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ARTICLE

The individual and joint effects of process control and process-based rewards on new product performance and job satisfaction

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Summary An important issue facing innovation managers is how to exercise adequate managerial control over new product development (NPD) teams in order to ensure that project goals are met. The current study advances research on this subject matter by analyzing the individual and joint effects of process control and process-based rewards on job satisfaction and four measures of new product performance. Findings from our study reveal that process control and process-based rewards can have either positive or negative effects depending on the type of performance outcome considered. Thus, process control is beneficial to new product quality but detrimental to adherence to budget, adherence to schedule, and team's job satisfaction. Interestingly, our results suggest opposite effects for process-based rewards. In terms of their joint effects, results suggest that firms should only combine process control and process-based rewards when their goal is to develop new products with high quality.

Introduction

An important issue facing innovation managers is how to exercise adequate control over new product development (NPD) teams in order to ensure that project goals are met (Rijsdijk and van den Ende, 2011). The present study focuses on two types of managerial control systems: process control and process-based rewards. Process control pertains to the specification and monitoring of the appropriate behaviors, activities and processes in which NPD teams must engage to achieve the expected project goals (Bonner et al., 2002). Process-based rewards denote a reward system that compensates NPD teams for finishing specified procedures and activities that are crucial to accomplishing the project goals (Atuahene-Gima and Murray, 2004; Li et al., 2010; Sarin and Majahan, 2001). It is worth noting that although both process

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control and process-based rewards emphasize behaviors and/or activities; these two forms of controls perform different functions. Thus, while process control centers on the provision of information (i.e., directing, monitoring and feedback), process-based rewards focus on the provision of reinforcements (Challagalla and Shervani, 1997). The purpose of this study is to address two gaps in the extant empirical research in relation to the effects of process control and process-based rewards on NPD performance.

First, although several studies have examined the impact of process control and process-based rewards on NPD performance (e.g., Bonner et al., 2002; Li et al., 2010; Poskela and Martinsuo, 2009); the empirical findings to date have been ambiguous on both fronts. Regarding the effect of process control on new product performance, the empirical evidence is mixed suggesting negative (e.g., Bonner et al., 2002), positive (e.g., Tatikonda and Montoya-Weiss, 2001) and non-significant (e.g., Rijsdijk and van den Ende, 2011; Poskela and Martinsuo, 2009) effects of process control of new product performance. Similarly, extant research provides a confusing picture of the performance impact of process-based rewards, with empirical studies reporting positive (e.g., Song et al., 1997), negative (e.g., Sarin and Majahan, 2001) and non-significant (e.g., Li et al., 2010; Chang et al., 2007) effects of process-based rewards on new product performance. The unclear findings may stem from the fact that with a very few exceptions (i.e., Sarin and Majahan, 2001; Rijsdijk and van den Ende, 2011), most studies have used general or aggregate measures of NPD performance as the outcomes under investigation and ignored the fact that process control and process-based rewards can have differential effects across different performance outcomes. The current study therefore advances extant research by examining the effects of process control and process-based rewards on four separate dimensions of new product performance, mainly, product quality, adherence to budget, adherence to schedule and commercial success. Having a deeper understanding of the nature of the consequences of process control and process-based rewards is important, as managers may prioritize different outcomes such as development costs, development time or product quality in different projects and may therefore need to adapt the controls that they use to the outcomes they primarily want to attain (Rijsdijk and van den Ende, 2011). The present study also investigates the impact of process control and process-based rewards on job satisfaction. The issue of how management controls affect job satisfaction of NPD teams has received little research attention so far. This again is an important gap as job satisfaction has been widely recognized as a strong determinant of team effectiveness and performance (Barczak and Wilemon, 2003; Rodríguez-Escudero et al., 2010).

Secondly, it is unclear how process control and process-based rewards, together, can affect new product performance outcomes and job satisfaction. On one hand, one could argue that the simultaneous use of process control and process-based rewards could have synergistic effects. Thus, Sarin and Majahan (2001) stated that rewards and punishments are logical extensions of the control process, following information, monitoring and feedback. Rewards are important to control systems because people recognize actions that lead to positive consequences, repeat those actions, and avoid any action that lead to negative consequences (Challagalla and Shervani, 1996; Poskela and Martinsuo, 2009). Therefore, the use of process-based rewards along with process control can further reinforce the completion of those procedures and activities considered critical to accomplishing the project goals, strengthening the positive effects of process control. Also, contingent rewards such as process-based rewards are said to increase employees' perceptions of workplace justice (Podsakoff et al., 2006), which could help reduce some of the negative consequences of process control. On the other hand, rewarding has been associated with decreased intrinsic motivation and hampered creativity and even it has been interpreted as a type of bribe used to induce employees to do something that they may otherwise be reluctant to do (Burroughs et al., 2011). From this point of view, process-based rewards could offset (increase) the positive (negative) performance effects of process control. Unfortunately, to date there has not been research examining how process-based rewards influence the effectiveness of process control. Although previous work has examined the influence of process control (e.g., Bonner et al., 2002; Rijsdijk and van den Ende, 2011) and the influence of process-based rewards (e.g., Sarin and Majahan, 2001) on new product performance separately, no study has considered their joint effect. Therefore, the second objective of this study is to examine the joint effects of process control and process-based rewards on job satisfaction and several measures of new product performance.

Overall, this study makes two important contributions to the extant literature. First, this study provides a clearer and more refined picture of the impact of process control and process-based rewards on new product performance. As noted above, most research on the impact of process control and process-based rewards has considered general performance measures as the outcomes under investigation. In a significant improvement over existing studies, this study examines the impact of process control and process-based rewards on five different performance outcomes: adherence to budget, adherence to schedule, product quality, commercial success and job satisfaction. Second, this is the first study to report on the combined effects of process-based rewards and process control on new product performance and job satisfaction. To this day, research on this subject was lacking and thus it was unclear how these two types of control together affect new product performance outcomes. Our results show that the simultaneous use of process control and process-based rewards leads to both synergistic and incompatible effects depending on the nature of the project outcomes.

Theoretical model and definitions

Fig. 1 illustrates our theoretical model, which proposes that process control and process-based rewards individually and jointly impact product quality, adherence to budget, adherence to schedule, and job satisfaction. Indirect effects of process control and process-based rewards on commercial success are also posited via the above mentioned outcome measures. As noted earlier, process control refers to the extent that management attempts to achieve desired ends

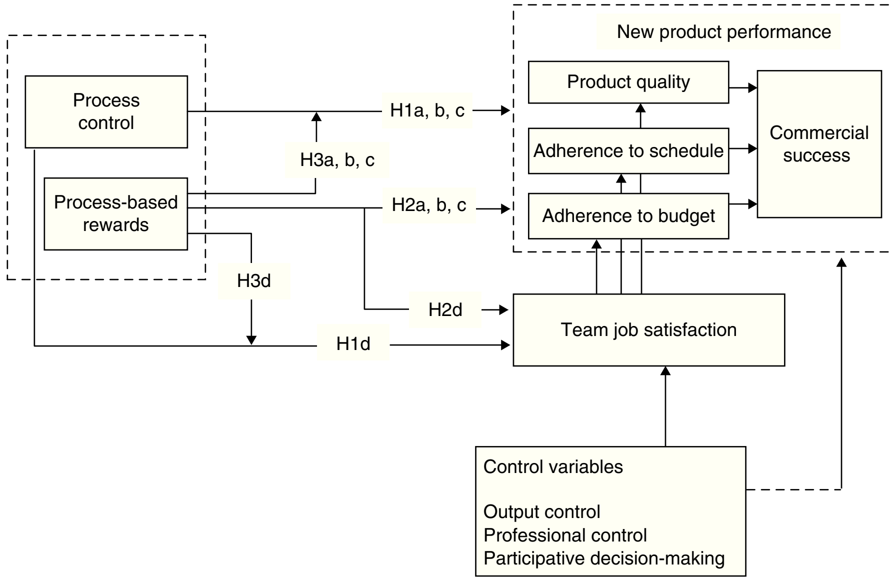

Figure 1 Proposed model.

by specifying and monitoring the procedures and activities to be pursued by the NPD project team (Jaworski, 1988; Omta et al., 1997; Bonner et al., 2002). Process-based rewards are defined as rewards that are contingent on completing relevant NPD activities and behaviors (Sarin and Majahan, 2001). New product quality alludes to the degree to which the new product satisfies customer's expectations and requirements (Kessler and Bierly, 2002). Adherence to budget involves the extent to which the NPD team operated in a cost-efficient manner and adhered to its budget. Adherence to schedule comprises the extent to which the NPD team met deadlines, was efficient with their time and managed to launch the project on time (Hoegl et al., 2004). Commercial success concerns the extent to which the new product meets sales and profit objectives (Lee and O'Connor, 2003). Job satisfaction is defined as the team members' satisfaction with regard to the recognition, responsibilities, supervision and opportunities offered during the NPD project (Sarin and Majahan, 2001).

In order to accurately capture the impact of process control and process-based rewards on the selected performance outcomes and reduce the possibility of specification bias (due to omitted variables), the theoretical model accounts for the effects on new product performance and job satisfaction of other kinds of management control systems, mainly output control, professional control and participative decision-making. Output control refers to the extent to which management emphasizes the achievement of end results when monitoring, evaluating and rewarding NPD team members (Jaworski, 1988). An output control system directs team members by specifying output goals and standards (Ramaswami, 1996). Output control has been related to increased new product performance (Bonner et al., 2002), project timeliness and new product quality (Rijsdijk and van den Ende, 2011). Professional control represents control by neither outcome nor behavior, but by socialization (Anderson and Oliver, 1987). Professional control is implemented by promulgating common values, beliefs and philosophy within the team. Rather than requiring employees to follow a written set of procedures, the socialization process, as well as rituals and ceremonies, serve to identify and reinforce acceptable behaviors (Kirsch, 1997). Jaworski et al. (1993) reported a positive relationship between professional control and job satisfaction. Participative decision-making represents the extent to which NPD team members participate in and have influence on decisions regarding the NPD project (Tatikonda and Rosenthal, 2000). Research shows a positive effect of participative decision-making on adherence to budget and schedule and new product quality (Bonner et al., 2002; Alegre and Chiva, 2008).

The following section presents the hypotheses of our study. Of note, hypotheses for the direct effects of new product quality, adherence to budget and adherence to schedule on commercial success are not included in this article since they have been extensively examined in the literature (e.g. Carbonell and Rodríguez, 2006; García et al., 2008).

Hypotheses

Effect of process control on new product outcomes and job satisfaction

We posit that process control enhances new product quality for several reasons. First, process control increases the amount of discipline, completeness and care exercised during the development of new products (Lukas and Menon, 2004). A process control system is aimed at specifying critical NPD activities and ensuring that such activities are carried out by team members in line with the plan (Schultz et al., 2013; Tatikonda and Montoya-Weiss, 2001). Therefore, under a process control system, critical activities, processes and procedures are neither overlooked nor performed out of sequence by the NPD team (Bonner et al., 2002). Second, a process control system creates the needed structure for managing innovation projects, supporting communication and coordination among different functional groups. Better communication and coordination in NPD teams has been found to positively influence new product quality (Sivasubramaniam et al., 2012). Finally, by clarifying tasks, authority and decision procedures process control strengthens cross-functional integration which, in turn, facilitates the creation of high quality products (Im and Nakata, 2008). Based on the previous discussion, we propose that process control will have a positive impact on product quality.

H1a. Process control has a positive effect on product quality.

The use of process control is expected to have a negative impact on meeting budget and schedule objectives. Thus, studies suggest that under a process control system, companies tend to err by requiring far too much from project teams. Some companies build every possible activity into the stages of the development process which results in longer development times and higher costs (Cooper, 2011). Also, the use of process control can introduce too much bureaucracy into the development process (Poskela and Martinsuo, 2009). Menon and Lukas (2004) noted that bureaucratization can slow down NPD by inhibiting the speed at which information is disseminated and utilized. Finally, the over-specification of procedures may hinder the team's ability to make needed adjustments early on in the project leading to delays and cost overruns later in the project (Bonner et al., 2002). We, therefore, hypothesize that:

H1b-c. Process control has a negative effect on (b) adherence to schedule and (c) adherence to budget.

Process control is expected to have a negative impact on job satisfaction for the following two reasons. First, the use of process control imposes strict guidelines on NPD teams regarding which activities and procedures are to be performed during the development of new products and how they should be performed, limiting team member's flexibility (Carbonell and Rodríguez, 2013). NPD teams require flexibility to react to emerging project needs and unanticipated demands and opportunities for action. A highly formalized environment (i.e., process control) curtails the flexibility expected and/or required for their job, thus increasing the likelihood that the NPD team members experience job dissatisfaction. Second, process control involves high levels of supervisory monitoring, reducing team members' levels of discretion and autonomy (Ramaswami, 1996). Team members who do not feel empowered may develop negative attitudes toward their work, which may then lead to lower job satisfaction. Therefore, we propose that:

H1d. Process control has a negative effect on job satisfaction.

Effect of process-based rewards on NPD performance outcomes and job satisfaction

A process reward system reflects an internal process that compensates project members for finishing specified procedures and activities that are crucial to achieving the NPD project's goals (Li et al., 2010). In this respect, process-based rewards are defined as contingent rewards because they are administered to NPD teams based on the extent to which the NPD teams adhere and follow desirable behaviors rather than on the basis of some other non-contingent rule (e.g., need, equality, seniority, etc.). Research in organizational justice has shown that the use of contingent rewards is positively related to employee perceptions of workplace justice. Contingent rewards increase employees' perceptions that the outcomes they receive are fair (i.e., distributive justice) and that the procedures that determine how the outcomes are administered are fair (i.e., procedural justice) (e.g., Aime et al., 2010; Podsakoff et al., 2006,2010). This is important given that employee's perceptions of workplace fairness haven been related to higher team performance in NPD. Thus, Dayan and Colak (2008) and Akgün et al. (2010) showed a positive impact of perceptions of workplace justice on new product creativity and speed to market. Brockner and Wiesenfeld (1996) also note that the degree to which group members perceive the existence of fair procedures to assess their innovative efforts is a key factor in predicting their engagement in innovative activities. Further, Janssen (2004) found that low levels of perceived workplace justice produce higher levels of anxiety and burnout which, in turn, can reduce employee's innovative behaviors and slow down their actions. Taken together, the previous studies seem to suggest that process-based rewards, because of their contingent nature, can positively affect team members' perception of workplace fairness, leading the project team to work harder (i.e., more creatively, more efficiently and faster). Therefore, we propose that:

H2a-c. Process-based rewards have a positive effect on (a) product quality, (b) adherence to schedule and (c) adherence to budget.

Process-based rewards are expected to have a positive impact on job satisfaction. As noted above, process-based rewards, because of their contingent nature, will positively affect employee's perception of workplace fairness. In this respect, research on organizational justice suggests that employees who are perceived to be treated fairly have more positive attitudes toward their jobs and organizations (Colquitt et al., 2001). Agency theory also provides support for a positive effect of process-based rewards on job satisfaction. Thus, it has been argued that NPD teams respond to reward structures in a manner that minimizes their own risk and thus reward structures that are most effective in enhancing job satisfaction are those that present minimal risk to them (Sarin and Majahan, 2001). Under a process-based rewards system, project members receive rewards as long as specified NPD procedures and activities are completed, irrespective of the performance output achieved (Sarin and Majahan, 2001). From this point of view, it is argued that process-based rewards present minimal risk to the team because under this system the organization, rather than the team members, assumes responsibility for much of the project's performance (Li et al., 2010). A process-reward system decreases project members' pressure to achieve the expected performance and thus under this reward structure team members will feel more satisfied with their jobs.

Challagalla and Shervani (1996) found a positive association between activity-based rewards and employees' job satisfaction. Thus, we propose that:

H2d. Process-based rewards have a positive effect on job satisfaction.

Interaction effects between process control and process-based rewards

Installing both process control and process-based rewards will have positive effect on product quality. Both process control and process-based rewards are expected to have a positive effect on product quality, therefore the combination of these two forms of control becomes mutually reinforcing such that new product quality is substantially better when process control is combined with the provision of process-based rewards. Regarding adherence to budget and adherence to schedule, our view is that process-based rewards could reduce the negative influence of process control on project's timeliness and budget. Process control is expected to have a negative effect on adherence to budget and adherence to schedule, in part, because of the increased bureaucracy and decreased flexibility. Our argument here is that the provision of rewards tied to the successful completion of targeted procedures and activities would motivate project members to fight their way through the bureaucratic elements of process control and complete their work in a timely and costly manner. Thus, we propose that:

H3a-c. There is a positive interaction effect of process control and process-based rewards on (a) product quality, (b) adherence to budget and (c) adherence to schedule.

As noted earlier, process control can have a negative impact on job satisfaction due to the fact that team members experience less flexibility and autonomy in their jobs. Process-based rewards, on the other hand, increase job satisfaction by increasing team members' perceptions of workplace fairness and decreasing their exposure to risk. Based on the positive effects of process-based rewards on job satisfaction, we expect that when used together, process-based rewards would decrease the negative impact of process control on job satisfaction. Therefore, we propose that:

H3d. There is a positive interaction effect of process control and process-based rewards on job satisfaction.

Methodology

Sample and data collection

The initial sampling frame included 1403 Spanish manufacturing firms across several industries. We selected industries that exhibited high innovation rates based on R&D spending and percentage of innovative firms. In particular, we focused on those industries classified as high-tech and medium-high-tech by EUROSTAT (SIC codes 28, 35, 36 and 37) along with those with high absolute values of R&D spending according to the Spanish National Institute of Statistics (INE) (SIC codes 20-27). The sampling frame was drawn from the Duns and Bradstreet directory.

Data were collected through a web-based questionnaire sent to a senior executive in charge of the NPD activities at each company. Before collecting the data, the questionnaire was pre-tested with six managers and six academics.

Reminder e-mails and phone calls were sent to all non-respondents two weeks after the initial contact. A total of 197 complete questionnaires were received, yielding an effective response rate of 14%. Although this response rate is not as high as one might wish, it is consistent with other studies on NPD. Also of note, although extensive evidence details lower costs and faster response times for online surveys than for mail surveys (e.g. Illieva et al., 2002), web-based surveys offer no clear advantages over mail surveys in terms of response rate (Olsen, 2009).

To test for non-response bias, we tested for statistically significant differences in the responses of early and late returned surveys based on the assumption that the opinions of late respondents are representative of the opinions of non-respondents (Armstrong and Overton, 1977). Therefore, the answers of the earliest 33% and latest 33% of the respondents were compared via a *t*-test. No significant differences were found between the two groups regarding firm size and the constructs examined in this study at $p < 0.05$. Sample representativeness was also checked. The 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. Table 1 shows the sample characteristics.

Table 1 Sample characteristics.

SIC code and sectors	% of sampled firms	Number of employees	% of sampled firms	Sales volume (mill. €)	% of sampled firms
28. Chemical products	27.9	<50	20.3	<6	13.7
35, 37. Machinery and transportation equipment	28.9	51–150	25.4	6–18	20.8
36. Electrical and electronic machinery	28.9	151–250	18.8	18–30	11.2
20 to 27. Others	14.2	251–500	19.8	30–60	21.8
		>500	13.7	>60	21.3
		Non-response	2.0	Non-response	11.2
Total	197		197		197

The unit of analysis was the new product project. Respondents were asked to select a new product developed and launched within the last three years and introduced in the market for more than 12 months. To assess quality of the responses, respondents were asked to indicate their degree of knowledge about the new product and the NPD process using a seven-point Likert scale (1 = very limited, 7 = very substantial). The mean responses were 5.98 and 5.31, respectively, thus showing a high level of knowledge on the new product selected and the NPD process.

Measures

Constructs of interest in this study were measured by adapting established measures to our research context. Process control was operationalized using four items that referred to the extent to which upper management set procedures and methods, and supervised, modified, and provided feedback on the extent that the NPD team followed the established procedures (Jaworski, 1988). Process-based rewards were measured with an item asking the extent to which project members were rewarded for following laid down procedures pertaining to the NPD project. Adherence to budget, adherence to schedule and commercial success were measured with three, three and five items, respectively from Sarin and Majahan (2001), and product quality was measured with six items adapted from Garvin (1987). The team job satisfaction scale measures satisfaction with regard to recognition, responsibilities, supervision and opportunities (Hartline and Ferrell, 1996; Sarin and Majahan, 2001).

Output control was measured with three items that captured the extent to which upper management specified project's objectives, monitored and provided feedback on the extent that the team achieved such objectives (Jaworski and MacInnis, 1989). Professional control was measured with five items that asked respondents to assess the degree of interaction, feedback and evaluation among members in the NPD team (Jaworski and MacInnis, 1989). Participative decision-making was measured with five items asking the extent to which the NPD team participated in defining the project's goals and objectives, specifying the project's deadlines, selecting the team's members, determining the team's budget and the format of progress review (Bonner et al., 2002; Tatikonda and Rosenthal, 2000). Measures and descriptive statistics of all the variables are shown in Table 2.

Unidimensionality, reliability and validity

The scales used in this study possess sufficient unidimensionality, reliability and validity. Composite reliability (CR) estimates and average variance extracted (AVE) values exceeded the critical values of 0.70 and 0.50 respectively recommended by Bagozzi et al. (1991). Standardized item loadings for all constructs were greater than 0.50 and significant ($p < 0.05$). Alpha coefficients values were equal or greater than 0.84. Discriminant validity across the scales was assessed with two tests. First, we respecified the initial measurement model in a series of constrained models in which each intertrait correlation was constrained to 1. In every instance the constrained models showed a worse fit and the difference in χ^2 value between each of the constrained models and the baseline measurement model was found to be significant. Second, we applied the Fornell and Larcker (1981) test. This procedure dictates that the square root of the AVE of each construct exceeds the correlation shared between the construct and other constructs in the model in order to achieve discriminant validity. As shown in Table 3, all constructs satisfactorily pass this test, as the square root of the AVE (on the diagonal) is larger than the cross-correlations with other constructs. Prior to testing the model, scale items were averaged to create a single measure of each construct. Table 3 exhibits means, standards deviations and zero-order correlations for the model constructs.

Common method bias

Most researchers agree that common method variance (CMV) is a potentially serious biasing threat in behavioral research, especially with single informant surveys. According to Podsakoff et al. (2003), method bias can be controlled through both procedural and statistical remedies. We addressed procedural remedies by protecting respondent anonymity, reducing evaluation apprehension, improving item wording, and separating the measurement of the predictor and criterion variables. We also applied the following statistical remedies.

First, we used exploratory and confirmatory approaches to Harman's one-factor test. Evidence for common method bias exists when a single factor emerges from the exploratory factor analysis or when one general factor accounts for the majority of the covariance among the measures. Results from the exploratory approach to Harman's one-factor test showed eight factors in the unrotated factor structure with the first factor only accounting for 37.7% of the total variance explained (total variance explained = 75.9%). The confirmatory approach to Harman's test also confirmed the multi-factorial structure of the data. All measures of goodness of fit indicated a worse fit for the one-factor model than for the original measurement model.

Second, we employed Lindell and Whitney's (2001) marker variable technique. Essentially, this technique requires researchers to identify a marker variable that should be theoretically unrelated to, at least, one of the variables in the model. In our case, the extent to which the new product was commercialized jointly with other companies was designated as the marker variable since to the best of our knowledge, no theoretical arguments have been advanced to support a relationship between this variable and the type of managerial control system used by a firm. Following Lindell and Whitney (2001), the second-smallest positive correlation ($r = 0.02$) was used as a conservative estimate of CMV. Results indicated that the correlations reported in Table 3 were still significant after partialling out the influence of the marker variable. Furthermore, to minimize concerns about common method bias, we included the marker variable as an additional control variable in the estimated model and verified that our empirical findings remain unaltered. In summary, results from the above-mentioned tests suggest that common method bias did not pose a serious threat.

Table 2 Construct definition and measures.

Construct name	Construct measurement	Mean (S.D.)
Process control (α = 0.91, CR = 0.91, AVE = 0.64)	During the NPD process, upper management:	
	• Specified the processes and procedures to be used by the project members.	4.45 (1.52)
	• Supervised the extent to which the project members followed established procedures.	4.69 (1.48)
	• Modified procedures when desired results were not obtained.	4.20 (1.68)
	• Provided feedback concerning the extent to which project members followed established procedures.	4.57 (1.45)
Process rewards	During the NPD process, upper management based rewards on the extent the project members followed established procedures.	3.38 (1.64)
Product quality (α = 0.85, CR = 0.88, AVE = 0.50)	The product is more reliable than competing products available to the customer.	5.39 (1.25)
	The product's performance meets our expectations.	5.90 (0.96)
	The product's quality exceeds our expectations.	5.55 (1.36)
	The product has an excellent post-purchase service.	4.98 (1.37)
	This product is superior to competing products available to the customer.	5.52 (1.25)
	Our clients are very satisfied with this product.	5.74 (1.10)
Adherence to schedule (α = 0.90, CR = 0.88, AVE = 0.76)	The team made efficient use of its time.	4.73 (1.42)
	The team did a good job of meeting all of its schedule deadlines.	4.29 (1.63)
	The new product was launched on time.	4.38 (1.75)
Adherence to budget (α = 0.89, CR = 0.90, AVE = 0.73)	The team operated in a cost-efficient manner.	4.72 (1.46)
	The team did a good job adhering to its budget.	4.57 (1.53)
	The team's project was within the budget.	4.84 (1.42)
Job satisfaction (α = 0.91, CR = 0.91, AVE = 0.73)	Team members were satisfied with:	
	• The recognition they got for their work on the project.	4.59 (1.53)
	• The amount of responsibility given during the project.	5.04 (1.32)
	• The way the team was managed.	4.96 (1.29)
	• The opportunities given to use their knowledge and capabilities.	5.20 (1.28)
Commercial success (α = 0.94, CR = 0.91, AVE = 0.72)	The new product:	
	• Met sales expectations.	4.77 (1.46)
	• Met sales growth expectations.	4.78 (1.52)
	• Met market share expectations.	4.64 (1.53)
	• Met profit expectations.	4.73 (1.44)
	• Met return on investments expectations.	4.71 (1.46)
Output control (α = 0.84, CR = 0.91, AVE = 0.71)	During the NPD process, upper management:	
	• Established specific performance objectives for the NPD project.	5.36 (1.44)
	• Supervised the extent to which project performance goals were attained.	5.28 (1.32)
	• Provided feedback concerning the extent to which new product objectives were attained.	5.19 (1.38)
Professional control (α = 0.94, CR = 0.94, AVE = 0.77)	The work-climate during the NPD process:	
	• Encouraged cooperation among NPD team members.	5.33 (1.34)
	• Stimulated job-related discussions among NPD team members.	5.29 (1.33)
	• Fostered an environment where NPD team members respected each other's work.	5.31 (1.30)
	• Fostered an environment where most NPD team members were familiar with each other's work.	5.26 (1.25)
	• Fostered an environment where most NPD team members were familiar with each other's productivity.	5.06 (1.35)
Participation in decision-making (α = 0.86, CR = 0.86, AVE = 0.55)	During the NPD process, the team participated in:	
	• Defining the project's goals and objectives.	5.07 (1.43)
	• Specifying project's deadlines.	5.09 (1.48)
	• Selecting team members.	4.73 (1.60)
	• Determining the team's budget.	4.37 (1.56)
	Determining the format of progress review.	5.42 (1.34)

Note: Seven point Likert-type scales (1 = strongly disagree to 7 = strongly agree), α = Cronbach's alpha, CR = composite reliability, AVE = average variance extracted.

Table 3 Means, standard deviations, and zero-order correlations.

	Mean (S.D.)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Process control	4.48 (1.32)	**0.80**									
2. Process rewards	3.38 (1.64)	0.52**	**n.a.**								
3. Product quality	5.52 (0.88)	0.33**	0.08	**0.71**							
4. Adher. to schedule	4.46 (1.46)	0.18*	0.20**	0.24**	**0.87**						
5. Adher. to budget	4.69 (1.33)	0.20**	0.19*	0.31**	0.56**	**0.85**					
6. Job satisfaction	4.76 (1.30)	0.33**	0.35**	0.46**	0.53**	0.48**	**0.85**				
7. Commercial success	4.96 (1.20)	0.26**	0.18*	0.49**	0.48**	0.41**	0.45**	**0.85**			
8. Output control	5.29 (1.23)	0.64**	0.31**	0.41**	0.41**	0.35**	0.48**	0.42**	**0.84**		
9. Professional control	5.25 (1.17)	0.40**	0.12	0.47**	0.46**	0.46**	0.74**	0.46**	0.56**	**0.88**	
10. Part. decision-making	4.93 (1.17)	0.26**	0.28**	0.35**	0.33**	0.35**	0.52**	0.32**	0.42**	0.45**	**0.74**
11. Commercialization of NP with other companies	2.17 (1.20)	0.14	0.01	0.02	−0.01	−0.05	−0.04	0.15	0.07	−0.03	0.04

* Significance level: $p < 0.05$ (two-tailed test).
** Significance level: $p < 0.01$ (two-tailed test).
Note: Square root of the AVE is shown in bold on the diagonal.

Analysis and results

Model estimation

Covariance-based path analysis with maximum likelihood estimation (AMOS 20.0) was used to estimate the theoretical model. Interaction terms were included in the model to test for the interaction hypotheses. For interpretative purposes (Echambadi and Hess, 2007) process control and process-based reward were mean-centered prior to the creation of the interaction terms. Because multicollinearity is an endemic problem in models that simultaneously contain linear and interaction terms of the same variables, collinearity was examined by calculating variance inflation factors (VIF). All VIF values were below 10, indicating no severe multicollinearity problems. We checked whether parameter estimates were sensitive to the addition or deletion of the interaction terms by estimating a main-effect-only model. Because the coefficients' signs and magnitudes did not change only the final model (model with main and interaction effects) is shown.

A series of post hoc power analyses were completed using the G*POWER 3 computer software (Faul et al., 2007) to determine the *p*-values for the statistical analyses included in the study. Power values were calculated for each dependent variable in the path model. In all instances, power values for a medium effect size and Type I error (α) of 0.05 exceeded Cohen (1988) recommended criterion of 0.80. Hence, an alpha-value of 0.05 seems to be appropriate to judge the statistical significance of the analysis.

After deleting the insignificant paths, the hypothesized model showed a good fit to the data ($\chi^2 = 80.03$, df = 20, NFI = 0.90, CFI = 0.92, RMSEA = 0.08). The model explained 33%, 34%, 27%, 53% and 35% of the variance in product quality, adherence to schedule, adherence to budget, job satisfaction and commercial success.

Hypotheses testing

Data in Table 4 support H1a, H1b, H1c and H1d which, respectively predicted a positive association between process control and product quality ($\beta = 0.18$, $p < 0.01$), and negative associations between process control and adherence to schedule ($\beta = -0.28$, $p < 0.01$), adherence to budget ($\beta = -0.18$, $p < 0.05$) and job satisfaction ($\beta = -0.17$, $p < 0.01$). Contrary to our expectations, we found a negative relationship between process-based rewards and product quality ($\beta = -0.19$, $p < 0.01$); H2a is thus not supported. Results provide support for H2b which hypothesized a positive relationship between process-based rewards and adherence to schedule ($\beta = 0.12$, $p < 0.05$). The relationship between process-based rewards and adherence to budget was not significant; thus H2c is not supported. Finally, results confirm H2d which predicted a positive effect of process-based rewards on job satisfaction ($\beta = 0.19$, $p < 0.01$).

In keeping with H3a, results suggest a positive interaction effect of process control and process-based rewards on product quality ($\beta = 0.12$, $p < 0.05$). Results fail to support H3b and H3c which predicted positive interaction effects of process control and process-based rewards on both adherence to schedule and adherence to budget. Instead, the results show that process-based rewards do not significantly moderate the effect of process control on adherence to schedule. The interaction effect of process control and process-based rewards on adherence to budget is negative and significant ($\beta = -0.12$, $p < 0.05$). Finally, the results reveal an insignificant moderating effect of process-based rewards on the effect of process control on job satisfaction; H3d is thus not supported.

Floodlight analysis

The results regarding the moderating effect of process-based rewards on the relationship between process control and new product performance outcomes only establish

Table 4 Path analysis: standardized parameter estimates.

Hypothesized relationships		
Process control → Product quality	0.18**	H1a accepted
Process control → Adherence to schedule	−0.28**	H1b accepted
Process control → Adherence to budget	−0.18*	H1c accepted
Process control → Job satisfaction	−0.17**	H1d accepted
Process rewards → Product quality	−0.19**	H2a not accepted
Process rewards → Adherence to schedule	0.12*	H2b accepted
Process rewards → Adherence to budget	0.09	H2c not accepted
Process rewards → Job satisfaction	0.19**	H2d accepted
Process control × Process rewards → Product quality	0.12*	H3a accepted
Process control × rocess rewards → Adherence to schedule	−0.09	H3b not accepted
Process control × Process rewards → Adherence to budget	−0.12*	H3c not accepted
Process control × Process rewards → Job satisfaction	0.01	H3d not accepted
Control relationships		
Output control → Job satisfaction	0.21**	
Professional control → Job satisfaction	0.59**	
Participative decision making → Job satisfaction	0.10	
Output control → Product quality	0.09	
Professional control → Product quality	0.21**	
Participative decision making → Product quality	0.06	
Output control → Adherence to schedule	0.30**	
Professional control → Adherence to schedule	0.30**	
Participative decision making → Adherence to schedule	−0.01	
Output control → Adherence to budget	0.18*	
Professional control → Adherence to budget	0.22**	
Participative decision making → Adherence to budget	0.08	
Output control → Commercial success	0.13*	
Professional control → Commercial success	0.11	
Participative decision making → Commercial success	0.01	
Process control → Commercial success	−0.04	
Process rewards → Commercial success	0.03	
Job satisfaction → Product quality	0.18**	
Job satisfaction → Adherence to schedule	0.21**	
Job satisfaction → Adherence to budget	0.22**	
Product quality → Commercial success	0.28**	
Adherence to schedule → Commercial success	0.23**	
Adherence to budget → Commercial success	0.12*	
R^2 Product quality	0.33	
R^2 Adherence to schedule	0.34	
R^2 Adherence to budget	0.27	
R^2 Job satisfaction	0.53	
R^2 Commercial success	0.35	

* $p < 0.05$ (one-tailed test).
** $p < 0.01$ (one-tailed test).

that the impact of process control on new product performance outcomes depend on the level of process-based rewards. Therefore, we conducted a floodlight analysis using Johnson–Neyman's (J–N) approach (Hayes, 2013) in order to calculate the range of values of process-based rewards for which process control has an effect on new product performance outcomes different from zero. Johnson–Neyman's technique is an alternative approach to Aiken and West (1991) procedure, which derives the values along the continuum of a moderator at which the effect of *X* on *Y* transitions between statistically significant and not significant. The advantage of this approach over Aiken and West's procedure is that it does not require the investigator to arbitrarily operationalize low or high in reference to values of moderators. Whereas the Aiken and West (1991) procedure uses one particular value of the moderating variable to test the

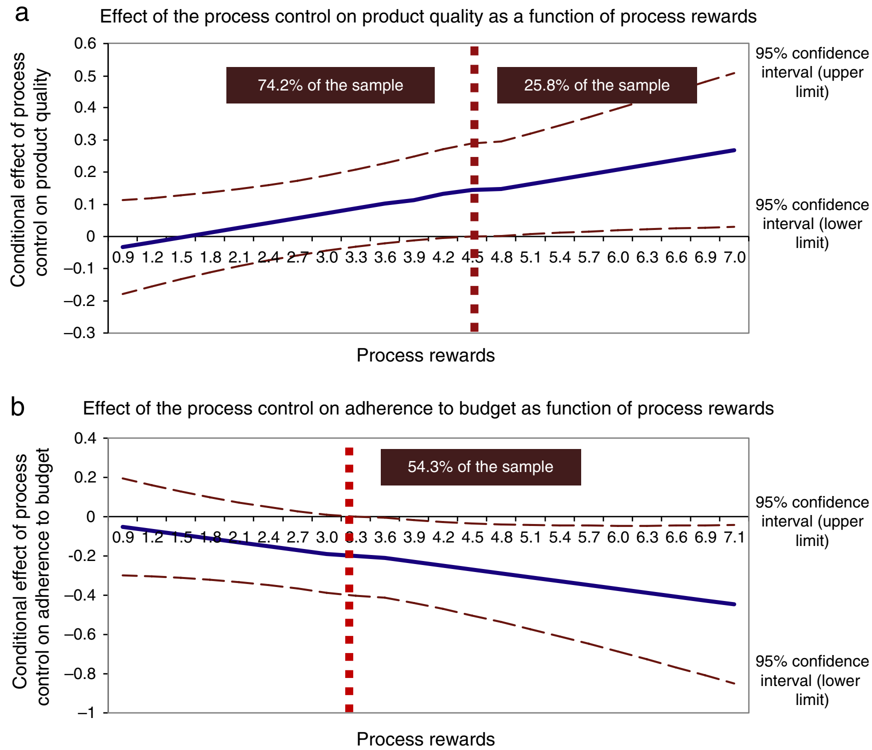

Figure 2 Floodlight analysis for probing interactions. (a) Effect of the process control on product quality as a function of process rewards. (b) Effect of the process control on adherence to budget as function of process rewards.

simple effect of X on Y, the J–N point technique uses the entire range of this variable to show where the simple effect is significant and where it is not (Spiller et al., 2013).

We applied the floodlight analysis using the PROCESS macro (Hayes, 2013). The results are shown in Fig. 2. As it can be seen in Fig. 2a, the effect of process control on product quality is positive and significant (i.e., confidence interval does not contain zero) for values of process-based rewards above 4.5. The effect of process control on adherence to budget is negative and significant for values of process-based rewards above 3.16 (Fig. 2b).

Indirect effects and control relationships

We found positive effects of job satisfaction on product quality ($\beta = 0.18$, $p < 0.01$), adherence to schedule ($\beta = 0.21$, $p < 0.01$) and adherence to budget ($\beta = 0.22$, $p < 0.01$). Product quality, adherence to schedule, and adherence to budget all had a positive effect on commercial success ($\beta = 0.28$, $p < 0.01$; $\beta = 0.23$, $p < 0.01$, $\beta = 0.12$, $p < 0.05$, respectively). Hence, the indirect effects of process control and process-based rewards on commercial success were calculated. Results show that the total indirect effect of process control on commercial success was negative and significant ($\beta = -0.06$, $p < 0.05$) with significant specific indirect effects via adherence to schedule, adherence to budget, product quality, and job satisfaction. For process-based rewards, the total indirect effect of process-based rewards on commercial success was not significant. However, specific indirect effects indicated that product quality, adherence to schedule and job satisfaction mediated the effect of process-based rewards on commercial success.

In relation to the control variables, the results show a positive relationship between output control and four of the five dependent variables in the model –adherence to schedule, adherence to budget, job satisfaction and commercial success. Professional control is positively related to product quality, adherence to schedule, adherence to budget and job satisfaction. Unlike output and professional controls, participative decision-making does not have a significant effect on any of the outcomes variables included in the model.

Alternative model

An alternative model can be useful to demonstrate the theoretical and empirical relevance of our theoretical model. With this in mind, we developed an alternative model which omitted the mediating variables of process control and process-based rewards on commercial success (i.e., product quality, adherence to schedule, adherence to budget and job satisfaction) (see Fig. 3). Results from the alternative model reveal that whereas process control has a negative and significant effect on commercial success, process-based rewards do not have a significant relationship with commercial success. Furthermore, for both variables the exclusion of the mediating variables hides the existence of specific indirect significant effects with opposite signs on commercial success. These results offer support to the notion that the existing lack of clarity regarding the effects of process control and process-based rewards on new product performance may stem from the fact that most studies to date

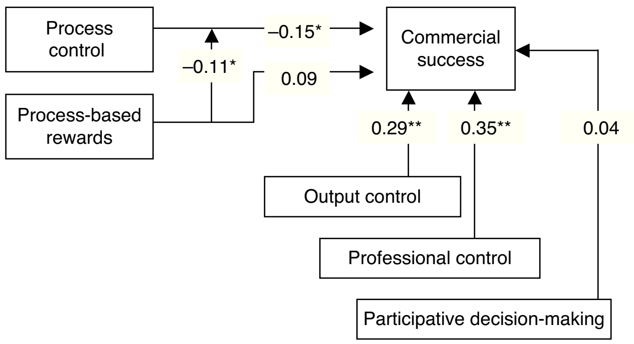

Figure 3 Alternative model.

have used general or aggregate measures of NPD performance as the outcomes under investigation and ignored the fact that process control and process-based rewards can have differential effects across different performance outcomes.

Discussion and implications

The study examined the direct and interaction effects of process control and process-based rewards on product quality, adherence to schedule, adherence to budget and job satisfaction. As noted earlier, most research on the impact of process control and process-based rewards has considered general measures of new product performance. Therefore, our findings provide a clearer and more refined picture of the impact of process control and process-based rewards on new product performance. Moreover, our results show that the simultaneous use of process control and process-based rewards leads to both synergistic and incompatible effects depending on the nature of the project outcomes.

As predicted, process control proved beneficial to new product quality and detrimental to adherence to schedule, adherence to budget and job satisfaction. The use of process control can help firms develop high quality products by facilitating the integration of the various functional perspectives impacting a development project and ensuring that important activities, processes and procedures are neither overlooked nor performed out of sequence by the NPD team (Bonner et al., 2002). However, process control can introduce too much bureaucracy into the development process. The overspecification of procedures could hinder the team's ability to make needed adjustments early on in the project leading to delays and cost overruns later in the project (Bonner et al., 2002). Also, the use of process control impairs job satisfaction by reducing team members' amount of autonomy, independence and freedom in how they execute the NDP project.

In keeping with our predictions, findings point out that process-based rewards have a positive effect on adherence to schedule. Process-based rewards, because of their contingent nature, can positively affect team members' perception of workplace fairness, leading the project team to fulfill the project task requirements effectively and in a timely manner. We, however, did not find a significant effect of process rewards on adherence to budget. It might be that team members are likely to put greater emphasis on schedule rather than cost objectives. As Cooper (2011) has argued, faster, better, cheaper is a laudable but difficult goal.

Counter to our expectations, the study's results reveal that process-based rewards are detrimental to new product quality. A plausible explanation for this effect lies within the literature on creativity which suggests that task-related rewards can undermine creativity. Thus, Woodman et al. (1993) contended that rewards contingent on performing certain tasks can have a negative impact on employees' creativity by limiting the individual's choice of task strategies or redirecting the person's attention away from the heuristic aspects of the task (Amabile, 1983). Creativity in turn has been linked to new product quality (Tu, 2010). Finally, process-based rewards have a positive relationship with job satisfaction. A process-reward system decreases project members' pressure to achieve the expected performance and thus under this reward structure team members will feel more satisfied with their jobs.

Regarding the performance effect of combining process control and process-based rewards, findings from our study reveal that, as predicted, moderate to high levels of process-based rewards strengthen the positive effect of process control on new product quality. However, and contrary to our expectations, we also found that process-based rewards accentuate the negative effect of process control on adherence to budget. A plausible explanation for these results could be that by increasing the salience of complying with process control's regulations, process-based rewards reinforce the performance effects (whether positive or negative) of process control. That is, when process-based rewards are used in conjunction with process control, team members will be more likely to adhere to process control's procedures, reinforcing then the performance effects of process control.

In relation to adherence to schedule, the moderating effect of process-based rewards was found to be insignificant which suggests that process control has a negative effect of adherence to schedule irrespective of the level or presence of process-based rewards. A plausible explanation for this result lies in the strength of the direct effect of process control on adherence to schedule. Process control, alone, has a strong negative effect on adherence to schedule which could explain why the use of process-based rewards in combination with process control does not add to or detract from the individual effect of process control on adherence to schedule. Similarly, contrary to our expectations that process-based rewards would decrease the negative impact of process control on job satisfaction, the interaction effect of process control and process-based rewards on job satisfaction was not significant.

Finally, the results reveal that although process control does not have a significant direct effect on commercial success, it has a negative overall indirect effect on commercial success. Thus, the analysis of the indirect path coefficients shows that the positive indirect effect of process control on commercial success via product quality is nullified by the negative indirect effects of process control on commercial success via adherence to budget, adherence to schedule and job satisfaction, resulting in a negative overall indirect effect of process control on commercial success. Process-based rewards were found to have specific indirect effects on commercial success via product quality, adherence to schedule and job satisfaction. However, the direct and overall indirect effects of process-rewards on commercial success are not significant.

Managerial implications

The findings of our study make three important contributions to managerial practice. First, process control and process-based rewards can have either positive or negative effects depending on the type of performance outcome considered. Thus, whereas process control is beneficial to new product quality, it is detrimental to adherence to schedule, adherence to budget and job satisfaction. Interestingly, our results suggest opposite effects for process-based rewards.

Second, recommendations about the combined use of process control and process-based rewards are also subject to the type of performance outcomes that the firm seeks. In particular, our results show that whereas combining process control with process-based rewards is desirable for product quality, it is not for adherence to budget. From a managerial perspective, this means that NPD managers should use process control and process based rewards together when the firm's goal is to develop new products with high quality.

Finally, results show that process control has an overall negative indirect effect on commercial success so companies should employ other types of managerial control systems such as output control when aiming at increasing commercial success of their new products (i.e., our findings indicate that output control has a positive effect on commercial success). Process-based rewards on the other hand, do not have a direct or indirect influence on commercial success, so firms can employ process-based rewards in isolation when seeking out to increase adherence to schedule and job satisfaction or in combination with process control when aiming at increasing product quality.

Limitations and future research

The present study has several limitations. First, caution must be exercised in drawing cause-effect inferences because of the cross-sectional research design employed. Second, the study relied on retrospective accounts of NPD projects, which can result in some distortion of the facts. Third, a single key informant provided the data in each company, thus introducing the possibility of common method bias (Ernst and Teichert, 1998). Although results from the tests realized in the methodology section suggest that this bias is not a major problem in our sample, we cannot entirely rule out this possibility. Fourth, data for the study was collected in 2009, a year after the onset of the world financial crisis of 2008. It is possible that the economic downturn facing Spain at that time limited the use of incentives and rewards for new product development teams. Finally, process-based rewards were measured using a single-item scale.

Several promising directions are suggested for future research. First, a limitation of our study is that we do not explicitly capture the effects of process control and process-based rewards on some important intervening variables such as procedural and distributive justice, team communication, team coordination and team autonomy. It is important for future studies to include these variables so we can obtain a better understanding of the primary mechanisms through which process control and process-based rewards influence new product performance outcomes. Including these variables reduces the risk of making inferential errors. Second, future research could explore the moderating effects of several project and environmental characteristics such as project risk and competitive intensity on the relationships between process control, process-based rewards and performance outcomes. Finally, the use of a more fine-grained, multi-item index of process-based rewards would improve our understanding of the effect of process-based rewards on new product performance outcomes.

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