J. Eng. Technol. Manage. 26 (2009) 28–45

Contents lists available at ScienceDirect

J. Eng. Technol. Manage.

journal homepage: www.elsevier.com/locate/jengtecman

Relationships among team's organizational context, innovation speed, and technological uncertainty: An empirical analysis

Pilar Carbonell [a,*], Ana I. Rodríguez-Escudero [b]

[a] School of Administrative Studies, Faculty of Liberal Arts and Professional Studies, York University, 4700 Keele Street, Toronto, ON, Canada M3J 1P3
[b] Facultad de Ciencias Economicas y Empresariales, Universidad de Valladolid, Spain

ARTICLE INFO

Article history:
Available online 29 March 2009

JEL classification:
032

Keywords:
Innovation speed
Technology novelty
Technological turbulence
Organizational contextual factors

ABSTRACT

This study examines the moderating effect of uncertainty on the relationships between three organizational context factors (i.e. top management support, clarity of goals and speed-based rewards) and innovation speed. It considers two aspects of uncertainty: technology novelty and technological turbulence. Findings from 183 new product projects indicate that top management support has a more positive effect on innovation speed under conditions of high technology novelty and high technological turbulence. Clarity of goals is more important to innovation speed under conditions of medium technology novelty and low technological turbulence. The results suggest a curvilinear, positive relationship between speed-based rewards and innovation speed. This is true for all the situations considered in this study, with the exception of environments characterized by high technological turbulence, where a negative curvilinear relationship was found between speed-based rewards and innovation speed.

1. Introduction and background

Innovation 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

* Corresponding author. Tel.: +1 416 736 2100x33819; fax: +1 416 736 5963.
E-mail address: pilarc@yorku.ca (P. Carbonell).

0923-4748/$ – see front matter
doi:10.1016/j.jengtecman.2009.03.005

Edgett, 2008; Swink, 2003). 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 innovation 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; Calantone et al., 1997).

A number of changes have been instituted in organizations over the past 20 years to improve innovation speed. One of the most influential of theses has been the use of cross-functional teams to guide product development activity from inception to commercial launch (Cooper and Edgett, 2008; McDonough, 2000). Despite their potential to reduce time-to-market, many companies find that implementing effective cross-functional teams is an extremely difficult task and one that they have not always performed successfully (McDonough, 2000). One area of inquiry that deserves more research attention is the organizational context in which cross-functional teams reside (Denison et al., 1996; Ellinger, 2005; Doolen et al., 2006).

The organizational context that surrounds a team has been identified by researchers as an important consideration in the study of work team effectiveness. Guzzo and Shea (1992) clearly articulated the need for researchers to broaden team research to look beyond the interactions and processes between team members and to include the relationships between teams and the organization they reside in: "Improvements in group effectiveness can best be obtained by changing the circumstances in which groups work. Thus, organizational reward systems can be changed to recognize team accomplishments, group and organizational goals must be actively managed to ensure that group and organizational goals are aligned, technical and human resource support systems can be adapted to promote the welfare of work groups, and so on. A diagnosis of the contextual factors facilitating or inhibiting group effectiveness should precede implementing changes in order to identify the specific changes to be made to enhance effectiveness (Guzzo and Shea, 1992, p. 306)". This study considers three team's contextual variables: the extent of senior management support, the degree of clarity with regard to the NPD project's goals, and the presence of monetary rewards for faster innovation speed.

It is generally argued that top management support, goal clarity and speed-based rewards play an important role in creating conditions that affect innovation speed (Mabert et al., 1992; Murmann, 1994; Zirger and Hartley, 1994; Kessler and Chakrabarti, 1996; McDonough, 2000). However, it is unclear, if these management practices are at all appropriate for all conditions of uncertainty. For example, prior research has shown that goal clarity, top management support, and speed-based rewards may have little or no impact on innovation speed when uncertainty is high (Eisenhardt and Tabrizi, 1995; Swink, 2002; Chen et al., 2004). Given these mixed results and the importance of this topic to the literature in innovation and technology management, it is vital to understand the conditions under which top management support, goal clarity and speed-based rewards improve innovation speed. Specifically, it is important to examine the extent to which the effects of these contextual factors on innovation speed may be attenuated or intensified by the level of uncertainty surrounding the innovation project.

Against this backdrop, we examine the moderating effect of uncertainty on the impact of top management support, clarity of goals and speed-based rewards on innovation speed (Fig. 1). In order to precisely attribute the effects of uncertainty, this study considers two sources of uncertainty: project-related characteristics and external environmental factors (Tushman, 1979; Gales and Mansour-Cole, 1995). Regarding the project characteristics, we consider technology novelty. Technology novelty refers to the degree of newness of the technologies embodied in the NPD project (Tatikonda and Montoya-Weiss, 2001). Of the many environmental factors affecting project's uncertainty, we focus on technological turbulence, that is, the degree of change associated with new product technologies in the industry (Jaworski and Kohli, 1993). The product development literature describes both technology novelty and technological turbulence as common sources of uncertainty for innovation projects (Swink, 2000; Tatikonda and Montoya-Weiss, 2001; Tidd and Bodley, 2002; Chen et al., 2005). To date, few empirical studies have investigated the extent to which the effect of top

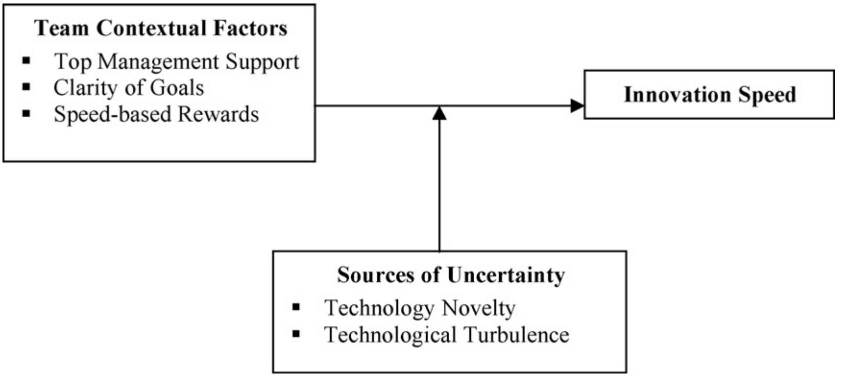

Fig. 1. Conceptual framework.

management support, clarity of goals and speed-based rewards on innovation speed is contingent upon the degree of innovativeness and change in new product technologies. Furthermore, existing results are inconsistent across studies and are many times contrary to expectations. Further examination is necessary from both theoretical and managerial perspectives.

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. Literature review and hypotheses development

2.1. Top management support

Top management support refers to the amount of support given by top management to the NPD project. Top management support can be made visible in a variety of ways: by acting as an executive sponsor, helping a team to surmount obstacles, providing encouragement to a team, maintaining open channels of communication with people involved in NPD, streamlining decision-making processes, and providing adequate capital and human resources (Gupta and Wilemon, 1990; Smith and Reinertsen, 1992). By and large, existing research indicates that top management support plays a positive role in accelerating innovation speed (Mabert et al., 1992; Emmanuelides, 1993; Kessler and Chakrabarti, 1996). In this study, we hypothesize that the positive effect of top management support on innovation speed will likely be enhanced by increasing technology novelty and technological turbulence. Below, we review the relevant research from which we generate our hypotheses.

For most operating businesses, radical innovation is ‘‘an unnatural act’’ because the uncertainty is too high, the time horizon too long, and the investment too large, given the risks (Rice et al., 1998). Research has shown that radical project’s teams continually struggle to attract the resources they require as internal cultures and pressures often push efforts toward more low risk, immediate reward, incremental projects (McDermott and O’Connor, 2002). Even when highly innovative projects are formally established, their funding is generally unstable over time. Under these circumstances, top management has the potential to influence how quickly NPD teams will progress by securing access to required resources and establishing a climate of urgency for the projects. As pointed out by Rice et al. (2008), in the face of obstructionism from various parts of the organization, it makes sense that radical innovations receive management attention and support earlier rather than later as to reduce time-to-market and make the most effective use of development resources.

Despite the perceived importance of senior management support for the speed of technologically innovative projects, the valence of the relationship between top management support and innovation speed, in the context of highly innovative projects, is not yet clear, as suggested by the conflicting results of research that examined this relationship. Thus, while Clift and Vandenbosch (1999) reported a positive association between top management support and the speed of technologically innovative projects, Kessler and Chakrabarti (1999) and Chen et al. (2004) results showed a lack of relationship between top management's support and innovation speed for radical innovations. In this study, because of the higher risks and costs inherent in radical innovations, we expect top management support to be more important to the speed of radical technological projects than incremental projects.

H1a. The positive effect of top management support on innovation speed will be stronger when technology novelty is high than when technology novelty is low.

The positive effect of top management support on innovation speed is likely to be enhanced by increasing technological turbulence. Turbulent environments are characterized by frequent and dramatic changes, impeding accurate prediction and timely responses. Existing knowledge, resources, processes or products become obsolete quickly, and it is difficult to monitor or predict technological discontinuities (Droge et al., 2008; Eisenhardt, 1989). In these circumstances, project team members experience confusion, helplessness and intense anxiety as they are not yet familiar with the new relevant facts and are unable to foresee the consequences of their actions (Akgün et al., 2006), which contribute to delays in decision-making (George, 1980). It is, therefore, argued that in the context of highly turbulent environments, senior management can facilitate innovation speed by providing physiological safety, empowerment and motivation, and cultivating a team's capabilities of handling unpredictability (Akgün et al., 2007). Thus, we hypothesize:

H1b. The positive effect of top management support on innovation speed will be stronger when technological turbulence is high than when technological is low.

2.2. Clarity of goals

Goal clarity refers to the precision and detail of the project's objectives. Goal clarity has been shown to be highly related to goal stability. When a team has a clear understanding of the project goals, it will be more likely to stick to the pre-determined goals, resulting in fewer goals changes during the project (Lynn et al., 2000). Generally, research on NPD has shown clarity and stability of goals as important for development speed (Kessler and Chakrabarti, 1996; Lynn et al., 2000; McDonough, 2000; Murmann, 1994).

The positive effect of goal clarity on innovation speed is likely to be stronger under conditions of medium technology novelty than under conditions of low or high technology novelty. For projects with low technology novelty, setting clear goals at the project outset may not be critical for increasing development speed because of the low degree of uncertainty present with these types of innovations. Lynn and Akgün's (2001) study reported a lack of association between vision clarity and the success of incremental innovations. For highly technological projects, goal clarity and stability may be difficult or even unfeasible. Lynn and Akgün (2001) stated that for radical innovations, because there can be many paths for achieving the designed ends, which may be unknown or unknowable at the project outset, project's goals will likely experience several changes and corrections along the way. The literature on radical innovations describes highly innovative products as requiring extensive exploring and experimenting and probing and learning rather than targeting and developing (Meyer and Utterback, 1995; Peters, 2006). Thus,

H2a. The positive effect of goal clarity on innovation speed will be stronger under conditions of medium technology novelty than under conditions of low or high technology novelty.

The positive effect of goal clarity on innovation speed will likely to be weakened by increasing technological turbulence. If an environment is characterized by high technological turbulence, a lot of new technical information will emerge during the typical timeline of a development project (Iansiti, 1995). Acceleration in this context involves flexible options as to cope with the unclear and changing environment. As put forward by Eisenhardt and Tabrizi (1995), under high levels of environmental turbulence, the main goal of the NPD process should be to achieve flexibility, a high responsiveness to environmental changes and the ability to adapt to emerging challenges. Iansiti (1995) noted that, under highly turbulent conditions, effective fast product development becomes contingent on the firm's capability to rapidly react to changes in the technology and market as the project evolves. Henard and Szymanski (2001) found that more flexible product development procedures are important to the success of new products in dynamic environments. Consistent with these arguments, we hypothesize:

H2b. The positive effect of goal clarity on innovation speed will be weaker when technological turbulence is high than when technological turbulence is low.

2.3. Speed-based rewards

Speed-based rewards allude to the presence of a reward system to accelerate new product development. Although time-based reward systems are said to aid in directing NPD activities toward speed (Kessler and Chakrabarti, 1996; Zirger and Hartley, 1994), empirical evidence to date shows a lack of relationship between rewards for speed and innovation speed (Eisenhardt and Tabrizi, 1995; Kessler and Chakrabarti, 1996; Swink, 2002). In this study, we argue that a non-linear relationship is likely to exist between speed-based rewards and innovation speed. Expectancy theory of motivation attributed to Vroom (1964) proposes that the strength of a tendency to act in a certain way depends on the strength of an expectation that the act will be followed by a given outcome and on the attractiveness of that outcome to the individual (Robbins, 1992). Perceptions of rewards being too low can lead to dissatisfaction and lower morale and performance (Cropanzano and Randall, 1993). Consistent with the expectancy theory, we argue that setting rewards for speed may not necessarily be a sufficient condition for achieving fast product development. Low levels of speed-based rewards can fail to motivate the team to move fast and thus have little impact on innovation speed. As speed-based rewards rise, an increase in the reward level will have greater than linear effects on innovation speed. Thus,

H3a. A curvilinear, with a positive increasing slope, relationship is expected to exist between speed-based rewards and innovation speed.

Project control theory holds that output-based controls and rewards should be applied in situations of low uncertainty, when managers can accurately measure outputs (Ouchi, 1979). Although development time is amenable to measurement, when developing technologically innovative products, the accuracy of such deadlines is suspect due to the greater uncertainty implicit in these innovations. Thus, LaBahn et al. (1996) noted that due to the high levels of uncertainty, the development of technologically innovative projects may have deadlines that are, at best, educated guesses. Similarly, McDermott and O'Connor (2002) indicated that for teams engaged in very highly uncertain technical developments, the only thing certain is that they cannot predict with accuracy the pace at which progress would be made. It is the inaccuracies introduced into the scheduling by the greater uncertainty that hamper any sort of reward system linked to the achievement of high innovation speed. Consistent with this reasoning, Kessler and Chakrabarti (1999) only find a positive association between speed-based rewards and the speed of incremental innovations. Similarly, in Sarin and Mahajan's (2001) study outcome-based rewards were only positively associated with the speed of less-complex projects. No significant association was found between outcome-based rewards and the speed of more complex projects. Because technology novelty increases uncertainty and impair accurate goal setting, we propose the following hypothesis:

H3b. The curvilinear positive effect of speed-based rewards on innovation speed will be weaker under high technology novelty.

The positive effect of speed-based rewards on innovation speed is likely to be weakened by increasing technological turbulence. It has been argued that teams respond to reward structures in a manner that minimizes their own risk (Sarin and Majahan, 2001). Environments that are perceived to be highly turbulent will tend to generate a lack of confidence on the part of the project team (Milliken,

1987) and will likely be viewed as contexts in which erroneous decisions could result in trouble (Bstieler, 2005). Under such conditions, rewards for high innovation speed would have little influence on motivating the team responsible for the NPD project because they would reflect greater performance risk being shifted on the team (Sarin and Mahajan, 2001). This is in keeping with research in goal-choice and expectancy theory that suggests that goals considered ambiguous, risky or too difficult to achieve are more likely to be rejected. For example, Lawler's (1973) extrinsic motivation model indicated that monetary incentives will have little influence on those who believe that they are incapable of achieving a necessary level of performance. Similarly, Farh et al. (1991) and Rubin and Perloff (1993) pointed out that workers unsure of their own abilities bear additional income risk under the pay for performance system and thus, would be expected to reject plans that distribute reward based on performance. Drawing on this research, we argue that:

H3c. The curvilinear positive effect of speed-based rewards on innovation speed will be weaker under high technological turbulence.

3. Methodology

3.1. Sample and data collection

Selection of the research sample is motivated by the objective of being able to generalize the findings of the study beyond the idiosyncratic nature of one or two industries. Data were gathered using a cross-sectional survey methodology encompassing six diverse industries: food, chemical, plastic, mechanical equipment, electrical equipment, and transportation. According to Kessler and Chakrabarti (1999), cross-sectional samples provide access to a range of tasks and institutional environments where rapid product development is pursued. The frame consisted of 1650 Spanish manufacturing firms with 50 or more employees. Firms with fewer than 50 employees were not chosen because they are more likely to have more idiosyncratic new product development activities.

A questionnaire was mailed to the technical director in each firm. To minimize social desirability bias in the measurement of constructs, the respondents were reminded that there was no right or wrong answers to the questions being asked. They were also informed that their responses would remain anonymous and would not be linked to their companies or products. This increased the motivation of the informant to cooperate without fear of reprisals (Huber and Power, 1985). All respondents were offered summaries of the results.

Of the original 1650 surveys mailed, 60 were returned by the post office as undeliverable. From the remaining pool, a total of 188 questionnaires were received. Of these, five surveys were eliminated due to missing data, yielding a response rate of 11.5%. Although this response rate is not as high as one might wish, it is consistent with other studies on new product development (Calantone et al., 2003; Swink, 2000). Hunt (1990) maintains that it is possible to achieve valid generalizations from studies with low response rates unless there is a good reason to believe that the respondents do in fact differ from the non-respondents on the substantive issues in question and that these differences would make the results of the study unreliable. To test for non-response bias we compared early with late respondents as suggested by Armstrong and Overton (1977). No significant differences were found on the constructs of this study at the .05 level. Accordingly, non-response bias does not appear to be a significant problem. We also checked for sample representativeness. 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. The median respondent firm had 200 employees and 33.35 million € annual revenue. Respondents had a positive attitude towards the investigation, as demonstrated by the fact that 84% of the respondents wanted to receive the results of the study. Table 1 shows the sample characteristics.

Because projects were drawn from several companies from different industries, tests for between-group differences in any of the constructs included in this study were undertaken. Analysis of variance procedures and post-hoc Tukey multiple-comparison tests reveal that there were no significant between-group differences with the averages of innovation speed, top management support, clarity of goals, speed rewards, technology novelty, and technological turbulence at 95% significance level.

Table 1
Sample characteristics.

SIC code	Number of employees	Sales in Euros ($\times 10^6$)
20: Food (14.1%)	50–75: 9.9%	<12.5: 9.4%
28: Chemical (22.4%)	76–100: 13.2%	12.5–25.0: 24.5%
30: Plastic (10.9%)	101–150: 17.0%	25.1–37.5: 21.1%
35: Machinery equipment (19.2%)	151–200: 10.4%	37.6–50.0: 8.2%
36: Electrical equipment (22.4%)	201–300: 17.1%	50.1–75.0: 11.7%
37: Transportation (10.9%)	301–500: 11.5%	75.1–150: 10.5%
	>500: 20.9%	>150: 14.6%

3.2. Measures

The unit of analysis was the new product development project. This is because the project level is most directly relevant to innovation speed – projects are accelerated, not individuals or organizations (Kessler and Chakrabarti, 1999). Respondents were asked to base their answers on a new product project fully completed within the past 3 years.

A pool of items was generated for measuring each of the constructs using literature search and interviews with academics and practitioners. The questionnaire was pretested with seven technical managers. The operational definition, and scales items for each construct are provided in Appendix A at the end of this paper. Innovation speed was measured through three items borrowed from previous studies: (1) time effectiveness (i.e. launching the product on or ahead of schedule), (2) time efficiency (doing the project faster relative to how it could have been done), and (3) time relative to what was considered customary for the industry (Akgün and Lynn, 2002; Cooper and Kleinschmidt, 1994; Kessler and Bierly, 2002). The fact that relative measures were used enabled us to compare dissimilar product development projects.

Technology novelty was measured by the extent to which the technology embodied in the project was new (Chen et al., 2005), ranging from ‘application of in-house known technologies’ to ‘use of emerging/new technologies’. Technological turbulence was measured by the rate of change of the technology used in the industry – ranging from very dynamic (changing rapidly) to very stable (virtually no change) (Jaworski and Kohli, 1993). Top management support was assessed by four items adapted by Cooper and Kleinschmidt (1995). Clarity of goals was measured by asking whether the objectives were clear, formal and stable during the project execution (Clark and Wheelwright, 1993). Speed-based reward was measured by asking whether rewards were built-in to accelerate the new product development process (Eisenhardt and Tabrizi, 1995).

Competitive intensity, team size, development cost and NPD resources were included as control variables on the basis of prior research examining the determinants of innovation speed. Thus, the literature suggests that highly competitive markets drive the firm to innovate more quickly in order to seize the moment from a competitor, or to respond quickly to a competitor’s new product (Cooper, 1995). Competitive intensity was measured through three items borrowed from Ali (2000). There is evidence of a relationship between time size and innovation speed. Specifically, small development teams reach consensus and complete assignments faster than large cumbersome teams (Millson et al., 1992). Team size was measured by number of team members (Sarin and McDermott, 2003). A cost-based strategy may be at odds with accelerating the new product development process because firms may have to “pay for speed” by committing more man-hours, materials, and/or equipment to projects (Kessler and Bierly, 2002).

Development costs were measured by asking to what extent the project’s costs met the budget. Finally, effective product development depends on the availability of required resources such as financial resources, human resources, specialized equipment and facilities (Emmanuelides, 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 multi-item measures and reflective multi-item measures. If a construct was a summary index of observed variables, we used a formative measurement model. In this case, observed variables cover different facets of the construct and cannot be expected to have significant inter-correlations. In contrast, if observed variables were manifestations of underlying constructs, we used a reflective measurement model (Diamantopoulos and Winklhofer, 2001). Based on our understanding and conceptualization of the variable NPD resources, it appears appropriate to use formative measurement approaches for this construct. The reflective multi-item measures used were innovation speed, top management support, clarity of goals, competitive intensity, and market uncertainty. The scales items for each construct are provided in Appendix A.

To obtain unidimensionality for the reflective multi-item variables, the item-to-total correlations were calculated for each item, taking one scale at a time. Items for which these correlations were lower than .35 were eliminated (Saxe and Weitz, 1982). Computing reliability coefficients explored the reliability of each purified, unidimensional scale. As shown in Appendix A, alpha coefficients values were equal or greater than .70, which indicates 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 = 119.5, d.f. = 69, $p < .00$; Normed Fit Index (NFI) = .88; Comparative Fit Index (CFI) = .93; Root Mean Square Error of Approximation (RMSEA) = .06). Composite reliabilities estimates exceeded the standard of .6 suggested by Bagozzi and Yi (1988). Values of average variance extracted also provided satisfactory results with the exception of top management support, which had an average variance extracted slightly below .5. Standardized item loadings for all constructs were greater than .5 and significant ($p < .05$), which evidences good convergent validity (Bagozzi et al., 1991). The discriminant validity was assessed with a series of constrained models in which each intertrait correlation was constrained to unity. The constrained models showed a worse fit than the baseline measurement model, thus providing evidence of discriminability (Gerbing and Anderson, 1988). Together the results of the tests suggest that the reflective measures included in this study possess sufficient unidimensionality, reliability and validity.

To determine the appropriateness of the formative scales, we followed the recommendations of Bollen and Lennox (1991) and Diamantopoulos and Winklhofer (2001) to examine indicator collinearity. In relation to the NPD resource index, the correlations (max Pearson correlation = .58), variance inflations factors (max VIF = 2.4), and condition numbers (max CN = 19.6) offered no indication that collinearity is a concern. Typically, correlations over .70, VIFs over 10, and CNs over 30 indicate serious multicollinearity problems. Hence, all items were retained. 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.

3.3. Common method bias

To examine the potential for common method bias, four tests were performed (Podsakoff et al., 2003). First, Harman's one-factor test was conducted. In this test, all the principal constructs are

Table 2
Means, standard deviations and zero-order correlations.

	Mean	S.D.	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Innovation speed	4.36	1.05	1.0								
2. Top management support	5.52	1.00	.26**	1.0							
3. Clarity of goals	5.57	1.15	.33**	.42**	1.0						
4. Speed-based rewards	2.92	1.78	.13*	.35**	.29**	1.0					
5. Technology novelty	3.61	1.85	.02	.12	.12	.22**	1.0				
6. Technological turbulence	3.23	1.65	−.01	.11	.05	.21**	.19*	1.0			
7. Competitive intensity	3.56	1.53	−.08	−.09	−.08	−.10	.10	.14	1.0		
8. Team size	7.50	5.41	−.11	.14	.16*	.28*	.01	.19*	−.04	1.0	
9. NPD resources	5.56	.95	.24**	.32**	.56**	.13	.09	−.02	−.08	.05	1.0
10. Market uncertainty	3.64	1.49	.00	.15*	−.11	.14	.02	.42**	−.05	.00	−.01

* Significance level: $p < .05$.
** Significance level: $p < .01$.

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 24.5% of the total variance explained (total variance explained = 65.8%). Second, a confirmatory factor-analytic approach to Harman's single-factor test was performed. The one-factor model yielded a chi-square of 727.00 with 78 degrees of freedom (RMSEA = .22, NFI = .16, CFI = .15) compared with a chi-square of 119.5 with 69 degrees of freedom for the measurement model (RMSEA = .06, NFI = .88, CFI = .93). All measures of goodness of fit indicated a worse fit for the one-factor model than for the measurement model, which suggest that common method variance does not pose a serious threat. Third, we used a partial correlation method. The highest factor from the principal component factor analysis was added as another independent variable on the dependent variable (i.e. innovation speed). This variable is assumed to contain the best approximation of the common method variance if it is a general factor on which all variables load (Podsakoff et al., 2003). This independent variable did not significantly increase the variance explained in the dependent variable, indicating no common method bias. Fourth, the correlation matrix (Table 2) does not show any exceptionally correlated variables. The average correlation between variables was .26. 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

Hypotheses were tested using moderated hierarchical regression analysis. This methodology allows us to sequentially introduce different blocks of variables and to check their respective explanatory capacities (Anderson, 1986). Control variables including competitive intensity, NPD resources, team size, and market uncertainty were entered in Model 1. The main effects of top management support, clarity of goals and speed-based rewards, followed by the squared term for speed-based rewards were added in Model 2 and Model 3, respectively. Technological turbulence, technology novelty and the squared term for technology novelty were entered in Model 4. Finally, interaction effects between top management support, clarity of goals, speed-based rewards and technological turbulence and technology novelty were introduced in Model 5. The constituent variables were mean-centered prior to creating the interaction terms to reduce multicollinearity. The variance inflation factors for all coefficient estimates in Model 5 were below the cut-off of 10, indicating that multicollinearity was not a problem.

A post-hoc power analysis was performed to determine the appropriate alpha-level for the moderated hierarchical regression analysis. Power values were calculated for the dependent variable using the G*POWER 3 computer software (Faul et al., 2007). In all of the models used to test the hypotheses (Model 3 and Model 5), power values for a medium effect size and Type I error (α) of .05 exceeded Cohen's (1988) recommended criterion of .80. Hence, an alpha-value of .05 seems appropriate to judge the statistical significance of our model.

4. Results

Table 3 shows the results for the moderated hierarchical regression analysis. One-tailed tests were used for the hypotheses because directional predictions were offered. Consistent with H1a, the interaction term between top management support and technology novelty is significant and positive (β = .14, $p < .05$) (Model 5). The nature of this interaction was examined using the procedure suggested by Aiken and West (1991). When technology novelty was low, the relationship between top management support and innovation speed was not significant. A significant positive relationship was found between top management support and innovation speed under conditions of high technology novelty (β = .30, $p < .00$). H1b predicted that the positive relationship between top management support and innovation speed is likely to be enhanced by increasing technological turbulence.

The interaction effect between technological turbulence and top management support was found to be positive and significant (β = .22, $p < .01$) providing support for H1b. The Aiken and West (1991)

Table 3
Moderated regression analysis[a].

	Model 1	Model 2	Model 3	Model 4	Model 5
Control variables					
Competitive intensity	−.08	−.06	−.07	−.07	−.04
NPD resources	.25**	.04	.04	.04	.08
Team size	−.14*	−.18**	−.17**	−.17*	−.17**
Market uncertainty	.00	.01	.01	.01	.03
Independent variables					
Top management support		.15*	.13	.13	.16*
Clarity of goals		.27**	.27**	.27**	.38**
Speed rewards		.00	−.09	−.08	−.08
Speed reward^2			.18**	.18**	.08
Moderators					
Technology novelty				−.05	−.14
Technology novelty^2				.01	.01
Technological turbulence				.01	.26*
Interaction terms					
TM support × technology novelty					.14*
TM support × technological turbulence					.22**
Clarity of goals × technology novelty					−.02
Clarity of goals × technology novelty^2					−.21*
Clarity of goals × technological turbulence					−.15*
Speed-rewards × technology novelty					.05
Speed reward^2 × technology novelty					.18
Speed reward × technological turbulence					−.02
Speed reward^2 × technological turbulence					−.37**
R^2	.08	.16	.19	.19	.36
F-value (d.f.)	3.85** (4)	4.63** (7)	4.70* (8)	3.41** (11)	4.29** (20)
ΔR^2		.08	.03	.00	.17
F-change value (d.f.)		5.28** (3)	4.49* (1164)	.14 (3)	4.57** (9)

[a] Standardized regression coefficients are reported.
* Significance level: $p < .05$ (one-tailed test).
** Significance level: $p < .01$ (one-tailed test).

test revealed that top management support had a strong effect on innovation speed under conditions of high technological turbulence ($\beta = .34$, $p < .00$). Under conditions of low technological turbulence, the relationship between top management support and innovation speed was not significant. The forms of the significant moderated relationships are shown in Fig. 2.

H2a predicts that the positive effect of goal clarity on innovation speed is highest under conditions of medium technology novelty. Results in Model 5 show a negative and significant curvilinear interaction term between goal clarity and the square of technology novelty ($\beta = -.21$, $p < .05$) which provides support for H2a. Aiken and West's (1991) procedure was used to examine the nature of the relationship between goal clarity and innovation speed under conditions of low, medium and high technology novelty. In keeping with H2a, the results reveal the positive relationship between goal clarity and innovation speed is stronger under conditions of medium technology novelty than under conditions of low or high technology novelty ($\beta = .25$, $p < .05$ for low; $\beta = .34$, $p < .00$ for medium; and $\beta = .25$, $p < .05$ for high technology novelty) (see Fig. 3).

Results support H2b which predicted a negative interaction effect between clarity of goals and technological turbulence ($\beta = -.15$, $p < .05$) (Model 5). Results from the Aiken and West (1991) procedure reveal that goal clarity has a significantly stronger positive relationship with innovation speed when technological turbulence is low ($\beta = .43$, $p < .00$) than when it is high ($\beta = .21$, $p < .05$) (see Fig. 3).

Consistent with H3a, there is evidence of a positive curvilinear relationship between speed-based rewards and innovation speed. Results from Model 3 show that the addition of the quadratic term for speed-based rewards increases R^2 by 3% ($p < .05$). Furthermore, the coefficient estimate for

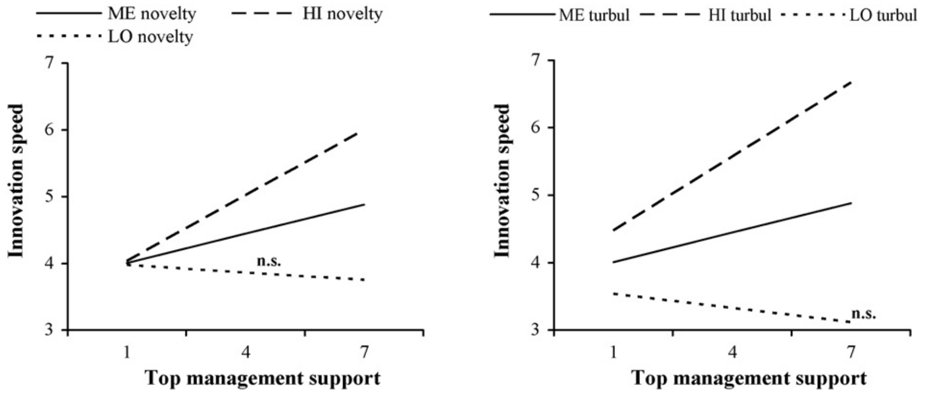

Fig. 2. Effect of top management support on innovation speed under high, medium, and low technology novelty and technological turbulence.

the quadratic term of speed-based rewards is positive and significant ($\beta = .18$, $p < .05$). A partial derivative of the regression function explores this relationship further: Innovation Speed (IS) = $.18 \times$ Rewards $(R)^2 - .09R$, reaches its minimum when $R = .82$. This suggests that in the range of interest (1–7), this function is strictly increasing. In other words, there is a positive curvilinear relationship between speed-based rewards and innovation speed, denoting a faster than linear increasing return on innovation speed (see solid line in Fig. 4 for a graphical illustration of the relationship).

H3b predicted that the curvilinear positive effect of speed-based rewards on innovation speed will be weaker under high technology novelty. As shown in Table 3 (Model 5), the coefficient of the interaction term between technology novelty and the squared term for speed-based reward is not significant. H3b is thus rejected. Consistent with H3c a negative and significant interaction term was found between technological turbulence and the square of speed-based reward ($\beta = -.37$, $p < .01$). Results from the Aiken and West's (1991) procedure revealed a positive and significant relationship between speed-based rewards squared and innovation speed under low technological turbulence ($\beta = .35$, $p < .01$), and a significant and negative relationship between speed-based rewards squared

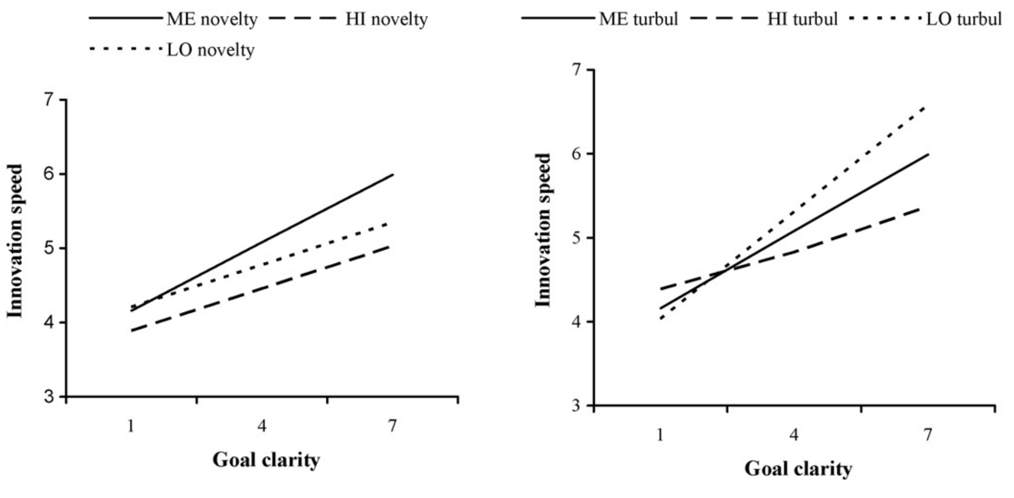

Fig. 3. Effect of goal clarity on innovation speed under high, medium, and low technology novelty and technological turbulence.

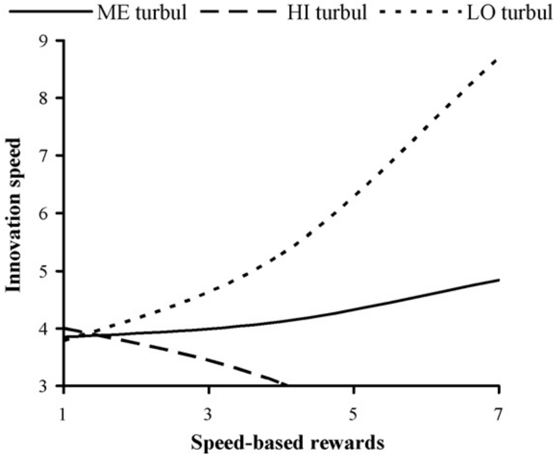

Fig. 4. Effect of speed-based rewards on innovation speed under high, medium, and low technological turbulence.

and innovation speed when technological turbulence was high ($\beta = -.19$, $p < .05$). The first derivative of the regression function of speed-based rewards and innovation speed under conditions of low technological turbulence indicates that this function reaches its minimum when Rewards = .15. This suggests that in the range of interest (1–7), speed-based rewards have an increasing curvilinear effect on innovation speed (short-dashed line in Fig. 4). A similar analysis under conditions of high technological turbulence shows that the function relating speed-based rewards to innovation speed has a maximum at Rewards = −.47, which denotes a decreasing curvilinear relationship between speed-based rewards and innovation speed in the range of variation of speed-based rewards (1–7) (long-dashed line in Fig. 4).

5. Discussion

This study has examined the moderating effect of technology novelty and technological turbulence on the relationships between a number of organizational context factors (i.e. top management support, clarity of goals and speed-based rewards) and innovation speed. Particularly, results indicate that top management support is more important to innovation speed under conditions of high technology novelty and high technological turbulence. This is in keeping with the previously discussed literature suggesting that in the face of high uncertainty and high risk, top management support plays a key role in driving new product projects forward (Rice et al., 1998). For incremental products or projects under relatively stable environments, for which both uncertainty and risk are low, top management support does not appear to facilitate innovation speed. Under these conditions, innovation speed mainly depends on the competency of the project manager to complete a known series of tasks in the shortest amount of time. In this situation, top management involvement may, in fact, consume valuable time, energy and resources without proving significant benefits in the form of faster solutions.

With regard to the moderating role of technology novelty on the relationship between clarity of goals and innovation speed, our findings indicate that goal clarity has a stronger positive impact on innovation speed when technology novelty is medium than when technology novelty is low or high. For incremental projects, for which project objectives are frequently well known and acknowledged among the team members, and radical innovations, where project's objectives are likely to experience several changes and corrections along the project's life cycle (Lynn and Akgün, 2001), goal clarity is less important for achieving faster speed.

Our results suggest that technological turbulence has a moderating effect on the relationship between clarity of goals and innovation speed. In this case, results show that clarity of goals is more important to innovation speed when technological turbulence is low. Firms in technologically stable environments can take the time to set clear/stable goals and plans, knowing that the assumptions and facts guiding the plans probably will still hold at the end of the development process. Conversely, setting clear project objectives at the project outset is a rather futile exercise when the environment is changing rapidly and unpredictably (Eisenhardt, 1989). Aaker (1998) noted that having a dynamic goal – broad goals with many flexible targets rather than a few and stable targets is needed to cope with highly turbulent environments.

The question of how to motivate workers to speed up the development process has always been a difficult one for managers to answer. This is due in part to the fact that some researchers have reported a lack of relationship between time-based incentives and innovation speed. In keeping with our predictions, the results suggest a curvilinear, positive relationship between speed-based rewards and innovation speed. These results are consistent with the expectancy theory. The central tenet of expectancy theory suggests that people are motivated to greater performance when they perceive a clear link between the efforts/performance and rewards (Baron and Byrne, 1997). Making rewards contingent on the outcomes establishes such a clear link (Merchant, 1985). However, low levels of speed-based rewards can fail to motivate the team and thus have little impact on innovation speed. As speed-based rewards rise, an increase in the reward level will have greater effects on innovation speed.

Regarding the moderating effect of technological turbulence on the speed-based rewards–innovation speed relationship, the results suggest a decreasing curvilinear relationship between speed-based rewards and innovation speed under conditions of high technological turbulence. This result is in keeping with Sarin and Majahan (2001) argument that when facing considerable uncertainty about future outcomes, purely output-based rewards place NPD teams at greater risk and thus may have a counterproductive effect on performance. This is not to say, however, that a firm should entirely disconnect rewards from speed outcomes for all conditions of uncertainty. Doing so will not only force the organization to absorb a disproportionate amount of the risk, but it will also fail to motivate the team. As our findings show, under conditions of low technological turbulence, speed-based rewards have a positive curvilinear relationship with innovation speed.

Counter to predictions, the relationship between speed-based rewards and innovation speed was not impacted by the degree of technology newness within the new product project. This might be explained by the fact that, contrary to the degree of technology turbulence, the level of technology newness is a visible aspect of the new product strategy (Crawford, 1980; Cooper, 1984; Meyer and Roberts, 1986). That is to say, one could assume that rewards and evaluation systems will be modified to account for the risk and uncertainty accompanying the degree of technology newness sought. In this respect, for a firm seeking to develop a new technology, in anticipation of a more difficult, riskier, and uncertain development process, speed-based rewards may well be linked to a more flexible, lax calendar, or higher money incentives. Alternatively, rewards are expected to be associated with tighter schedules when lower degrees of change are sought.

6. Conclusions and managerial implications

This study adds to the knowledge in the field of technology and innovation management by empirically demonstrating that the interaction effects between technology novelty, technological turbulence and a number of team organizational context factors (i.e. top management support, clarity of goals and speed-based rewards) are more complex than those traditionally hypothesized in the literature. Particularly, findings from the study indicate a curvilinear interaction effect between technology novelty and goal clarity in explaining innovation speed. Also, the study demonstrates the presence of a curvilinear positive relationship between speed-based rewards and innovation speed.

Two important managerial implications follow from these results. First, the organizational context in which a NPD team operates is a major determinant of innovation speed. Specifically, this study indicates that top management support, goal clarity and speed-based rewards play an important role in creating conditions that improve innovation speed.

Second, organizational context variables may simply work in particular circumstances and contexts but not in others. In this regard, our study results indicate how the effects of top management support, goal clarity and speed-based rewards on innovation speed can be attenuated or intensified by the level of uncertainty surrounding the innovation project, mainly by the degree of technology newness and technological turbulence. For instance, clear, formalized, and stable project's goals are more important to innovation speed when the degree of technology newness is medium and technological turbulence is low.

Providing time, resources and enthusiasm to the NPD team by top management is essential in encouraging teams to speed up NPD when technology novelty and technological turbulence are high. Extant research points out the challenge firms face in encouraging their employees to speed the NPD process in the context of radical innovation and rapidly changing environments. Under such scenarios, the roles and tasks team members must handle in these arenas are quite distinct from what is encountered in more familiar situations (i.e. incremental projects, stable markets). Yet, there is often little "upside" for the team members (O'Connor and McDermott, 2004). Managerial attention to building supportive governance systems and infrastructural support is a critical step in enhancing innovation speed.

Managers should not be discouraged from implementing speed-based rewards in an effort to increase speed-to-market under highly turbulence environments. The fact that under these circumstances our study shows non-linear decreasing returns of speed-based rewards on innovation speed should not cause managers to ignore this type of rewards. On the contrary, our findings should motivate managers to understand the variables associated with the effectiveness of rewards in this context. For example, extant research has shown that in less uncertain environments, money incentives will have greater influence on performance if workers set their own goals. Therefore, managers should urge teams to set their own goals. This is important because, according to Austin (1989), the goals of the organization cannot simply be assumed to be those of the individual. As put forward by Donnellon (1993), managers often insist on unrealistic objectives and refuse to hear that these will not be met. The result is that managers are told what they want to hear and only learn the real story after the goals have been missed, which it is too late to make corrections. Therefore, emphasizing self-set goals under monetary incentive systems is one mechanism that managers may apply to connect personal goals to organizational goals and to increase employees' commitment (Moussa, 1996), providing the organization with a much clearer sense of what the team's performance would be.

7. Limitations and directions for further research

This study is subject to several limitations. First, the study uses a single-informant per firm in the data collection and single-item Likert-type measures for some constructs (e.g. technology novelty, technological turbulence and speed-based rewards), which may result in common method bias. Although results from several tests (i.e. Harman's one-factor test, CFA approach to Harman's one-factor test, and partial correlation method) indicated that common method bias does not seem to be a problem in this study, it should be noted 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. Future studies can benefit from gathering multi-informant data on the key dependent variable (i.e. innovation speed) and using multi-item scales.

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.

A third limitation is that the research is based on perceptual data. Yet, despite the extensive use of such retrospective perceptual data in strategy research and especially in new product research (Venkatraman and Ramanujan, 1986), one should not rule out the shortcomings associated with subjectivity.

Finally, there is clearly much more that can be learned from further exploration of the studied relationships. Our study only examined the moderating effects of perceived technology novelty and perceived technological turbulence. Future research should explore how other sources of uncertainty independently and jointly affect the relationship between team organizational context factors and innovation speed. Other sources of uncertainty include market uncertainty, competitive uncertainty and resource uncertainty. In this study, we investigated only one project outcome, innovation speed. However, the technical success of new products, project development cost, and product quality should also be considered as NPD performance outcomes. Lastly, this study argues that top management support can help speed up product development in high uncertain situations via the provision of psychological safety, a clear direction for NPD efforts, empowerment and motivation. Nonetheless, the study does not measure any of the aforementioned constructs nor does it measure their mediating effect in the relationship between top management support and innovation speed. Future research should consider a focus on these constructs and their mediation effects.

Acknowledgements

The authors wish to acknowledge the financial support provided by the Spanish Ministry of Education and Science (research project: SEJ2006-08854/ECON) and the Seneca Foundation – Agency of Science and Technology of the Region of Murcia (Spain).

Appendix A. Construct definition and measures.

Construct name (Cronbach's alpha or correlation coefficient, composite reliability, average variance extracted)	Construct measurement	Mean (S.D.)
Innovation speed[a]	The project was completed in less time than what was considered normal and customary for our industry	4.16 (1.37)
(α = .70, CR = .74, AVE = .58)	The project was launched on or ahead of schedule	4.13 (1.24)
	The project was done fast relative to how it could have been done	4.70 (1.45)
Top management support[a]	Top management supported the project	6.36 (.85)
(α = .75, CR = .78, AVE = .48)	Top management devoted a lot of time to the project	4.72 (1.67)
	Top management provided adequate resources	5.72 (1.20)
	Top management created an enthusiastic atmosphere	5.28 (1.42)
Clarity of goals[a]	The goals were clear	5.93 (1.15)
(α = .83, CR = .84, AVE = .63)	The goals were formalized	5.42 (1.38)
	The goals were stable during the project execution	5.29 (1.46)
Speed-based rewards[a]	Existence of rewards to speed up the NPD process	2.92 (1.81)
Technology novelty[b]	Newness of the technology embodied in the project	3.60 (1.86)
Technological turbulence[a]	The technology in our industry was changing rapidly	3.22 (1.64)
Competitive intensity[a,c]	There was not much aggressive competitive activity in the market	3.14 (1.67)
(r = .46, CR = .66, AVE = .50)	There were few or no competitors in the marketplace	3.97 (1.87)
	Competitors were relatively small or weak companies[d]	2.44 (1.56)
Team size	Number of members on the project team	7.46 (5.12)
NPD resources[a]	Our firm had the technical skills to develop the product	5.71 (1.17)
	Our firm had the marketing skills to develop the product	5.02 (1.43)
	Our firm had the managerial skills to develop the product	5.55 (1.81)
	Our firm had the financial resources to develop the product	5.90 (1.20)
Market uncertainty[a]	Uncertainty about customer preferences and taste was high	3.53 (1.61)
(r = .71, CR = .74, AVE = .71)	Uncertainty about competitive situations was high	3.76 (1.61)

[a] Seven-point Likert-type scale (1 = strongly disagree to 7 = strongly agree).
[b] Seven-point scale (1 = application of in-house known technologies to 7 = application of new technologies).
[c] Reversed scale.
[d] Suppressed item (item-to-total correlation lower than .35).

References

Aaker, D.A., 1998. Strategic Market Management, 5th ed. John Wiley Sons Inc., New York.

Aiken, L.S., West, S.G., 1991. Multiple Regression: Testing and Interpreting Interactions. Sage Publications Inc..

Akgün, A., Lynn, G., 2002. Antecedents and consequences of team stability on new product development performance. Journal of Engineering and Technology Management 19, 263–286.

Akgün, A.E., Lynn, G.S., Byrne, J.C., 2006. Antecedents and consequences of unlearning in new product development. Journal of Product Innovation Management 23, 73–88.

Akgün, A.E., Byrne, J.C., Lynn, G.S., Keskin, H., 2007. New product development in turbulent environments: impact of improvisation and unlearning on new product performance. Journal of Engineering and Technology Management 24, 203–230.

Ali, A., 2000. The impact of innovativeness and development time on new product performance for small firms. Marketing Letters 11 (2), 151–163.

Anderson, C.H., 1986. Hierarchical moderated regression analysis: a useful tool for retail management decisions. Journal of Retailing 62, 186–204.

Armstrong, J.S., Overton, T.S., 1977. Estimating no response bias in mail surveys. Journal of Marketing Research 14, 396–402.

Austin, J.T., 1989. Effects of shifts in goal origin, on goal acceptance, and attainment. Organizational Behavior and Human Decision Processes 44, 415–435.

Bagozzi, R.P., Yi, Y., 1988. On the evaluation of structural equation models. Journal of the Academy of Marketing Science 16 (1), 74–94.

Bagozzi, R.P., Yi, Y., Phillips, L.W., 1991. Assessing construct validity in organizational research. Administrative Science Quarterly 36, 421–458.

Baron, R., Byrne, D., 1997. Social Psychology, 8th ed. Allyn and Bacon, Boston.

Bollen, K., Lennox, R., 1991. Conventional wisdom on measurement: a structural equation perspective. Psychological Bulletin 110 (2), 305–314.

Bstieler, L., 2005. The moderating effect of environmental uncertainty on new product development and time efficiency. Journal of Product Innovation Management 22, 267–284.

Calantone, R., Garcia, R., Dröge, C., 2003. The effects of environmental turbulence on new product development strategy planning. Journal of Product Innovation Management 20, 90–103.

Calantone, R., Schmidt, J.B., di Benedetto, A., 1997. New product activities and performance: the moderating role of environmental hostility. Journal of Product Innovation Management 14, 179–189.

Carbonell, P., Rodríguez, A.I., 2006. The impact of market characteristics and innovation speed on perceptions of positional advantage and new product performance. International Journal of Research in Marketing 23 (1), 1–12.

Chen, J., Reilly, R., Lynn, G.S., 2005. The impacts of speed to market on new produce success: the moderating effects of uncertainty. IEEE Transactions on Engineering Management 52 (2), 199–202.

Chen, J., Reilly, R., Ma, J., Lynn, G., 2004. Impact of empowerment on speed in new product development: the role of uncertainty. Working paper, Wesley, J. Howe School of Technology Management, Stevens Institute of Technology, 04/32.

Clark, K.B., Wheelwright, S.C., 1993. Managing New Product and Process Development. The Free Press, New York, NY.

Clift, T.B., Vandenbosch, M.B., 1999. Project complexity and efforts to reduce products development cycle time. Journal of Business Research 45, 185–198.

Cohen, J., 1988. Statistical Power Analysis for the Behavioral Sciences, 2nd ed. Lawrence Erlbaum Associates, Hillsdale, NJ.

Cooper, R.G., 1984. How new product strategies impact performance. Journal of Product Innovation Management 1 (1), 5–18.

Cooper, R.G., 1995. Developing new products on time, in time. Research Technology Management 38 (September–October), 49–58.

Cooper, R.G., Kleinschmidt, E.J., 1994. Determinants of timeliness in new product development. Journal of Product Innovation Management 11 (5), 381–396.

Cooper, R.G., Kleinschmidt, E.J., 1995. Benchmarking the firm's critical success factor in new product development. Journal of Product Innovation Management 12, 374–391.

Cooper, R.G., Edgett, S.J., 2008. Maximizing productivity in product innovation. Research Technology Management (March–April), 47–58.

Crawford, M., 1980. Defining the charter for product innovation. Sloan Management Review 22 (Fall (1)), 3–12.

Cropanzano, R., Randall, M., 1993. Justice in the workplace: a historical review. In: Cropanzano, R. (Ed.), Justice in the Workplace: Approaching Fairness in Human Resource Management. Erlbaum, Hillsdale, NJ, pp. 3–20.

Denison, D.R., Hart, S.L., Kahn, J.A., 1996. From chimneys to cross-functional teams: developing and validating a diagnostic model. Academy of Management Journal 39 (4), 1005–1023.

Diamantopoulos, A., Winklhofer, H.M., 2001. Index construction with formative indicators: an alternative to scale development. Journal of Marketing Research 38, 269–277.

Donnellon, 1993. Crossfunctional teams in product development: accommodating the structure to the process. Journal of Product Innovation Management 10 (November (5)), 377–392.

Doolen, T.L., Hacker, M.E., Aken, E.V., 2006. Managing organizational context for engineering team effectiveness. Team Performance Management 12 (5–6), 138–154.

Droge, C., Calantone, R., Harmancioglu, N., 2008. New product success: is it really controllable by managers in highly turbulent environments? Journal of Product Innovation Management 25 (3), 272–286.

Eisenhardt, K.M., 1989. Making fast strategics decisions in high-velocity environments. Academy of Management Journal 32, 543–576.

Eisenhardt, K.M., Tabrizi, B.N., 1995. Accelerating adaptive processes: product innovation in the global computer industry. Administrative Science Quarterly 40, 84–110.

Ellinger, A.D., 2005. Contextual factors influencing informal learning in a workplace setting: the case of "reinventing itself company". Human Resource Development Quarterly 16 (3), 389–415.

Emmanuelides, A.P., 1993. Towards an integrative framework of performance in product development projects. Journal of Engineering and Technology Management 10, 363–392.

Farh, J., Griffeth, R.W., Balkin, D.B., 1991. Effects of choice of pay plans on satisfaction, goal setting and performance. Journal of Organizational Behavior 12, 55–62.

Faul, F., Erdfelder, E., Lang, A., Buchner, A., 2007. G*Power 3: a flexible statistical power analysis program for the social, behavioral and biomedical science. Behavior Research Methods 39 (2), 175–191.

Gales, L., Mansour-Cole, D., 1995. User involvement in innovation projects. Journal of Engineering and Technology Management 12 (1–2), 77–109.

George, A.L., 1980. Presidential Decision Making in Foreign Policy. Westview Press, Boulder, CO.

Gerbing, D., Anderson, J., 1988. An updated paradigm for scale development incorporating unidimensionality and its assessment. Journal of Marketing Research 25 (2), 186–192.

Gupta, A.K., Souder, W.E., 1998. Key drivers of reduced cycle time. Research Technology Management 41, 38–43.

Gupta, A.K., Wilemon, D.L., 1990. Accelerating the development of technology-based new products. California Management Review 32, 24–44.

Guzzo, R.A., Shea, G.P., 1992. Group performance and intergroup relations in organizations. In: Dunnette, M.D., Hough, L.M. (Eds.), Handbook of Industrial and Organizational Psychology. Psychological Press, Palo Alto, CA, pp. 269–313.

Henard, D.H., Szymanski, D.M., 2001. Why some new products are more successful than others. Journal of Marketing Research 38 (August), 362–375.

Huber, G.P., Power, D.J., 1985. Research notes and communications retrospective reports for strategic-level managers: guidelines for increasing their accuracy. Strategic Management Journal 6, 171–180.

Hunt, S., 1990. Commentary on an empirical investigation of a general theory of marketing ethics. Journal of the Academy of Marketing Science 18, 173–177.

Iansiti, M., 1995. Shooting the rapids: managing product development in turbulent environments. California Management Review 38 (1), 37–58.

Jaworski, B.J., Kohli, A.K., 1993. Market orientation: antecedents and consequences. Journal of Marketing 57 (3), 53–70.

Kessler, E.H., Bierly III, P.E., 2002. Is faster really better? An empirical test of the implication of innovation speed. IEEE Transactions on Engineering Management 49 (1), 2–12.

Kessler, E.H., Chakrabarti, A.K., 1996. Innovation speed: a conceptual model of context, antecedents and outcomes. Academy of Management Review 21 (4), 1143–1191.

Kessler, E.H., Chakrabarti, A.K., 1999. Speeding up the pace of new product development. Journal of Product Innovation Management 16, 231–247.

LaBahn, D., Ali, A., Krapfel, R., 1996. New product development cycle time. The influence of project and process factors in small manufacturing companies. Journal of Business Research 56, 179–188.

Lawler, E.E., 1973. Job attitudes and employee motivation: theory, research and practice. Personnel Psychology 23, 23–237.

Lynn, G.S., Akgün, A.E., 2001. Project visioning: its components and impact on new product success. Journal of Product Innovation Management 18, 374–387.

Lynn, G.S., Reilly, R., Akgun, A.E., 2000. Knowledge management in new product teams: practices and outcomes. IEEE Transactions on Engineering Management 47 (2), 221–231.

Mabert, V.A., Muth, J.F., Schmenner, R.W., 1992. Collapsing new product development times: six case studies. Journal of Product Innovation Management 9, 200–212.

McDermott, C., O'Connor, G.C., 2002. Managing radical innovation: an overview of emergent strategy issues. Journal of Product Innovation Management 19 (6), 424–438.

McDonough III, E.F., 2000. Investigating of factors contributing to the success of cross-functional teams. Journal of Product Innovation Management 17, 211–235.

Merchant, K., 1985. Control in Business Organizations. Pittman Publishing, Boston.

Meyer, M.H., Roberts, E.B., 1986. New product strategy in small technology-based firms: a pilot study. Management Science 32 (7), 806–821.

Meyer, M.H., Utterback, J.M., 1995. Product development time and commercial success. IEEE Transactions on Engineering Management 42, 297–304.

Milliken, F.J., 1987. Three types of perceived uncertainty about the environment: state, effect, and response uncertainty. Academy of Management Review 12, 133–143.

Millson, M., Murray, R., Raj, S.P., Wilemon, D., 1992. A survey of major approaches for accelerating new product development. Journal of Product Innovation Management 9, 53–69.

Moussa, F.M., 1996. Determinants and process of the choice of goal difficulty. Group and Organization Management 21 (December (4)), 414–438.

Murmann, P.A., 1994. Expected development time reductions in the German mechanical engineering industry. Journal of Product Innovation Management 11, 236–252.

O'Connor, G.C., McDermott, C., 2004. The human side of radical innovation. Journal of Engineering and Technology Management 21, 11–30.

Ouchi, W.G., 1979. A conceptual framework for the design of organizational control mechanisms. Management Science (September), 833–848.

Peters, L., 2006. Rejoinders to establishing an NPD best practices framework. Journal of Product Innovation Management 23, 117–127.

Podsakoff, P.M., Mackenzie, S.B., Lee, J.-Y., Podsakoff, N.P., 2003. Common method bias in behavioral research: a critical review of the literature and recommended remedies. The Journal of Applied Psychology 88 (5), 879–903.

Rice, M., O'Connor, G., Peters, L., Morone, J., 1998. Managing discontinuous innovation. Research Technology Management 41 (3), 52–58.

Rice, M., O'Connor, G.C., Pierantozzi, R., 2008. Implementing a learning plan to counter project uncertainty. Sloan Management Review (Fall), 54–62.

Robbins, S.P., 1992. Essentials of Organizational Behavior. Prentice Hall, Englewood Cliffs, NJ.

Rubin, D.K., Perloff, J.M., 1993. Who works for piece rates and why. American Journal of Agricultural Economics 75, 1036–1043.
Sarin, S., Majahan, V., 2001. The effect of reward structures on the performance of cross-functional product development teams. Journal of Marketing 65 (2), 35–53.
Sarin, S., McDermott, C., 2003. The effect of team leader characteristics on learning, knowledge application, and performance of cross-functional new product performance teams. Decision Sciences 34, 707–739.
Saxe, R., Weitz, B.A., 1982. The socio scales: a measure of the customer orientation of salespeople. Journal of Marketing Research 19 (3), 343–351.
Smith, P.G., Reinertsen, D.G., 1992. Shortening the product development cycle. Research Technology Management 35, 44–49.
Swink, M., 2000. Technological innovativeness as a moderator of new product design integration and top management support. Journal of Product Innovation Management 17 (3), 208–220.
Swink, M., 2002. Product Development—faster, on-time. Research Technology Management 45 (July–August (4)), 50–58.
Swink, M., 2003. Completing projects on-time: how project acceleration affects new product development. Journal of Engineering and Technology Management 20 (December (4)), 319–344.
Tatikonda, M.V., Montoya-Weiss, M., 2001. The influence of project execution factors on operational and market outcomes in new product development. Management Science 47 (1), 151–172.
Tidd, J., Bodley, K., 2002. The influence of project novelty on the new product development process. R&D Management 32 (2), 127–138.
Tushman, M.L., 1979. Work characteristics and subunit communication structure: a contingency analysis. Administrative Science Quarterly 24, 8298.
Venkatraman, N., Ramanujan, V., 1986. Measurement of business performance in strategy research: a comparison of approaches. Academy of Management Review 11, 801–814.
Vroom, V.H., 1964. Work and Motivation. Wiley, New York.
Zirger, B.J., Hartley, J., 1994. A conceptual model of product development cycle time. Journal of Engineering and Technology Management 11, 229–251.