An exploration of organizational factors in new product development success

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Abstract

Purpose – This study surveys a broad spectrum of new product development (NPD) projects from the biochemistry industry in the USA, Canada, Germany, the UK, and Belgium with the purpose of exploring the role of the organizational activity factors in the NPD success.

Design/methodology/approach – Drawing on the resource-based view of the firm, the authors present a set of hypotheses concerning the relationship between the people resources, development resources, testing resources, and launch resources committed to NPD projects and their financial success. In addition, the effect of the firm's international market involvement on the NPD project success is considered. In this study, testing of the hypothesized relationship is accomplished through linear probability model, binary probit model, and binary logit model.

Findings – Empirical results generally support the predictions from the theory. Specifically, the findings of this study show that: the involvement of a strong champion, use of a multi-disciplinary team, and focus of a dedicated team are key factors for NPD project success among the people resources; the detailed market research has a significant impact on the project success in the development phase of the NPD process; the allocation of resources to the testing of the product with the final customer, market testing, and production start-up positively influences the NPD project success; advertising quality plays a key role in the NPD project success during its launch; and the NPD project success is positively associated with the degree of a firm's diversification into international markets.

Originality/value – This study provides several guidelines for product managers seeking to launch new products. It offers critical insights into the identification of firm resources that influence the NPD project success. This study also has important implications for firms that consider diversifying or have already diversified into international markets. Understanding the role of market diversification in the NPD project success advances the ability of managers to direct their efforts in international market involvement.

Keywords Product development, Resources, International marketing, Diversification, Biochemistry

Paper type Research paper

An executive summary for managers and executive readers can be found at the end of this article.

New products are undeniably vital for the viability and success of a firm. Firms need to create and sustain competitive advantages in order to survive in today's highly competitive business environment (Porter, 1985). One major determinant of sustaining competitive advantage is the ability of the firm to develop and launch successful new products (Song and Parry, 1997a). Although many factors that affect the success of the new product development (NPD) process of a firm have been identified in the literature (e.g. Cooper, 1979; Henard and Syzmanski, 2001; Montoya-Weiss and Calantone, 1994), from the perspective of the resource-based view of the firm, the importance of the resources committed to the NPD process are highlighted. The resources committed are part of the firm's planned actions or "strategy characteristics" that potentially will create a competitive advantage to the firm in the marketplace (Henard and Syzmanski, 2001).

The resource-based view of the firm seeks to explain the long-lived pattern of performance differences among firms in terms of the resources they have. The performance of a firm is based on its sustained competitive advantage. Sustained competitive advantage, in turn, is explained by idiosyncrasy and immobility of firm resources (Barney, 1991). Firms are assumed to be heterogeneous with respect to the resources, or factors of production they control (Barney, 1991; Godfrey and Hill, 1995; Peteraf, 1993). Firm resources include all assets, capabilities, organizational processes, firm attributes including information, knowledge, etc. controlled by a firm that enable the firm to develop and implement strategies, which, in turn, improve its efficiency and effectiveness (Daft, 1983). These resources can be classified into three categories:

(1) Physical resources such as plant and equipment, technology, geographic location, access to raw materials.
(2) Human resources such as training, experience, judgment intelligence, insights of the managerial and the technical staff.
(3) Organizational routines that the firm uses to plan, control and coordinate their physical and human

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resources and put them in productive use (Barney, 1991; Nelson and Winter, 1982; Penrose, 1959).

The literature on new product performance has identified that new product development process-related and organization-related factors affect success (Cooper, 1979; Cooper and Kleinschmidt, 1987; Montoya-Weiss and Calantone, 1994). While organization-related factors include resources and skills, the NPD process mainly consists of technical and marketing activities (e.g. Cooper and Kleinschmidt, 1987). Therefore, a firm must possess the resources that are attached to the NPD process-related activities to create value (Porter, 1985). It is the firm's ability to exploit and combine resources through organizational processes. With respect to new product development process, these resources can be seen in terms of people resources (top-management commitment, involvement of a strong champion, use of a multi-disciplinary team, and focus of a dedicated team), development resources (preliminary market assessment, detailed market study/market research, business/financial analysis prior to product development), testing resources (in-house product testing, customer tests of the product, test market/trial sell, and production start-up), and launch resources (quality and magnitude of advertising and promotion activity). The details regarding these resource groups and their measurement are given in the appendix.

In this study, we investigate the impact of the resources (people resources, development resources, testing resources, and launch resources) committed to new product development projects on their financial success drawing on the resource-based view of the firm. Further, we include in the analysis the degree of international market involvement of the firm as a factor that potentially explains the financial success of new product development projects. International market involvement of the firm when selling its new product can be seen as an asset or a resource of the firm. Hence, the degree of international market involvement represents the firm's commitment in the new product development project in terms of resources.

In addition to interpreting the international market involvement of the firm as a resource commitment, there is a substantial body of research that investigates the impact of the firm's international market involvement on its overall performance. Since one very important indicator of performance is profitability, and new product success plays an important role for a firm's overall financial performance, it is desirable to tie the level of international market involvement of the firm when selling its new product directly to the financial success of new product development projects. To this end, we include the level of international market involvement (domestic, regional, global) in selling the new product of the firm as an explanatory variable in our model.

It is certainly true that the definition of international market involvement (selling the new product in regionally or worldwide) can be seen as an oversimplification given the vast amount of research in diversification literature (e.g. Grant, 1987; Kim *et al.*, 1993; Tallman and Li, 1996). However, we believe that our results will provide a base in establishing the direct link between international market involvement and NPD success. Resource-based view of the firm suggests that leverage, and economies of scale and scope in the resource application across markets should enable the firm to improve its returns on resource investments while reducing the variance of its cash flows (Kim *et al.*, 1993). Hence, the firms that sell their products in foreign markets as well as in their domestic markets may benefit from this international market involvement, and attain financial success in their NPD projects.

In the remainder of the paper, first the hypotheses are presented. Next, data characteristics are described and the methodological aspects of the analyses are discussed. Then, the results of the estimation using three techniques (linear probability model, binary probit model, and binary logit model) are presented followed by the discussion of the results.

The conceptual model and research hypotheses

Our proposed framework examines the relationship between the organizational factors and the NPD project success as shown in Figure 1. As shown, a collection of firm's resources combined with its international market involvement is hypothesized to affect the NPD project success positively. The resources that are studied in this paper are people resources, development resources, testing resources, and launch resources; and the international market involvement refers to the selling activities at the domestic, regional, and global levels.

The people resources

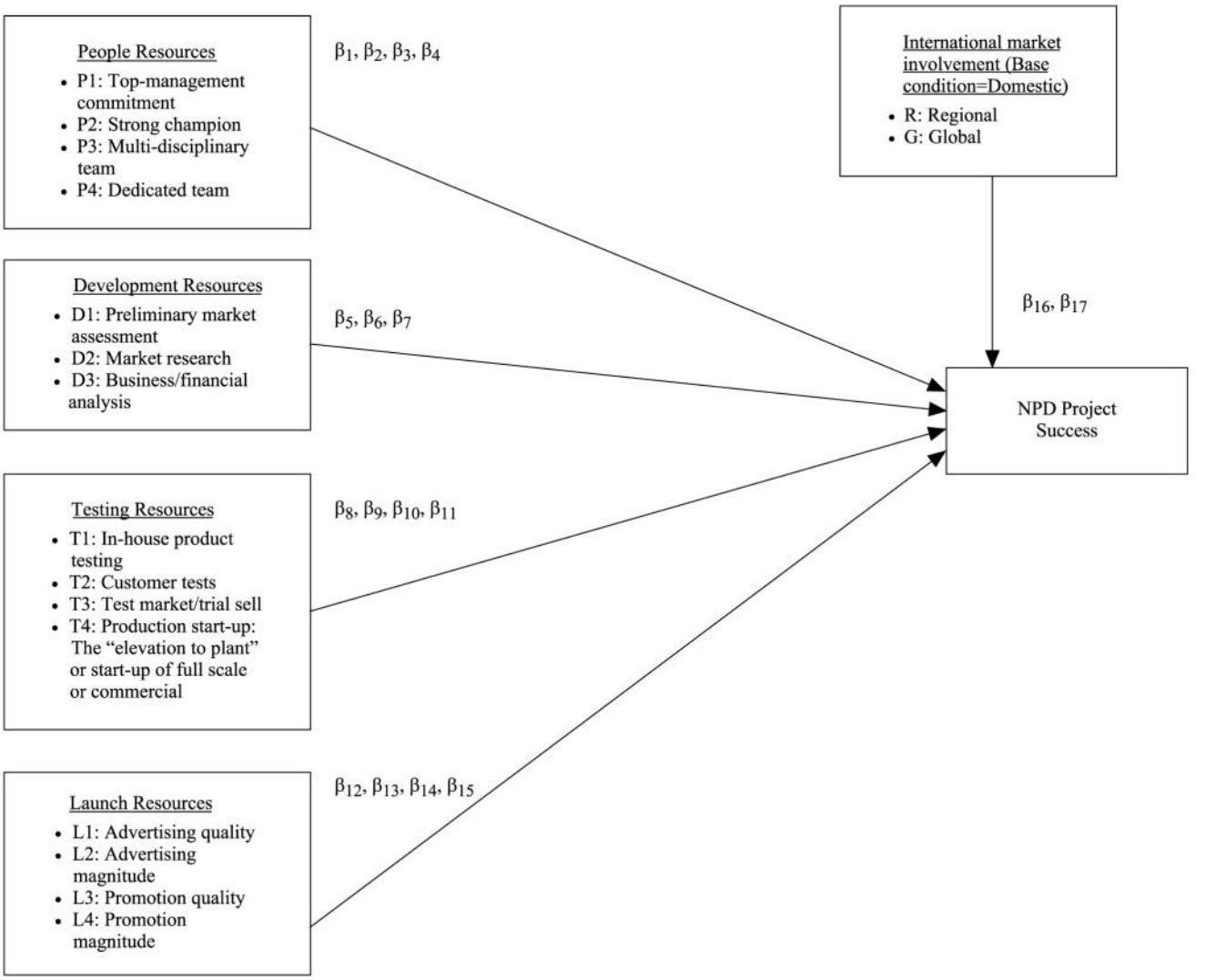
People resources are important for implementing and maintaining of the NPD project. These resources are composed of top-management commitment, involvement of a strong champion, use of a multi-disciplinary team, and focus of a dedicated team. The commitment of a top-management is critical for the initiation of the NPD project. Further, top-management commitment influences the level of resources devoted to the NPD project (Gupta and Wilemon, 1990), because firm resources are controlled by the top-management. On the other hand, the NPD literature points to the significance of communication for the NPD project success (e.g. Allen, 1971). External and internal communications across and/or within functional departments have been emphasized by the researchers (Song *et al.*, 1997; Souder, 1981). The strong champions who may be assumed as powerful project leaders can enhance the external and internal team communication (Joyce, 1986). In addition, communication across multi-disciplinary teams such as research and development (R&D), marketing, and manufacturing is critical to the NPD project success. Cooper (1993) has noted that information critical to the product's formation and function can get withheld, misunderstood, or lost as the gap between functions increases. Therefore, firms should decrease the boundary of each function's permeability, and increase the accessibility of the information necessary for the NPD project. The focus of a dedicated team is important for the NPD project success, as well. Individuals from different departments have different "systems of meaning" and understand the different aspects of new product development (Dougherty, 1990). Consequently, this difference leads to varying interpretations. The team that is dedicated to the NPD project develops its shared interpretation through interaction and integration of individuals combined from multi disciplines. Collectively, these arguments suggest that:

H1a. The greater the top-management commitment, the higher the probability of the NPD project success.

H1b. The greater the involvement of a strong champion, the higher the probability of the NPD project success.

H1c. The greater the use of a multi-disciplinary team, the higher the probability of the NPD project success.

Figure 1 A conceptual framework of the relationship between organizational factors and NPD project success



H1d. The greater the focus of a dedicated team, the higher the probability of the NPD project success.

The development resources

Market orientation has been emphasized by the researchers (Kohli and Jaworski, 1990; Narver and Slater, 1990) for the success of a new product. Market orientation can be described as the organization-wide generation of market intelligence about customers and competitors, dissemination of the intelligence across departments, and organization-wide responsiveness to it (Kohli and Jaworski, 1990, p. 6). The search for information about consumers' current and latent needs, preferences, tastes, price sensitivities, purchasing behaviors, and competitors' products and actions are essential for the NPD project success. Therefore, development resources that are devoted to the marketing activities increase the chance of a new product success. Marketing activities specific to the NPD project include preliminary market assessment, detailed market research, and sales projections for determining the financial feasibility of the NPD project (Calantone and di Benedetto, 1988). Consequently, it is hypothesized that:

H2a. The greater the resources committed to the preliminary market assessment, the higher the probability of the NPD project success.

H2b. The greater the resources committed to the market research, the higher the probability of the NPD project success.

H2c. The greater the resources committed to the business/financial analysis, the higher the probability of the NPD project success.

The testing resources

NPD process involves technical activities that are mostly related to the testing of the product under several conditions. The firm should possess sufficient level of testing resources and skills to coordinate its technical activities. The activities include in-house product testing, prototype testing with the final customer, market testing, and pilot production. Firm lacking testing resources have difficulties in launching a

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product, and thus will eventually fail on the market (Calantone and di Benedetto, 1988). Based on these arguments, it is hypothesized that:

H3a. The greater the level of in-house product testing, the higher the probability of the NPD project success.

H3b. The greater the level of testing of the product with the final customer, the higher the probability of the NPD project success.

H3c. The greater the level of market testing, the higher the probability of the NPD project success.

H3d. The greater the level of production start-up skill, the higher the probability of the NPD project success.

The launch resources

Launch activities that are another subset of NPD process can be described as marketing-mix activities. Inadequate marketing has been identified as a major cause of new product failure (Calantone and Cooper, 1981; Calantone *et al.*, 1996). All capabilities relevant to the launch of new products into the market include strategic market management and marketing mix policies, specifically strategic decisions about the quality and magnitude of advertising and promotion activity. Therefore, the ability to creatively and imaginatively make strategic decisions is critical for achieving product effectiveness (Verona, 1999). Taken together, these arguments suggest that:

H4a. The greater the level of advertising quality, the higher the probability of the NPD project success.

H4b. The greater the investment in advertising magnitude, the higher the probability of the NPD project success.

H4c. The greater the level of promotion quality, the higher the probability of the NPD project success.

H4d. The greater the investment in promotion, the higher the probability of the NPD project success.

International market involvement

In our conceptualization, the international market involvement is limited to international involvement in a single activity regarding the "selling" of new products. Further, a distinction is made among the levels of involvement that represent the selling activities at domestic, regional, and global levels. In the strategic management literature, it has been suggested that increasing levels of diversification, mainly product-market diversification, should have positive effects on the financial performance of a firm (e.g. Rumelt, 1974). The approach of international business identifies diversification as geographical expansion and addresses this shortcoming of strategic management literature (Bilkey, 1978; Rugman, 1976). International market involvement provides market diversification and new market opportunities for a firm to sell similar products or apply knowledge developed in old markets, while simultaneously reducing diversifiable risks (Kim *et al.*, 1993). A firm should increase the flow of rents, if it moves into markets that permit it to leverage organizational routines or strategic yielding resources (Geringer *et al.*, 2000; Simmonds and Lamont, 1996). Otherwise, diversification will not necessarily increase rents if a firm cannot exploit its resources and capabilities. Accordingly, we expect:

H5a. The probability of the NPD project success is higher, if the firm is involved in regional market activity compared to domestic involvement only.

H5b. The probability of NPD project success is higher, if the firm is involved in global market activity compared to domestic involvement only.

Methodology

Data

Data consists of 306 NPD projects from the biochemistry industry in the US, Canada, Germany, UK, and Belgium. A total of 220 of these projects were considered as financial successes, and 86 of them were considered as financial failures by the informants that answered the questionnaire. Table I provides the selected descriptive statistics of the data. These informants were mainly chemical/industrial engineers (although most have marketing related titles) who were extensively involved in all aspects of the NPD process. The response rate to the questionnaire was 38 per cent.

Measures

Researchers (e.g. Montoya-Weiss and Calantone, 1994; Song and Parry, 1997a, b) have examined new product success factors that are mainly drawn on two theoretical perspectives; the resource-based theory of the firm (e.g. Barney, 1991), and the industrial organization perspective (e.g. Porter, 1985). In this study, our primary focus is on the resource-based view of the firm. The resource-based view of the firm posits that firms are heterogeneous with respect to available resources, and these resources are immobile. Hence, the performance of the firm is determined by its resources and how well these resources are utilized. Drawing on the logic of the resource-based theory of the firm and the established NPD research literature, we identified the independent variables (organizational activity factors) that may play a role in determining the NPD project success. All independent variables were measured using 11-point bipolar scales,

Table I Descriptive statistics of the NPD project success data

Variable	Mean	SD	Minimum	Maximum
SF	0.7189	0.4502	0	1
P1	6.9346	2.5185	0	10
P2	8.1372	1.7482	3	10
P3	6.8758	2.8476	0	10
P4	5.9542	2.8865	0	10
D1	5.6797	2.7116	0	10
D2	3.8300	2.8670	0	9
D3	4.5098	2.9199	0	10
T1	6.7712	2.8226	0	10
T2	7.2352	2.7046	0	10
T3	5.6993	2.1821	0	10
T4	7.0065	2.1713	0	10
L1	5.3071	2.2507	0	10
L2	5.2091	2.1928	0	10
L3	5.8431	2.1397	0	10
L4	5.6797	1.9082	0	10
Dummy = 1 if regional	0.4379	0.4969	0	1
Dummy = 1 if global	0.2745	0.4470	0	1

Notes: Frequency: success = 220; failure = 86; $n = 306$

except for the categorical independent variables. Also, the dependent variable was measured as a dichotomous variable (financial success versus financial failure). The items used for the measures are discussed below and listed in the appendix. We used the perceived success measurement scale, because it permits the use and/or comparison of different firms operating in a variety of different industries, cultures, and economic conditions (Calantone *et al.*, 1996).

Dependent variable

NPD project success was measured by a dichotomous variable indicating the financial performance of the product. Financial performance was determined by whether the profitability exceeded (success) or fell short of (failure) the acceptable return level.

Independent variables

People resources (four items) were measured by the top-management commitment, involvement of a strong champion (e.g. who drives the project), use of a multi-disciplinary team, and focus of a dedicated teams. Development resources (three items) were measured by the resources committed to the preliminary market assessment, detailed market research, and business/financial analysis. Testing resources (four items) were measured by the testing activities that are often undertaken as part of a new product project including in-house product testing, testing the product with final customers, market testing, and full-scale/commercial production start-up. Launch resources (four items) were measured by the level of advertising and promotion quality, and the investments in magnitude of advertising and promotion activities at the product launching stage. International market involvement was defined as a dummy variable referring to whether a firm is involved in selling activities at a domestic level (domestic = base condition), a regional level, or a global level.

Analysis

In our study, the outcome (NPD project success) is a binary variable. To answer our research question, testing of the hypothesized relationships was accomplished through three different models that are linear probability model (LPM), binary probit model, and binary logit model (Wooldridge, 1999) via the use of STATA. All paths were hypothesized to be positive.

LPM

The linear probability model is the regression model applied to a binary dependent variable. In our model, the binary dependent variable is the NPD project success. The probability of the NPD project success, $P(y = 1|x)$, is the same as the expected value of y. Thus, the LPM function for our model is:

$$E(y|x) = P(y = 1|x) = \beta_0 + \beta_1 P_1 + \beta_2 P_2 + \beta_3 P_3 + \beta_4 P_4 + \beta_5 D_1 + \beta_6 D_2 + \beta_7 D_3 + \beta_8 T_1 + \beta_9 T_2 + \beta_{10} T_3 + \beta_{11} T_4 + \beta_{12} L_1 + \beta_{13} L_2 + \beta_{14} L_3 + \beta_{15} L_4 + \beta_{16} R + \beta_{17} G$$

In the LPM, the response probability, $P(y = 1|x)$, is linear in the parameters (β_j) that measure the change in the probability of the NPD project success. We also computed the x-standardized coefficients (β^{Sx}), since it is useful when the scale of the variables is arbitrary (Long, 1997). The x-standardized coefficient (β^{Sx}) is only computed for the continuous independent variables, because it is inappropriate for a dummy variable (Long, 1997). We should also note that the variance of errors depends on the x's and is not constant. So, LPM violates the heteroscedasticity assumption. Since homoscedasticity is crucial for justifying the usual t and F statistics, we used robust standard errors in our analysis. The results for the LPM model are summarized in Table II.

Results for the LPM:

- *The people resources*. Two (β_2, β_3) of the four paths were found to be significantly greater than zero, as hypothesized. For example, the use of a multi-disciplinary team increases the predicted probability of NPD project success by 0.0345 (β_2), holding all other factors fixed. Also, it can said that for every standard deviation change in the use of a multi-disciplinary team increases the predicted probability of NPD project success by 0.0985 units, holding all other factors fixed. Even though the parameter estimate (β_1) for top-management commitment was found to be significant, its value was negative, −0.0206. In addition, β_4 was found to be non-significant with a value of 0.017. Hence, *H1b* and *H1c* regarding the relationships between the predicted probability of the NPD project success and the involvement of a strong champion and the focus of a multi-disciplinary team were supported.
- *The development resources*. Only one of the three paths was significantly greater than zero. *H2b* underscoring the relationship between the NPD project success and the detailed market research was supported with a parameter estimate of 0.0315 (β_6) significant at $p < 0.01$. β_5 and β_7 were found to be non-significant with the values of 0.0016 and 0.0077 respectively.

Table II LPM estimates of the NPD project success

Independent variables	β	Robust SD errors	β^{Sx} (*x*-standardized coefficients)	*t*
P1	−0.0206**	0.0083	−0.0518	−2.466
P2	0.0283**	0.0122	0.0495	2.303
P3	0.0345*	0.0080	0.0985	4.317
P4	0.0170***	0.0087	0.0492	1.941
D1	0.0016***	0.0101	0.0044	0.161
D2	0.0315*	0.0092	0.0904	3.402
D3	0.0077***	0.0073	0.0225	1.058
T1	−0.0805*	0.0062	−0.2273	−12.875
T2	0.0288*	0.0088	0.0781	3.277
T3	0.0452*	0.0101	0.0986	4.464
T4	0.0806*	0.0120	0.1751	6.719
L1	0.0147***	0.0110	0.0332	1.342
L2	0.0065***	0.0084	0.0143	0.773
L3	0.0449*	0.0140	0.0960	3.188
L4	−0.0733*	0.0175	−0.1400	−4.174
Regional	0.2303*	0.0579	–	3.979
Global	0.1799*	0.0642	–	2.799
Intercept	−0.4680	0.1227	–	−3.813

Notes: $R^2 = 0.5280$; *Significant at $p < 0.01$; **Significant at $p < 0.05$; ***Not significant; Dependent variable: SF (NPD project success factor; 1 = success, 0 = failure)

- *The testing resources*. All paths (β_9, β_{10}, β_{11}) were significantly greater than zero, except the path (β_8) from in-house product testing to the NPD project success. Hence, *H3b*, *H3c*, and *H3d* were supported with the parameter estimates of 0.0288, 0.0452, and 0.0806 (significant at $p < 0.01$), respectively. For example, the predicted probability of success increases by 0.0288 units when a firm commits resources to the testing of the product with the final customer, holding all other variables fixed.
- *The launch resources*. Only one (β_{14}) path of the four paths was found to be significantly greater than zero, as hypothesized. β_{12} and β_{13} were found to be non-significant, and β_{13} was found to be statistically significant but its value was negative. Thus, our results supported *H4c* only with a parameter estimate of 0.0449 significant at $p < 0.01$.
- *International market involvement*. Both paths (β_{16}, β_{14}) were significantly ($p < 0.01$) greater than zero, as hypothesized. Thus, the results of the LPM model supported our hypotheses (*H5a*, *H5b*) indicating that the predicted probability of the NPD project success is higher for firms involved in regional and global market activities compared to firms involved in domestic market activities only. For example, all other factors being equal, a firm involved in selling activities at a regional level has a 0.2303 higher chance of achieving NPD project success than that of a firm involved in selling activities in its domestic market only.
- *Probit and logit models*. In the LPM, we have an observed binary variable, whereas probit and logit models are derived from an underlying latent variable y^* ranging from $-\infty$ to $+\infty$. The idea of a latent y^* is that there is an underlying propensity to work that generates the observed state. For example, as the firm increases its resources committed to the detailed market research, it is reasonable that the NPD project's propensity to be a "success" would increase. The latent variable y^* is linked to the observed binary variable y by the threshold value (τ). The equation as follows:

$$y_i = 1 \text{ if } y_i^* > t$$
$$y_i = 0 \text{ if } y_i^* \leq t$$
$$y_i^* = \beta_0 + xi\beta + \varepsilon_i$$

Since the dependent variable is unobserved, ML estimation should be used instead of OLS estimation. The errors assumed to have normal and logistic distributions for probit and logit models respectively, and the functions for these distributions are as follows.

Probit model
Probability density function for normal distributions $[E(\varepsilon|x))= 0; Var(\varepsilon|x)) = 1]\phi(\varepsilon) = (2\pi)^{-1/2}\exp(-\varepsilon^2/2)$.

Logit model
Cumulative distribution function for logistic distributions $[E(\varepsilon|x) = 0; Var(\varepsilon|x) = \pi^2/3]$

$$\phi(\varepsilon) = \int_{\infty}^{\varepsilon} (2\pi)^{-1/2}\exp(-t^2/2)dt$$

For ML estimation used in these models, the desirable properties of consistency, normality, and efficiency are asymptotic. Even though there are no specific criteria for the selection of sample size, some guidelines have been offered to determine the sample size that is enough to use the ML estimates (Long, 1997). He has suggested that it is risky to use samples smaller than 100 and there should be at least ten observations for each parameter. Also, a larger sample is required if there is little variation in the dependent variable. We have 17 parameters and 71.8 percent of the outcomes are successes. There is enough variation in the dependent variable. Consequently, the sample size ($n = 306$) used in our analysis seems adequate, because it is higher than both the minimum required level (100) and the number of observations needed for parameters.

There are several approaches for interpretation. The use of marginal effects at the mean values is popular when the dependent variable is a dichotomous variable. However, the measure is inappropriate when there are categorical independent variables in the model. Also, it is difficult to translate the marginal effect into the change in the predicted probability that will occur if there is a discrete change in the independent variable. Since our model includes independent variables measured by bipolar scales and independent categorical variables, first we estimated the probit and logit models, and then computed the centered discrete changes. Discrete changes are calculated holding all other variables at their means.

Results for the probit and logit models. The estimates for probit and logit models are given in Tables III and IV, respectively. As can be seen, the z values and the significance levels are similar in both models.

- *The people resources*. For both probit and logit models, three (β_2, β_3, β_4) of the four paths were found to be significantly greater than zero, as hypothesized. Even though the parameter estimate (β_1) for top-management commitment was found to be negative, it was non-

Table III Probit estimates of the NPD project success

Variable	β	Standard errors	z	95% confidence interval	
P1	−0.095***	0.069	−1.379	−0.2304	0.04007
P2	0.233**	0.091	2.549	0.05385	0.41207
P3	0.192*	0.058	3.276	0.07722	0.3072
P4	0.152**	0.065	2.312	0.02316	0.28104
D1	0.066***	0.062	1.046	−0.0575	0.18913
D2	0.122**	0.055	2.201	0.01335	0.23066
D3	0.089***	0.053	1.652	−0.0166	0.19451
T1	−0.534*	0.101	−5.275	−0.7321	−0.3355
T2	0.235*	0.075	3.103	0.08637	0.38266
T3	0.381*	0.095	3.994	0.19407	0.56799
T4	0.406*	0.094	4.313	0.22181	0.59141
L1	0.247**	0.105	2.359	0.04188	0.45368
L2	−0.106***	0.117	−0.903	−0.3374	0.12463
L3	0.239***	0.131	1.824	−0.0179	0.49734
L4	−0.541*	0.157	−3.438	−0.8497	−0.2326
Regional	2.270*	0.492	4.606	1.30429	3.23642
Global	1.808*	0.441	4.099	0.94353	2.67271
Intercept	−7.050	1.213	−5.809	−9.4298	−4.6716

Notes: Pseudo $R^2 = 0.5770$; *Significant at $p < 0.01$; **Significant at $p < 0.05$; ***Not significant

Table IV Logit estimates of the NPD project success

Variable	β	Standard errors	z	95% confidence interval	
P1	−0.153***	0.125	−1.221	−0.3985	0.0924917
P2	0.419**	0.164	2.559	0.09824	0.7406417
P3	0.310*	0.100	3.098	0.11418	0.5073281
P4	0.283**	0.115	2.47	0.05867	0.5091867
D1	0.132***	0.114	1.148	−0.0931	0.3561769
D2	0.221**	0.098	2.257	0.0292	0.4144201
D3	0.176***	0.096	1.832	−0.0124	0.3659141
T1	−0.932*	0.179	−5.206	−1.2835	−0.5814105
T2	0.411*	0.127	3.227	0.16158	0.6613149
T3	0.644*	0.172	3.754	0.30788	0.9805599
T4	0.704*	0.167	4.206	0.37625	1.032944
L1	0.444**	0.183	2.425	0.08505	0.8025981
L2	−0.184***	0.204	−0.902	−0.5838	0.2157722
L3	0.428***	0.235	1.82	−0.033	0.890152
L4	−0.937*	0.288	−3.243	−1.5034	−0.3706461
Regional	3.980*	0.919	4.33	2.17847	5.781675
Global	3.137*	0.822	3.817	1.52623	4.74778
Intercept	−12.704	2.286	−5.556	−17.185	−8.222792

Notes: Pseudo $R^2 = 0.5725$; *Significant at $p < 0.01$; **Significant at $p < 0.05$; ***Not significant

significant. Hence, *H1b*, *H1c*, and *H1d* regarding the relationships between the NPD project success and the involvement of a strong champion, the use of a multi-disciplinary team, and the focus of a dedicated team were supported.

- *The development resources*. Only one of the three paths was statistically significant in probit and logit models. β_5 and β_7 were not significant in either model. Hence, *H2b* underscoring the relationship between the NPD project success and the detailed market research was supported.
- *The testing resources*. The results of both models indicated that all paths (β_9, β_{10}, β_{11}) were significantly greater than zero, except the path (β_8) indicating the relationship between NPD project success and in-house product testing. Accordingly, *H3b*, *H3c*, and *H3d* referring to the relationships between the NPD project success and customer testing of the product with the final customer, market testing, and production start-up skill were supported.
- *The launch resources*. One (β_{12}) path of the four paths was found to be significantly greater than zero, as hypothesized. β_{13} and β_{15} were found to be negative but non-significant, and β_{14} was found to be non-significant. Thus, the estimates supported *H4a* pointing out the relationship between the NPD project success and the advertising quality.
- *International market involvement*. Both paths (β_{16}, β_{14}) were significantly greater than zero, as hypothesized. Thus, the estimates of both models supported *H5a* and *H5b* positing that the NPD project success is higher for firms involved in regional and global market activities compared to firms involved in domestic market activities only.

The predicted discrete changes are shown in Tables V and VI for probit and logit models, respectively. Unit changes and standard deviation changes centered around the mean were calculated. For categorical independent variables, discrete changes were computed as the categorical independent variable changes from 0 to 1. Based on the probit estimates, for example, if a firm is involved in a regional market activity, the probability of the NPD project success is 0.362 higher than a firm that is involved in domestic market activity, holding all other variables at their means. Similarly, if a firm is

Table V Discrete changes in the probability of the npd project success for the probit model

Variable	Change from 0 to 1	Centered unit change	Centered standard deviation change
P1		−0.0156	−0.0393
P2		0.0382	0.067
P3		0.0315	0.0904
P4		0.0249	0.0722
D1		0.0108	0.0292
D2		0.02	0.0574
D3		0.0145	0.0426
T1		−0.0881	−0.2618
T2		0.0384	0.105
T3		0.0626	0.1389
T4		0.0668	0.1478
L1		0.0406	0.0921
L2		−0.0174	−0.0382
L3		0.0393	0.0846
L4		−0.0893	−0.1743
Regional	0.3619		
Global	0.1966		

Table VI Discrete changes in the probability of the NPD project success for the logit model

Variable	Change from 0 to 1	Centered unit change	Centered standard deviation change
P1		−0.0124	−0.0314
P2		0.0342	0.0602
P3		0.0253	0.0731
P4		0.0231	0.0675
D1		0.0107	0.0291
D2		0.018	0.0521
D3		0.0144	0.0422
T1		−0.0771	−0.2418
T2		0.0335	0.0927
T3		0.0528	0.1188
T4		0.0578	0.1302
L1		0.0362	0.0828
L2		−0.015	−0.0329
L3		0.0349	0.0758
L4		−0.0775	−0.1546
Regional	0.3484		
Global	0.1781		

involved in a global market activity, the probability of the NPD project success is 0.348 higher than a firm that is involved in a domestic market activity, holding all other variables at their means. For a firm that is average on all characteristics, a standard deviation change in the involvement of a strong champion around the mean will increase the probability of the NPD project success by 0.067. As shown in Table VI, the similar values of discrete changes were found for the logit model.

Conclusion and discussion

Theoretical implications

This research advances the literature on NPD project success in several ways. First, most previous work examined the drivers of new product success by focusing on a single country, mostly the USA. This study uses data from firms that involved in selling activities at domestic, regional, and global levels. We tried to explore the effects of organizational activity factors in the NPD project success. The factors determined based on the level of resources committed to these activities. Second, our modeling approach differs from other studies. Our emphasis is on the theory testing rather than theory developing. A binary outcome is used to predict the probability of NPD project success in our modeling.

The comparison of the three models is given in Table VII. Based on the LPM results, we did find support for nine of the 17 hypotheses. The probit and logit models supported ten of the 17 hypotheses. Even though there is a slight difference in the statistical significance of LPM and probit (logit models, we used probit) logit models to overcome the shortcomings of the LPM, which will be discussed in the limitations section. In these models, the measures used for goodness-of-fit are R^2, pseudo R^2 and percent correctly predicted. For example, the

Table VII Comparison of LPM, probit, and logit estimates of the NPD project success

Variable	LPM β	Probit β	Logit β
P1	−0.0206**	−0.095***	−0.153***
P2	0.0283**	0.233**	0.419**
P3	0.0345*	0.192*	0.310*
P4	0.0170***	0.152**	0.283**
D1	0.0016***	0.066***	0.132***
D2	0.0315*	0.122**	0.221**
D3	0.0077***	0.089***	0.176***
T1	−0.0805*	−0.534*	−0.932*
T2	0.0288*	0.235*	0.411*
T3	0.0452*	0.381*	0.644*
T4	0.0806*	0.406*	0.704*
L1	0.0147***	0.247**	0.444**
L2	0.0065***	−0.106***	−0.184***
L3	0.0449*	0.239***	0.428***
L4	−0.0733*	−0.541*	−0.937*
Regional	0.2303*	2.270*	3.980*
Global	0.1799*	1.808*	3.137*
Percentage correctly predicted	89.54	86.27	86.27

Notes: *Significant at $p < 0.01$; **Significant at $p < 0.05$; ***Not significant

R^2 values were found to be 0.5780, 0.5770, and 0.5725 for LPM, probit, and logit models, respectively. We can conclude that more than half of the variation can be estimated by our models. Also, the percent correctly predicted values are 89.54, 86.27, and 86.27 percent for LPM, probit and logit models, respectively (Table VII).

Managerial implications (based on the estimates of probit – logit models)

Our results imply that the success of NPD projects is a function of organizational activity factors. Since the adequate performance on these factors is closely related to the level of resources allocated to the NPD process activities, we determined the factors based on the five main activities that are associated with people, development, testing, launch, and international market involvement. We posit that resources committed to these activities increase the probability of NPD project success. Consequently, we focused on the certain relationships between the organizational activity factors and the NPD project success.

People resources

Among the people resources, the key factors affecting the NPD project success are the involvement of a strong champion, use of a multi-disciplinary team, and focus of a dedicated team. Only top-management commitment is not supported. The implication is that the efficient and effective use of individuals that are closely associated with the NPD contributes to the success of the NPD project. Although, top-management commitment is necessary for the initiation of the project, its commitment may not be directly related to the accomplishment of the NPD project.

Development resources

In the development phase of the NPD process, the key organizational activity affecting the success of the NPD project is the detailed market research only. The other two factors, preliminary market assessment and business/financial analysis, are not significantly related to the NPD project success. This stresses the importance of the detailed, planned, and scientific market research. The integration of market intelligence into the other phases of NPD process (e.g. testing and/or launch) will result in higher levels of technical and/or launch capabilities.

Testing resources

The success of the NPD project is highly associated with the resources committed to the testing of the product with the final customer, market testing, and production start-up. The abilities and skills in testing and/or production aspects are contributing factors to the success.

Launch resources

The success of the NPD project is also related to the resources allocated to the marketing and launch activities, specifically advertising and promotion activities. Even though our estimates produced significant results for advertising quality only, we think that this may be due to the use of different industrial products that are heavily exported. The use marketing mix policies may differ according to the product type and level of international market involvement.

International market involvement

The NPD project success of a firm involved in regional and global market activities is higher than that of a firm involved in domestic market activities only. Also, our results imply that

the success of a firm involved in regional selling activities is higher than that of a firm involved in global selling activities.

Taken together, there are particular implications to product managers seeking to launch new products in the domestic marketplace as well as in the international markets. The managers should consider all the phases undertaken in the NPD project. The level of resources committed to the activities directly influences the skills and abilities in each phase. A firm should be able to use its resources effectively and efficiently and coordinate its technical and marketing activities, thereby achieving higher levels of NPD project successes. Our study has several implications for firms that consider diversifying or have already diversified into international markets. The international market diversification produces rents to the firms, and increases the success of the NPD project. However, a firm will not necessarily continue increasing rents unless it can exploit its resources and capabilities in other markets.

Limitations

Although, the linear probability model is easy to estimate and interpret, it has some shortcomings. For example, if we plug in certain combinations of values for the independent variables into our model, we can get predicted probabilities either less than zero or greater than one, which is impossible. In fact, our results indicated that ten of the fitted values are less than zero, and 74 of the fitted values are greater than one. Another problem is that a probability cannot be linearly related to the independent variables for all their possible values. In our study, we used bipolar scales (0 to 10) to measure independent variables. Also, the effect of going from 1 to 2 on a scale has the same effect of going from 2 to 3. The probit and logit models were used to overcome the limitations of the LPM, because the latent variable (y_i^*) is continuous in those models.

Yet, there are other limitations. Our data represent industrial products in chemical and biochemical industries that are heavily exported. Hence, our results cannot be generalizable to service industries and the mass of consumer products launched every year. Although the self-assessment measures are the most commonly used method in marketing, still they are prone to potential bias. For example, the definition of a product success may differ among managers, thereby creating conflicting results. To some managers, a product may be labeled as a "failure" even it did achieve a respectable share of the market. Or some managers may consider a product as a "success" when the product captured the threshold market share only.

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Appendix. Measurement items

NPD project success (1 = success, 0 = failure)
SF: Was this product a financial success or a failure?

People resources: to what extent ... (0 = not at all, 10 = to a great extent)
P1: ... was top management committed to the project, i.e. strongly supported the project?
P2: ... was there a strong champion, driving the project?
P3: ...was the project undertaken by a multi-disciplinary team (e.g. comprised of marketing, R&D, production, etc.)?
P4: ... was the project undertaken by a dedicated team, i.e. they devoted a large percentage of their time to the project?

Development resources: (0 = very poorly done, 10 = excellently done)
D1: preliminary market assessment: an initial, preliminary but non-scientific market assessment; a first and quick look at the market.
D2: detailed market study/market research: marketing research, involving a reasonable sample of respondents, a formal design, and consistent data collection procedure.
D3: business/financial analysis: a financial or business analysis leading to a go/no go decision prior to product development.

Testing resources: (0 = very poorly done, 10 = excellently done)
T1: In-house product testing: testing the product in-house; in the lab or under controlled conditions as opposed to in the field or with customers.
T2: Customer tests of product: Testing the product under real-life conditions, e.g. with customers and/or in the field.
T3: Test market/trial sell: a test market or trial sell of the product trying to sell the product but to a limited or test set of customers.
T4: production start-up: the "elevation to plant" or start-up of full scale or commercial.

Launch resources: (0 = very poor, 10 = excellent)
L1: advertising – quality of the advertising.
L2: advertising – magnitude of the effort, e.g. enough advertising.
L3: promotion (e.g. discounts; trade shows; events) – quality of the promotion effort?
L4: promotion – magnitude of the effort, e.g. enough activity?

International market involvement (base condition = domestic)
R: dummy = 1 if regional
G: dummy = 1 if global.

Executive summary and implications for managers and executives

This summary has been provided to allow managers and executives a rapid appreciation of the content of the article. Those with a particular interest in the topic covered may then read the article in toto *to take advantage of the more comprehensive description of the research undertaken and its results to get the full benefit of the material present.*

"You pay for what you get" might be too generalized or simplistic a term to apply to the success companies are seeking when they introduce a new product to the market. But it does convey an important truth – that the resources committed to the new product development (NPD) process are a significant factor in the intention of creating a competitive advantage.

If new products are undeniably vital for the viability and success of a firm, so too are the financial resources needed to develop and launch those products. Sustained competitive advantage does not come cheap. All the more important for companies to understand what parts of the processes are working effectively towards the success of the new product, and identifying factors which may have less impact on the desired outcome. In other words, making sure the money is well spent.

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One manager's definition of what constitutes a success, however, might be different from another's. To some managers a product may be labeled a "failure" even if it achieved a respectable share of the market while some managers might consider a product a "success" when it only captured the threshold market share.

Whatever assets, capabilities, processes, information and knowledge a firm possesses, success in new product development depends on the firm's ability to exploit and combine resources through organizational processes.

With respect to new product development processes, these resources can be seen in terms of people resources (top-management commitment, involvement of a strong champion, use of a multi-disciplinary team, and focus of a dedicated team), development resources (preliminary market assessment, detailed market study/market research, business/financial analysis prior to product development), testing resources (in-house product testing, customer tests of the product, test market/trial sell, and production start-up), and launch resources (quality and amount of advertising and promotion activity).

In a study focusing on heavily-exported products in the chemical and biochemical industries, Destan Kandemir, Roger Calantone and Rosanna Garcia investigated the impact of the resources committed to new product development projects on their financial success, including international market involvement.

They concluded that the level of resources committed to the activities directly influences the skills and abilities in each phase. A firm should be able to use its resources effectively and efficiently and coordinate its technical and marketing activities, thereby achieving higher levels of NPD project successes.

The success of the NPD project is also related to the resources allocated to the marketing and launch activities, specifically advertising and promotion activities which might differ in their mix depending on the product type and level of international market involvement.

Critical as top management is in influencing the level of resources devoted to the NPD project, once the process has been initiated, top management commitment may not be directly linked to the project being accomplished. "Here's the money, you get on with it," would seem to be an acceptable way of starting the process, the key factors affecting what happens next being the involvement of the strong champion and multi-disciplinary and dedicated team. It is the efficient and effective use of individuals that are closely associated with the NPD that contributes to the project's success.

Results imply that the success of new product development projects is a function of organizational activity factors. Since the adequate performance of these factors is closely related to the level of resources allocated to the NPD process activities, it was determined that resources committed to people, development, testing, launch and international market involvement increase the probability of NPD project success.

In the development phase, the key organizational activity affecting the success of the project is the detailed market research only. The other two factors, preliminary market assessment and business/financial analysis, are not significantly related to the NPD project success. This stresses the importance of the detailed, planned and scientific market research.

The integration of market intelligence into the other phases of the NPD process (e.g. testing and/or launch) will result in higher levels of technical and/or launch capabilities.

The success of the NPD project is highly associated with the resources committed to the testing of the product with the final customer, market testing, and production start-up. The abilities and skills in testing and/or production aspects are contributing factors to the success.

Kandemir *et al.* say:

> The NPD project success of a firm involved in regional and global market activities is higher than that of a firm involved in domestic market activities only. Also, our results imply that the success of a firm involved in regional selling activities is higher than that of a firm involved in global selling activities.
>
> Taken together, there are particular implications to product managers seeking to launch new products in the domestic marketplace as well as in the international markets. The managers should consider all the phases undertaken in the NPD project.

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