The effects of managerial output control and team autonomy on new product development speed: The moderating effect of product newness

Abstract

This study examines the direct and combined effects of managerial output control and team autonomy on the speed of new product development (NPD). The study also explores the moderating effect of product newness on the previous relationships. By studying 247 new product projects, we found that managerial output control is positively related to NPD speed. A positive interaction effect was found between managerial output control and team autonomy on NPD speed. Specifically, the results show that when managerial output control is high, team autonomy has a positive impact on the speed of new product development. Team autonomy has no influence on new product development speed otherwise. Regarding the moderating role of product newness, results indicate that managerial output control is more positively related to the speed of low innovative products than that of high innovative products.

Keywords

New product development, speed, time-to-market, managerial control, team autonomy, product newness, output control

1. Introduction

New product development (NPD) speed describes the pace at which product development activities occur between idea conception and market launch (Kessler and Bierly, 2002; Kessler and Chakrabarti, 1999). Speeding up new product development (NPD) remains a top priority for managers at many firms (Cooper and Edgett, 2008). Numerous accounts in the academic and popular press suggest that firms who rapidly develop new products enjoy substantial competitive advantages and higher new product success rates (Kessler and Bierly, 2002; Chen et al., 2005; Carbonell and Rodríguez, 2006). Trends such as globalization, greater competition, shorter product life cycles, and faster rate of technological change emphasize the importance of NPD speed in today's economy. It has not gone unnoticed, however, that the challenge is to carry out the development task faster without sacrificing quality or eliminating important steps in the development process (Gupta and Souder, 1998).

It has been argued that managers attempting to expedite the NPD process should have a system for control of the workforce engaged in the development process and provide incentives to maintain a speed-conscious environment (Menon and Lukas, 2004; Kessler and Chakrabarti, 1996; Anthony and McKay, 1992). For the same reason, managers should grant NPD teams with some degree of autonomy in decision-making (Menon et al., 2002). Autonomy provides control over development tasks and thus can lead to faster decision-making (Emmanualides 1993; McDonough and Barczak, 1991). As such, the joint effect of managerial control and team's autonomy may give rise to faster NPD speed. Surprisingly, very few studies to date have examined the individual and interaction effects of managerial control and team autonomy on NPD speed.

Against this backdrop, this study has a three-fold objective (see Figure 1). First, it investigates the direct effects of managerial output control and team autonomy on NPD speed. These effects have shown to be much more elusive in practice than the existing theoretical views have suggested and negative or null effects on performance have been found (Langfred and Moye, 2004, Kim and Lee, 1995).

Second, it examines the interaction effect of managerial output control and team autonomy on NPD speed. Not only are autonomy and control needed in new product development, but they cannot be understood separately (Feldman, 1989). Autonomy assumes autonomy or independence from something. Therefore, without an already established management control system, autonomy does not make any sense (Feldman, 1989). On a managerial level, autonomy must have at least, a minimal relation to managerial control so that it will be likely to produce results that are beneficial to the organization's goals and commitment (Feldman, 1989). This is the first study to examine the jointly effect of managerial output control and team autonomy on NPD speed.

Finally, in line with the contingent view of control (Kirsch, 1996), the present study explores the moderating effect of product newness. The innovativeness of the product being developed has been shown to determine what type of control structure is most appropriate (Jaworski et al., 1993). Therefore, this question is particularly relevant to study the influence of managerial output control and team autonomy on NPD speed.

(Figure 1 here)

This article is organized as follows. First, we present the research hypotheses. Next, we describe the research design and present the analysis and results. Subsequently, we analyze the findings and discuss the managerial and academic implications of this work. The article closes with some limitations and directions for future research.

2. Theoretical background and hypotheses

Managerial control can be defined as any process by which managers direct attention, motivate and encourage organizational members to act in desired ways to meet the firm's objectives (Cardinal, 1991). This view of control draws upon agency and organization theories in a way consistent with prior studies in organizational design (Eisenhardt 1985), information systems (Henderson and Lee, 1992; Kirsch, 1996) and marketing (Jaworski and MacInnis 1989). This paper focuses on one form of managerial control: output control.

Output control is defined as the degree to which the managers sets, monitors and evaluates the outcomes produced by the team (Henderson and Lee, 1992). Firms relying on output control manage the development teams by establishing broad objectives (e.g. launch date, cost constraints, performance goals) and monitoring the achievement of the goals.

Autonomy is defined as the degree to which the NPD team is given substantial freedom, independence, and discretion in setting operational tasks such as schedules, budgets and rules and procedures (Hackman, 1980; Kim and Lee, 1995). This concept is similar to what other authors have termed *team operational autonomy* (Sethi, 2000; Tatikonda and Rosenthal, 2000) and *team operational control influence* (Bonner et al., 2002).

Product newness reflects the degree of newness of the NPD project along two dimensions: (1) newness to the firm (Cooper, 1979; Song and Montoya-Weiss, 1998) and (2) newness to the market (Ali et al., 1995; Cooper, 1979, Danneels and Kleinschmidt, 2001). The first component, newness to the firm, refers to the degree of difference between the new product and other products within the company. The second component, newness to the market, represents the degree of difference between the new product and those already on the market. In particular, respondents were asked to indicate their perceptions of how different the company's new product was in relation to competing products.

NPD speed is defined as the pace of progress that a firm displays in innovating and commercializing new products. It describes a firm's capability to accelerate the activities and tasks that occur through the new product development process (Chen et al., 2005; Kessler and Bierly, 2002; Kessler and Chakrabarti, 1999).

2.1. Direct effect of managerial output control on NPD speed

Managerial output control is exercised to the extent that management sets performance standards and monitors results. Output control is likely to have a positive impact on NPD speed. Literature in new product development suggests that goal setting and frequent milestones tend to increase task motivation and create a sense of order within the project teams, thereby speeding up new product development (Kessler and Chakrabarti, 1996).

Milestones serve as key target that infuse team members with a sense of urgency and keep them focused on time-based objectives (Gersick, 1988). Despite its perceived importance, empirical findings report a lack of relationship between output control and time-to market (Henderson and Lee, 1992; LaBahn et al., 1996). These results encourage future research into the effect of output control on NPD speed. In this study we propose:

H1: Output control is positively related to NPD speed.

2.2. Direct effect of team autonomy on NPD speed

It is argued that team autonomy improves NPD speed. By driving decision-making down to the project team, teams can respond more quickly to change, and are able to reduce the time it takes to make decisions, solve problems and take actions, thus reducing product development cycle time (McDonough and Barczak, 1991; Reilly et al., 2003). Team autonomy provides the team with the necessary local control over the development task, which will be instrumental in guarding against interference from the functional managers (Emmanualides, 1993). It also gives the team a strong sense of responsibility over the project's outcomes, which in turn leads to high work effectiveness (Zirger and Hartley, 1994; Bonner et al., 2002). Empirical evidence on the relationship between autonomy and NPD speed is quite mixed. Tatikonda and Montoya-Weiss (2001) revealed a positive relationship between the degree of discretion available to project managers regarding work activities and decisions and time-to-market. Similarly, Bonner et al. (2002) showed that team's participation in setting operational tasks such as schedule, budget, rules and procedures, was associated with superior project performance. However, some researchers have noted that team autonomy does not contribute to reduced time-to-market (e.g. Zirger and Hartley, 1996). In Kim and Lee (1995), autonomy was found to have a significant negative effect on team performance. In spite of the mixed results, the following hypothesis is proposed in this study

H2: Team autonomy is positively related to NPD speed.

2.2. The combined effect of managerial output control and team autonomy

Regarding the joint impact of managerial output control and team autonomy, we expect that the joint occurrence of output control and team autonomy has a positive effect on innovation speed. Team's autonomy represents decentralization of decision-making however, it also represents the potential to deviate from a detailed plan (Tatikonda and Rosenthal 2002). Autonomous NPD teams still require an overriding managerial control system so they know when and how their work fits in with the goals of the organization (Feldman, 1989). Managerial control is necessary because diverse and often competing, individual goal sets must be managed in order to develop and commercialize products as rapidly as possible (Tannenbaum, 1968; Henderson and Lee, 1992). Therefore, we propose that:

> H3: The interaction effect of managerial output control and team autonomy is positively related to NPD speed.

2.4. Moderating effect of product newness

The control theory predicts that managerial output control is a more effective means of control when managers can accurately measure outputs (Jaworski, 1988; Ouchi, 1979). This is not as likely the case of high innovative NPD projects where there are fewer precedents on which to rely, and thus it is more difficult for management to specify realistic a priori outcome goals. For high innovative new product projects, the poor planning quality resulting from the high level of uncertainty surrounding the projects leads to a situation where pre-planned performance standards provide inadequate benchmarks for subsequent performance appraisals (Govindarajan, 1984). In this context, any pressure put on the project team to meet the pre-set targets will lead to schedule slips or budget overruns (Langmann and Koller, 2008). Providing empirical support for the arguments presented, LaBahn et al. (1996) found that strong application of managerial output control to the development of high innovative products lengthened cycle time. Thus, H4: The more innovative a NPD project, the weaker the positive relationship between managerial output control and NPD speed.

In contrast to managerial output control, team autonomy is thought to be more positively related to NPD speed for high innovative NPD projects than for less innovative ones. When product newness is high, there is less likely to be precedents on which to rely, and thus it will be less clear what are the appropriate activities, tasks, resources and the like (Kessler and Chakrabarti, 1999). In this context, teams need enough freedom to consider new alternative solutions, and thus decentralized control is more effective (March and Simon, 1958). Kessler and Chakrabarti (1999) and Olson et al. (1995) found a positive association between the use of relatively autonomous, self-directed NPD teams and the speed of high innovative NPD projects. Other research contradicts these findings, however. Yap and Souder (1994) and Tatikonda and Montoya-Weiss (2000) found no relationship between team autonomy and time-to-market for high innovative projects. In this study, we argue that:

H5: The more innovative a NPD project, the stronger the positive relationship between team autonomy and NPD speed.

3. Methodology

3.1. Sample and data collection

The target population for the study was drawn from the Dun & Bradstreet listing of Spanish manufacturing firms. We focused on the following manufacturing sectors: food, chemicals, plastics, machinery equipment, electrical equipment, and transportation. These industries exhibited higher levels of innovative activity than the average manufacturing industry, measured by proportion of innovative companies and expenditure on innovation, and emphasized product innovation over process innovation (INE, 2002). From each industry, only firms with 50 or more employees were chosen on the basis that large firms are more likely to have established new product development procedures as opposed to smaller firms with more idiosyncratic practices (Kessler and Chakrabarti, 1999). A total of 1650 firms made up the target population.

A questionnaire accompanied by a hand signed cover letter and a postage paid return envelope was mailed to the person in charge of new product development activities at each company. Of the 1650 surveys originally mailed, 60 were returned by the post office as undeliverable. From the remaining pool, a total of 247 completed questionnaires were received, yielding a response rate of 15.5%. To test for non-response bias we compared early with late respondents as suggested by Armstrong and Overton (1977). No significant differences were found in the mean responses for any of the constructs of this study. Sample representativeness was also checked. Chi-square analyses revealed no significant differences between our sample and the population it was drawn from in terms of industry distribution, employee number and, company sales. On average, the participating firm had 200 employees and 33.85 million € annual revenue. Table 1 shows the sample characteristics.

Table 1 here

3.2. Measurement of constructs and validation

The unit of analysis was the new product development project. This is because the project level is most directly relevant to NPD speed – projects are accelerated, not individuals or organizations (Kessler and Chakrabarti, 1999). Respondents were asked to base their answers on a new product project developed and launched during the last three years. By focusing on products that were launched not longer than three years ago, potential concerns about retrospective bias are reduced.

A pool of items was generated for measuring each of the constructs based on the review of the literature and interviews with academics and practitioners. The operational definition, and scales items for each construct are provided in Appendix. NPD speed was measured through three items borrowed from previous studies: time effectiveness (i.e., launching the product on or ahead of schedule), time efficiency (doing the project faster than it might have been done) and time compared to what was considered customary for the industry (Cooper and Kleinschmidt, 1994; Kessler and Bierly, 2002; Akgün and Lynn, 2002). The fact that relative measures were used enabled us to compare dissimilar product development projects. Managerial output control construct was measured by asking the extent to which formal goals were set for the project, project's performance was monitored, and there were cost, quality and schedule control mechanisms for the project (LaBahn et al., 1996; Bonner et al., 2002). Team autonomy was assessed with three items indicating the degree to which the team had influence over determining rules and procedures, decision making on project issues, and scheduling of activities (Bailyn, 1985; Sethi, 2000). Product newness was measured asking respondents to evaluate the amount of change involved in the NPD project relative to (1) similar completed projects in the organization 2) similar completed projects by competitors (Carbonell and Rodriguez, 2006).

The study includes three control variables to reduce the possibility of alternative explanations: team experience, team stability, NPD resources. In this study, team experience is operationalized as team members' knowledge about past projects. Integrating knowledge from past projects has been shown to have a positive impact on cycle time reduction (Sherman et al., 2000). Team experience was measured by three items from Emmanuelides (1993) and Akgün and Lynn (2002). Team stability plays a positive role in accelerating new product development (Akgün and Lynn, 2002). When teams are stable from the early stage of product development to launch, they carry out their work with greater effectiveness and speed. Alternately, group turnover causes information or knowledge loss, disrupts progress and in turn, slows down the project (Guzzo and Dickson, 1996). Team stability was operationalized by two items borrowed from Akgün and Lynn (2002). Effective product development depends on the availability of required resources such as financial resources, human resources, specialized equipment and facilities (Emmanualides, 1993). Without resources a project can languish while awaiting funding decisions (Smith and Reinertsen, 1992). Firm's NPD resources were measured through a four-item scale borrowed from Ali (2000).

Two types of measures were used in this survey: formative and reflective measures. Product newness was treated as a formative construct since the measurement items (i.e. newness to the firm and newness to the market) have a distinct content, are clearly not interchangeable, and cannot be dropped without altering the meaning of the construct (Diamantopoulos and Winkhofer 2001; Jarvis et al. 2003). Furthermore, Jarvis et al. (2003) posited that items of formatively indicated constructs do not necessarily have the same antecedents and consequences. In this respect, although new to the firm products and new to the market products are both forms of product newness, they have different outcomes. Findings from Sandik and Sandvik (2003) show that whereas new-to-the-market products have a positive impact on sales growth, relative price premium, capacity utilization and, in turn, firm profitability, new-to-the-firm products do not contribute to any of these effects.

The reflective multi-item scales used were output control, team autonomy, NPD speed, team experience, team stability and NPD resources. As shown in appendix, Cronbach's alpha values for the reflective scales were greater than 0.70 indicating good reliability. Internal consistency and convergent validity were investigated by performing a confirmatory factor analysis using AMOS. The results indicated that the measurement model fit the data well (χ^2=307,6, DF=157, $p<0.00$; Incremental Fit Index (IFI) = 0.90; Comparative Fit Index (CFI) = 0.90; Root Mean Square Error of Approximation (RMSEA) = 0.06). Composite reliabilities estimates exceeded the standard of 0.6 suggested by Bagozzi and Yi (1988). Values of average variance extracted also provided satisfactory results with the exception of team autonomy, which had an average variance extracted slightly below 0.5. Together the results of the tests suggest that the reflective measures included in this study possess sufficient reliability and validity. For hypotheses testing analysis, scale items were averaged to create a single measure of each construct. Table 2 shows the zero-order correlations along with means and standard deviations.

Table 2 here

3.3. Common method bias

To examine the potential for common method bias, several tests were performed (Podsakoff et al., 2003). First, Harman's one-factor test was conducted. In this test, all the principal constructs are entered into a principal component factor analysis. Evidence for common method bias exists when a single factor emerges from the analysis or when one general factor accounts for the majority of the covariance in the independent and dependent variables. This analysis produced seven factors, with the first factor accounting for 23.6% of the total variance explained (total variance explained = 68.04%). Second, a confirmatory factor-analytic approach to Harman's single-factor test was performed. The one-factor model yielded a chi-square of 963,8 with 171 degrees of freedom (RMSEA=0.14, IFI =0.49, CFI=0.47) compared with a chi-square of 307,6 with 157 degrees of freedom for the measurement model (RMSEA=0.06, IFI =0.90, CFI=0.90). All measures of goodness of fit indicated a worse fit for the one-factor model than for the measurement model, which suggests that common method variance does not pose a serious threat. Third, the correlation matrix (Table 2) does not show any exceptionally correlated variables. The average correlation between variables was 0.17. In summary, all preceding tests suggest that common method bias does not seem to be a major problem in this study.

3.4. Estimation procedure

To test the hypotheses, we used moderated hierarchical regression analysis. This methodology allows us to sequentially introduce different blocks of variables and to check their respective explanatory capacities. First, we included the control variables. Then, the main effects of managerial output control, team autonomy[1] and product newness were added. Finally, we incorporated the interaction terms of managerial output control with team autonomy, and managerial output control and team autonomy with product newness. In order to mitigate the possible multicollinearity problem generated by the inclusion of the interaction terms, we have centered the variables following Jaccard et al.'s (1990) recommendations. One-tailed tests were used for the hypotheses because directional predictions were offered.

A post-hoc power analyses were completed using the G*POWER 3 computer software (Faul et al., 2007) to determine the p-values for the regression analysis included in the study. Effect sizes seen in earlier studies should guide the choice of the effect size that sets the appropriate threshold of statistical significance for the analyses. Yet, a review of the literature in new product development offers no information about the size of the effect. In this context, Cohen (1988) has suggested that when no better reason for the choice of effect size exists in behavioral research, the medium effect size is the one that researchers should seek to demonstrate. The power values ($1-\beta$) for a medium effect size and Type I error (α) of 0.05 exceed Cohen's (1988) recommended criterion of 0.80. Hence, an alpha-value of 0.05 seems to be appropriate to judge the statistical significance of the parameter estimates in the regression analysis.

4. Results

[1] Autonomy has been shown in some research to have a nonlinear relationship with performance (e.g. Lanfred and Moye, 1988). In this study, we tested for the curvilinear effect of team's autonomy on NPD speed by including the squared term of team autonomy in the regression analysis. Results showed that the effect of team autonomy's squared term on NPD speed was not significant.

Table 3 shows the results for the moderated hierarchical regression analysis. Consistent with H1, managerial output control was found to be positively related to NPD speed (β =0.25, $p<0.01$). H2 hypothesizes that team autonomy has a positive effect on NPD speed. A nonsignificant regression coefficient estimate for team autonomy did not support H2.

(Table 3 here)

H3 posits a positive interaction between output control and team autonomy. The findings support H3 (β =0.16, $p <0.01$). The nature of this interaction was examined using the procedure suggested by Aiken and West (1991). When managerial output control was low, a lack of relationship was found between team autonomy and NPD speed. A significant positive relationship was found between team autonomy and NPD speed under conditions of high managerial output control (β=0.22, $p<0.01$).

As predicted in H4, the interaction effect between output control and product newness was negative and significant (β= -0.15 $p <0.05$) in explaining NPD speed. The Aiken and West (1991) procedure revealed a significant positive relationship between output control and NPD speed when product newness was low (β= 0.27 $p <0.05$). At a high level of product newness the relationship between output control and NPD speed was not significant.

Results fail to support H5, which predicted that the higher the product newness, the stronger the positive relationship between team autonomy and NPD speed. As shown in Table 3, the interaction term between team autonomy and product newness was not significant.

Additional analysis

Given the formative nature of the variable 'product newness', it seems reasonable to examine whether both indicators of product newness (i.e. new-to-the-firm and new-to-the-market) are acting as moderators or only one[2]. Accordingly, we run additional regression

[2] We would like to thank one of the reviewers for this suggestion.

analyses to test for the moderating effects of the product newness indicators separately. Results revealed that the moderating effect of product newness on the relationship between output control and NPD speed differed between the two indicators of product newness. In particular, while 'new-to-the-market' moderates the relationship between output control and NPD speed ($b=-.14$ $p<0.05$), the moderating effect of 'new-to-the-firm' is not significant ($b=-.03$). The Aiken and West (1991) procedure revealed a significant positive relationship between output control and NPD speed when market newness was low ($\beta= 0.33$ $p<0.05$). At a high level of market newness the relationship between output control and NPD speed was not significant.

In keeping with the results shown in Table 3, non-significant moderating effects were found for both 'new-to-the-firm' and 'new-to-the-market' on the relationship between team autonomy and NPD speed.

Figure 2 and Figure 3 show, respectively, a graphical illustration of the relationship between team autonomy and NPD speed under high, medium, and low managerial output control, and of the relationship between managerial output control on NPD speed under high, medium, and low market newness.

(Figure 2 here)

(Figure 3 here)

5. Discussion and managerial implications

For many companies, NPD speed is a central component of their competitive strategy. This study contributes to our understanding of how managerial output control and team autonomy contribute to NPD speed. In keeping with our predictions, the results of the study show that greater output control increases NPD speed. We found, however, a lack of effect of team autonomy on NPD speed. One plausible explanation for the lack of effect could be that team autonomy, albeit present, may serve for something other than reducing time-to-market.

For example, McDonough (2000) suggested that giving the team greater decision-making responsibility leads to greater work satisfaction and ownership. It is also conceivable that the association between team autonomy and NPD speed is contingent upon some variable or variables not examined here. For example, Hersey and Blanchard (1993) suggested that the amount of discretion and autonomy given to an individual must match that individual's maturity or readiness level. Thus, giving autonomy to an employee who perceives little benefit but great cost to autonomy -i.e. more autonomy in the job can result in more work, involving more difficult and uncomfortable decisions and greater stress (Spector et al., 1988)- is likely to harm motivation, and ultimately, work effectiveness (Lanfred and Moye, 2004). In any case, it is clear that our understanding of the effect of autonomy on NPD speed is incomplete and therefore represents a fruitful avenue for additional research.

A positive interaction effect was found between output control and team autonomy on NPD speed. Specifically, the results show that when output control was high, autonomy had a positive impact on NPD speed. Otherwise, autonomy was not associated with NPD speed. This result is consistent with Feldman (1989)'s arguments that team autonomy without the corresponding use of managerial control, makes it difficult to speed up innovation. Autonomous employees acting independently of managerial control have a tendency toward miscommunication with regard to the requirements they are supposed to meet, and can easily develop attitudes or goals incompatible with the development's goals. In a similar vein, Bonner et al. (2002) noted that autonomous NPD teams are free to wander off-strategy, pursue design options that exceed the firm's competencies resources, engage in endless partisan debate and run behind schedule or over budget before drawing the attention of higher-level management. Output control can help keep new product teams on an appropriate strategic track and to avoid unwelcome surprises (Cordero, 1991).

In relation to the moderating effects of the indicators of product newness on the relationship between managerial output control and NPD speed, results indicate a significant moderating effect for the 'new-to-the-market' indicator. Specifically, a positive relationship was found between managerial output control and NPD speed for products with a low-degree of market newness. Application of output control to the development of products with a high degree of market newness does not, however, increase NPD speed. Finally, the results reveal non-significant moderating effects for the two indicators of product newness. The non-significant moderating effects maybe the result of positive and negative effects of autonomy when NPD project is high which add up to zero net effect. In terms of negative effects, it has been suggested that workers with task autonomy are more cognitively distracted from the performance of the task, as autonomy changes a job from the single task of performance to the dual tasks of performance and evaluation and decision making. This cognitive distraction then leads to lower task performance. The argument here is that the distraction effects which come with task autonomy are heightened when tasks are more complex, which is the case of highly innovative NPD projects (Langfred and Moye, 2004).

The study has several managerial implications. First, the study show that managerial control takes precedent over autonomous decision-making within the teams when time to market is the objective. Under conditions in which NPD speed is important and autonomous teams are in place, management output control is needed as a sort of switching station to regulate interaction and set and enforce priorities. Without the formal mechanism of output control, team autonomy is haphazard at best. Managerial output control is necessary to make sure that the project is heading in the right direction and that everybody is abiding by the same plan (Kirsch, 1997). Second, project managers should be aware of the limitations of managerial output control when product newness with regard to market is high. Under these circumstances, project managers must be cautious about the accuracy of pre-planned projects targets and rethink the need for corrective action due to existing deviations.

6. Limitations and directions for further research

This study is subject to several limitations. First, the use of perceptual self-report measures and a single-informant per firm raises a legitimate concern that the relationships between the dependent and independent variables could be attributable to common method variance. As noted earlier, results from several tests (e.g., Harman's one factor test, CFA approach to Harman's one factor test) indicated that common method bias may not be a serious problem in the data. It should be noted, however, that these procedures do nothing to statistically control for method effects. They only assess the extent to which common method variance may be a problem. Second, the response rate is relatively low. Still, we have some reasons to believe that the response rate did not jeopardize the representativeness of our sample. Armstrong and Overton's (1977) test provided some indication of the absence of non-response error. We had representativeness of all major sectors and companies of different sizes. Variances in both dependence, independent and control variables seem to suggest we did not select specific types of companies.

There is clearly much more that can be learned from the expansion and refinement of the studied relationships. First, this study does not address all forms of control. Cultural, social or input controls are available to managers and are not part of this study. Examining different combinations of control is worth pursuing. Second, our study only examined the moderating effects of one source of uncertainty: product newness. Future research should explore how other sources of uncertainty independently and jointly affect the relationship between control, autonomy and NPD speed. Other sources of uncertainty include market uncertainty, technological uncertainty, competitive uncertainty and resource uncertainty. Third, this study examined the influence of output control and team's autonomy on NPD speed. Examining how control and autonomy influence other aspects of new project performance such as project development cost and new product quality is another interesting topic for future research. Finally, though controls are implemented to produce positive outcomes for management, negative consequences also may arise from control-in-use (e.g. job tension, dysfunctional behavior, and information asymmetry) (Jaworski and McInnis, 1989). Future research should examine how combinations of control affect the behavior of NPD teams.

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Table 1.

Sample characteristics

SIC Code		Number of employees		Sales (x 10^6 €)	
20: Food	20.1%	50-75:	10.1%	< 12.5:	11.3%
28: Chemicals	17.0%	76-100:	14.5%	12.5-25.0:	24.3%
30: Plastics	11.2%	101-150:	16.2%	25.1-37.5:	20.3%
35: Machinery equipment	17.9%	151-200:	11.0%	37.6-50.0:	7.7%
36: Electrical equipment	17.4%	201-300:	15.3%	50.1-75.0:	10.8%
37: Transportation	16.5%	301-500:	12.7%	75.1-150:	10.4%
		> 500:	20.2%	>150:	15.3%

Table 2.

Means, Standard Deviations and Zero-order Correlations

	Mean	S.D.	1.	2.	3.	4.	5.	6.	7.
1. NPD speed	4.3	1.1	1.00						
2. Output control	5.2	1.2	0.31**	1.00					
3. Team autonomy	4.9	1.4	0.06	0.06	1.00				
4. Product newness	4.7	1.3	0.17**	0.15*	0.08	1.00			
5. Team experience	5.2	1.2	0.25**	0.36**	0.03	-0.01	1.00		
6. Team stability	6.2	1.1	0.23**	0.17**	0.05	0.18**	0.17*	1.00	
7. NPD resources	5.5	0.9	0.28**	0.37**	0.10	0.06	0.41**	0.14*	1.00

Significance levels: ** p<.01, * p<.05

Table 3

Moderated hierarchical regression results[1] (Dependent variable: NPD speed)

	Model 1	Model 2	Model 3	
Team experience	.13*	.08	.08	
Team stability	.20**	.16**	.16**	
NPD resources	.22**	.15**	.17**	
Managerial output control		.25**	.20**	H1 Supported
Team autonomy		.05	.05	H2 Rejected
Product newness		.11*	.09	
Output control * Team autonomy			.16**	H3 Supported
Output control * Product newness			-.15*	H4 Supported
Team autonomy * Product newness			.01	H5 Rejected
R^2	.15	.22	.26	
F-value	12.06**	9.37**	7.66**	
ΔR^2		.07	.04	
F-change value		5.81**	3.52*	

Significance levels: ** p<.01, * p<.05 (one-tailed test).

[1]Standardized coefficient estimates

Figure 1

Theoretical Model

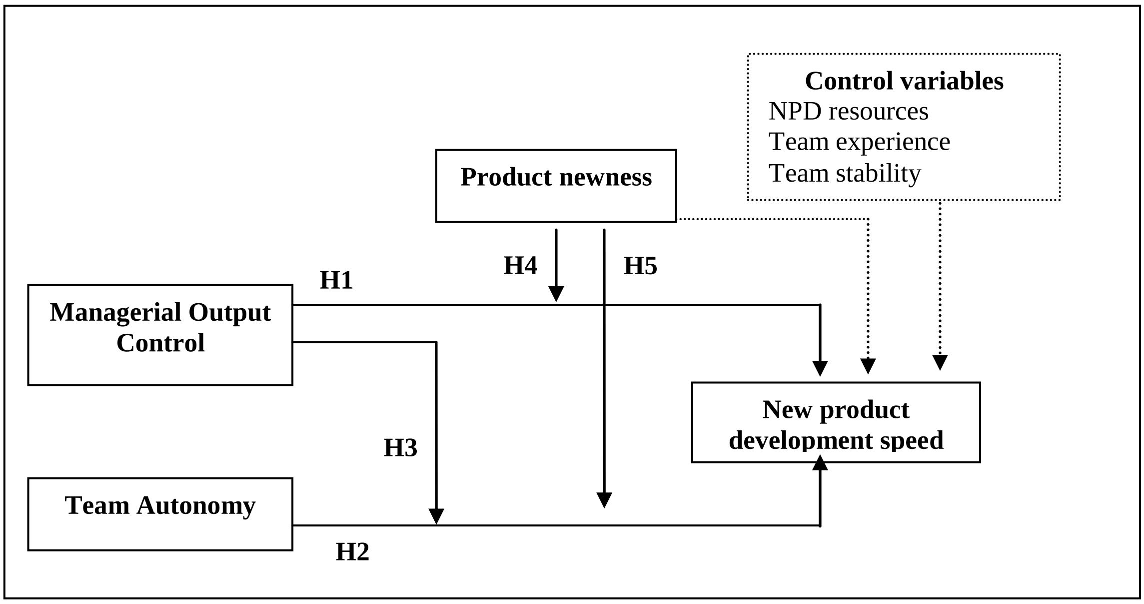


Figure 2

Effect of team autonomy on NPD speed under high, medium, and low managerial output control

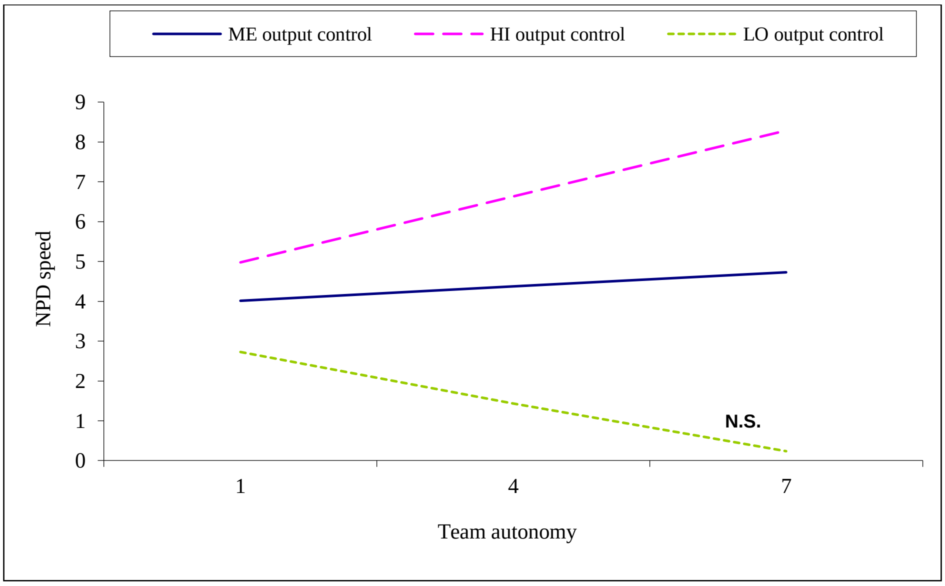
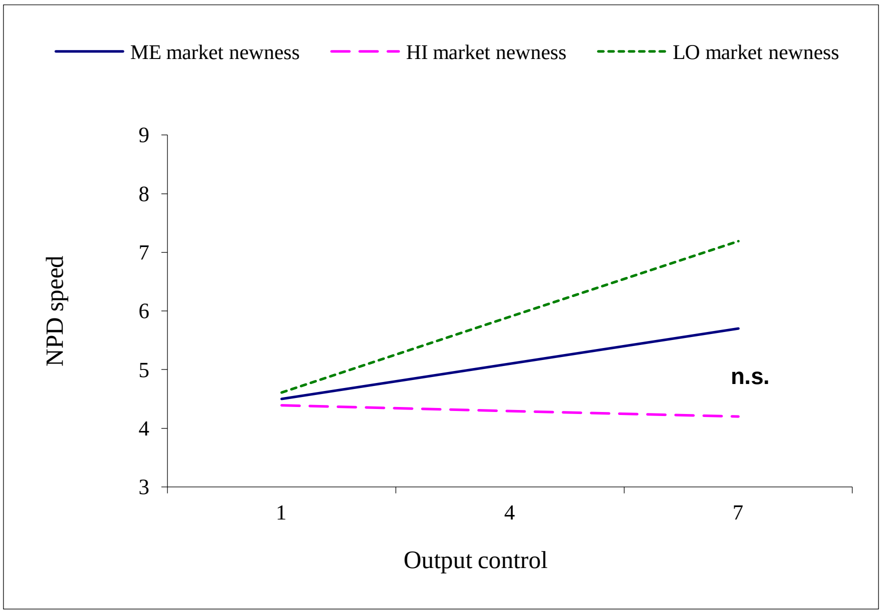


Figure 3

Effect of managerial output control on NPD speed under high, medium, and low market newness



Appendix

Construct definition and measures

Construct name	Construct measurement	Mean (S.D.)
NPD speed[1] (α=.75, CR=.78, AVE=.55)	The project was launched on or ahead of schedule	4.07 (1.30)
	The project was done fast relative to how it could have been done	4.64 (1.46)
	Completed in less time than what was considered customary for our industry	4.09 (1.38)
Output control[1] (α=.85, CR=.86, AVE=.67)	There were formal goals set for this project	5.40 (1.41)
	Project's performance was monitored	5.39 (1.54)
	There were cost control mechanisms for the project	4.96 (1.64)
	There were quality control mechanisms for the project	5.40 (1.48)
	There were schedule control mechanisms for the project	4.99 (1.56)
Team autonomy[2] (α=.72, CR=.72, AVE=.47)	Determined rules and procedures	5.12 (1.77)
	Decision-making on project issues	4.56 (1.76)
	Determined scheduling of activities	5.03 (1.72)
Product newness[3 a]	Amount of change involved in the new product relative to:	
	1) previous new products developed by the organization	4.95 (1.43)
	2) previous new products developed by competitors	4.37 (1.65)
Team experience[1] (α=.76, CR=.74, AVE=.54)	Experience with the technology used in the product	5.16 (1.39)
	Experience with developing similar products	5.39 (1.40)
	Experience with marketing similar products	5.19 (1.48)
Team stability[1] (r=.57, CR=.63, AVE=.47)	Team members who were on the team remained on it through completion	5.90 (1.42)
	The project manager who started this project remained on through completion	6.41 (1.17)
NPD resources[1] (α=.76, CR=.79, AVE=.50)	Our firm had the technical skills to develop the product	5.60 (1.28)
	Our firm had the marketing skills to develop the product	4.85 (1.43)
	Our firm had the managerial skills to develop the product	5.47 (1.19)
	Our firm had the financial resources to develop the product	5.82 (1.22)

[1] Seven-point Likert-type scale (1= Strongly disagree, 7 = Strongly agree)

[2] Seven-point scale (1= Top management, 7= Project team)

[3] Seven-point scale (1= Very low, 7 = Very high)

[a] Formative indicator. There is a correlation of 0.33 between the two items of product newness