPD initiatives produces a positive

ROI. A positive ROI can lead to higher discretionary funds being made available for investment in overall R&D initiatives. Therefore, dedicated firm investment in human and financial NPD resources is likely to lead to a positive cycle of performance returns and greater discretionary funds available for persistent new product development investment. In sum, our results both demonstrate the importance of persistently dedicating resources to NPD initiatives and highlight the temporal nature of the relationship between dedicated NPD investment and ROI.

Contributions

On a general level, this research is grounded in the resource-based view of the firm and recognizes that firms compete utilizing both tangible and intangible resources. As the innovation literature has voluminously expanded over the past decade, many investigations, while practical in approach, have lacked theoretical foundation. This study contributes to the literature by developing and testing a conceptual framework that investigates how the relative dedication of NPD resources can directly impact a measure of financial return. A further contribution lies in its application of the resource-based view of the firm to new product development. Similarly, much of the innovation research has been conducted using static, bivariate analyses. Our research, however, involves a longitudinal, multivariate analysis that allows us to statistically ascertain and account for the lagged effects between the time of NPD resource dedication and ROI. Additionally, whereas many empirical investigations of the predictors of firm performance look at multiple antecedents and categories, this research takes a more precise and focused investigation of two important and relatively underinvestigated predictors.

This study is useful to marketing managers because it quantifies the performance impact that allocating a largely intangible resource has on a company. Our analysis provides a specific

performance evaluation of NPD resource investments. Most managers intuitively believe that dedicating human and financial resources to new product development initiatives leads to positive ROI, yet there has been little direct empirical evidence to support such intuition. While other investigations of the effects of resource dedication on performance have sometimes relied on subjective measures, this study takes precise, objective measurements to provide managers with an accurate assessment of the relationships. Additionally, the dynamic longitudinal approach taken in this research allows managers to interpret performance over time, which is a more helpful approach for strategy formulation. Not only does this research capture the temporal effect between relative resource investment and subsequent performance, it determines empirically the unique lag period for each resource and looks at this effect over a period of years. Our study provides evidence that the lagged values of dedicated human resources and the current values of dedicated financial resources predict current values of ROI, after controlling for lagged values of ROI and R&D intensity. By examining the impact of resource dedication on ROI longitudinally, we present managers with an accurate picture of the investment-return relationship.

Implications for Research and Practice

Our results indicate that investments in human and financial NPD resources take varying times to produce a return. One implication of our study for scholars is that static analyses may not be entirely appropriate for evaluating the impact of human influences on NPD performance. This finding has implications for numerous innovation research initiatives, including studies investigating the degree of congruency between the marketing or technological skills employees currently possess and the skills necessary to execute a new product initiative successfully. Our research suggests that such skills take time to develop and that the degree of marketplace impact may not be accurately reflected in a

static study. Investigations of other NPD performance predictors such as task proficiencies, cross-functional integration, and market orientation face similar issues. A dynamic longitudinal approach that assesses the temporal effects in such relationships would enhance our understanding of these and other research topics.

Scholars are not the only ones who have relied on static analyses to the detriment of accurate understanding. Marketing managers, facing increased market pressures to produce positive financial results on a short-term, quarterly basis, may well be tempted to evaluate the performance of NPD initiatives prematurely. Our results clearly indicate that the return on human resource investments in new product initiatives is different depending on when it is measured. Thus, an implication of our research for managers is that returns from the dedication of resources to NPD projects should be evaluated over time, as dedication of human resources in particular takes time to produce positive results. When formulating strategy and deciding what resources to allocate to NPD, managers must remember the time-dependent nature of the link between resource dedication and resultant performance. Our results also support the RBV prescription for persistent resource investment. For example, without continued investment in human NPD resources, any performance returns gained in year $t + 2$, for example, may be mitigated if investments were not continued beyond period t . Additionally, persistently dedicating human and financial resources to NPD provides managers with a greater likelihood of generating discretionary funding for continued product development initiatives.

Limitations and Directions for Further Research

Due to the nature of our data, we face constraints regarding the generalizability of our results. First, although the inclusion of 22 companies from several industries and across several years

provides a strong degree of generalizability, a majority of the companies in our database are manufacturers of nondurable products. While there is no reason to believe that our results will not hold for manufacturers of durable goods, we are inclined not to extend the generalizability of our results to them. Second, while we constructed scaled variables across the firms in our database, we were unable to capture information for all competitors of our sample firms. The IRI/CIMS data uniquely capture information from some of the most innovative firms in the country. While these are data that, to our knowledge, are not available from other sources and allow us to uniquely examine the resource dedication decisions of clearly innovative firms, they do preclude our collection of information on firms that directly compete with our sample firms. While we are able to show that relative resource dedication leads to positive ROI, the constraints of our database do not permit us to compare our firms' relative level of resource dedication or magnitude of return with that of all their competitors, which is necessary for a complete demonstration of the competitive advantages of resource dedication.

Several avenues for future research remain for investigators. A line of inquiry analogous to that in our study would be to examine the differences between applied (that is, short-term) and basic (long-term) NPD research initiatives. What are the payback schedules for each, and does one approach improve firm performance more than the other? One of the foci of our research was dedicated human resources; an investigation of the relative financial performance returns of dedicated and shared human resource commitments would likewise provide researchers and managers with worthwhile insights. As noted in the limitations discussion, future research that incorporates more information on firm competition would enhance this current research. A focused investigation into potential curvilinear effects that result from dedicating resources would yield beneficial information as well. For example, how much relative resource dedication is

enough? Finally, research initiatives that investigate the effects of other notable intangible marketing variables, such as brand equity and firm reputation, would help to quantify marketing's impact on firm-level financial metrics. ■

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Notes

1. CIMS, IRI, and the National Science Foundation provided funding for this project. While use of these data is subject to restrictions regarding firm confidentiality, information regarding these data may be obtained by contacting Dr. Steve Markham, Director, Center for Innovation Management Studies, North Carolina State University, College of Management, Raleigh, NC 27695-7229.

2. The authors thank an anonymous reviewer for suggesting the inclusion of this variable.

3. We were also interested in controlling for any potential heterogeneity of performance attributable to across-industry effects and originally included four dummy variables to control for the five SIC industry groupings repre-

sented by the IRI/CIMS respondents in our model. These variables statistically dropped out of the model because the first differenced methodology eliminates firm-specific effects when calculating the model.

4. For example, we conducted auxiliary regressions by running random-effects GLS models for panel data for all model variables, regressing each independent variable on the remaining independent variables.

5. In line with Helfat (1994), we tested persistence (i.e., path dependence) by computing Pearson product-moment correlation coefficients of current-year observations with observations of prior years by lagging the observations. Results reveal no persistence for R&D intensity or ROI, low to moderate persistence for financial resource dedication, and high persistence for human resource dedication.

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