THE INDIVIDUAL AND JOINT EFFECTS OF THE PROCESS CONTROL DIMENSIONS ON NEW PRODUCT OUTCOMES

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ABSTRACT:

There are conflicting evidence about the influence of process control on job satisfaction and new product performance. It is our contention that the failure to consistently observe expected effect of process control is, in part, because empirical research has adopted a restrictive perspective on the dimensions of process control and the measurement of outcomes. Against this backdrop, this study builds upon the literatures on new product development and management control to examine the nature of the individual and joint effects of two process control dimensions – process supervision and process rewards– on five outcomes variables – job satisfaction, adherence to budget and schedule, product quality, product novelty and market performance. The model proposed is tested on a sample of 197 new product development projects.

KEY WORDS:

Process control, supervision, rewards, job satisfaction, new product performance.

1. Theoretical framework

The purpose of management control in organizations is to influence the attitudes and behaviors of workers to achieve the organization's objectives (Ouchi, 1979; Eisenhardt, 1985; Jaworski, 1988). Particularly, in the innovation area, control is considered important because it brings discipline into the process and increases the chance that the new product will meet quality requirements and be introduced into the marketplace in a timely manner.

A fundamental issue facing managers is how to exercise adequate control over NPD activities that by their nature require some degree of flexibility, creative freedom and participative decision processes. Control mechanisms are a means to keep NPD teams on track and to avoid surprises. But too much or the wrong type of control may constrain the team's creativity, impede their progress, and injure their ultimate performance. Therefore, an interesting question becomes how different types of control impact new product performance (Bonner et al. 2002).

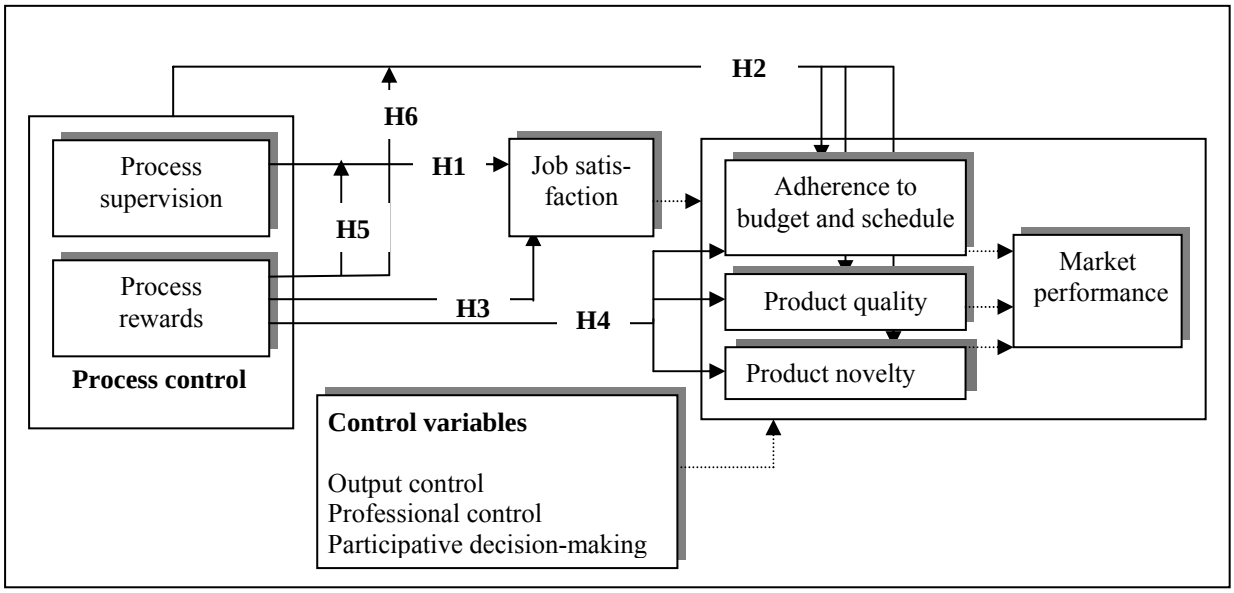
Anderson and Oliver (1987) classified control systems into outcome-based (output control) and behaviour-based (process control), which refers to the extent to which management places an emphasis on procedures and behavioural activities when monitoring, evaluating and rewarding employees. This study focuses on process control because of the conflicting evidence of the influence of process control on job satisfaction and new product performance. For example, Oliver and Anderson (1994) report that behavior control improves satisfaction, whereas Jaworski et al (1993) find no direct link between behavior control and satisfaction. Conflicting evidence also characterizes the relationship between process control and performance. Thus, whereas some authors indicate that the greater the level of process control, the more favorable the results are (e.g. Cravens et al., 1993 or Oliver and Anderson, 1994), others point that process control, by imposing rules and constraining behavior, reduces the level of creativity required for product development and, thus negatively affects performance (Amabile, 1998). Such inconsistent findings present an opportunity to further research on the effects of process control (Evans et al., 2007).

Conceptual definitions of control emphasize the importance of both supervision and reinforcements in the control process. Anderson and Oliver (1987) define a control system as setting goals, monitoring, and evaluating progress, providing feedback and reinforcing persons on the basis of their performance. In other words, control includes levels of supervision and direction (i.e. goal setting, monitoring and feedback) as well as methods of compensating employees (i.e. rewards) (Anderson and Oliver, 1987; Challagalla and Servani, 1996, Jaworski, 1988). This study examines the individual effects of the supervision and rewards dimensions of process control as well as the interaction effect between them. Despite the distinction between supervision and rewards, most empirical studies have paid attention to the impact of supervision (e.g. Bonner et al., 2002) while few studies have examined the impact of rewards (see Sarin and Mahajan, 2001 for an exception). In other words, whether rewards spur the person to expend greater effort or serve to diminish intrinsic interest in the task still remains in question. Moreover, little is known about the joint effects of the supervision and rewards dimension. Thus, the use of process rewards in combination with supervision may allow management to accentuate or diminish, respectively, the advantages and disadvantages associated with each dimension. To the best of our knowledge, this is the first effort to assess the independent and joint effects of the supervision and reward dimensions of process control in one study.

In measuring the effects of control systems Jaworski (1988) has criticized the exclusive use of market-based performance measures. A focus only on the market performance does not capture all range of consequences of process control. Thus, Churchill et al (1985) stress the need to balance performance and psychological assessments (i.e. job satisfaction). Process control could influence performance positively and job satisfaction negatively, with the consequent negative impact for long-term interest (future projects) of the firm. Against this backdrop, this study builds upon the new product development and control management literatures to examine the individual and joint effects of the process control dimensions (i.e., supervision and rewards) on job satisfaction and new product performance. New product performance is measured along four dimensions: adherence to budget and schedule, product quality, product novelty, and market performance. The model in Figure 1 includes the effect of satisfaction on new product performance and the effects of adherence to budget and

schedule, product quality, and product novelty on market performance as control relationships. Hypotheses for these relationships are not however included in this article since they have been already addressed in parallel literatures.

Figure 1
Model proposed



Although the central objective of this study rests on the two dimensions of process control, the review of prior literature indicates that other types of control have an important influence on the outcomes variables in the conceptual model. For example, output control increases job satisfaction and new product performance (Jaworski et al., 1993; Bonner et al., 2002), professional control is linking positively to a functional behavior (Jaworki and MacInnis, 1988), and participative decision making is positively related to faster completion times, lower budget overruns, and better product quality (Bonner et al., 2002). Therefore, the effects of these types of control are included in the model. Additionally, literature on organizational control has found positive correlations among the different types of control (Jaworski and MacInnis, 1988; Ouchi and Maguire, 1975; Celly and Frazier, 1996). We do consider the interrelationships among the different types of controls but do not formally hypothesize them.

2. Hypotheses development

2.1. Effect of process supervision on job satisfaction and new product performance

Process supervision has been predominantly viewed as a mechanism that fosters employee dissatisfaction (Alder and Borys, 1996). Use of process supervision imposes strict guidelines on which activities are to be performed and how they should be performed. Monitoring and correcting actions in an explicit manner is likely to reduce employee's sense of autonomy and self-control (Churchill et al., 1985; Ouchi, 1979). Employees may also feel that they are not being trusted. The debilitating effect that such feeling has on the intrinsic motivation of employees may result in lower job satisfaction. Therefore, we propose that:

H1. Process supervision is negatively related to job satisfaction.

Process control helps ensure that minimum acceptable standards of quality are met and satisfied. Specification and monitoring of a procedural framework seems beneficial for helping to integrate the various functional perspectives, and to ensure the critical tasks are neither overlooked nor performed out of sequence. Process supervision can increase the amount of discipline and care exercised during the development of new product by providing, for example, a frame of reference for selecting and

properly sequencing adequate quality control procedures (Wheelwright and Clark, 1992). Discipline and care are fundamental to making products of superior quality (Clark and Fujimoto, 1991; Kessler and Chakrabarti, 1996).

However, process control structures can lead to schedule and budget deviations and lower product novelty. The overspecification of procedures may hinder the team's ability to make needed adjustments early in the project, leading to delays and cost overruns later in the project. Bonner et al (2002) found that projects that are subjected to detailed a priori process requirements by upper managers are associated with delays and cost overruns.

Similarly, formalization through rules and procedures restricts NPD team members' ability to deal effectively with the high level of uncertainty inherent in the NPD process. As a result, the greater the formalization the less likely experimentation will occur. Also, frequent monitoring of activities may reduce the likelihood that the NPD team pursues non-routine and radical changes that involve higher probability of failure. Monitoring of behavior by frequent performance appraisals may cause NPD team members to focus their efforts on small improvement so as to demonstrate productivity for bureaucratic gatekeepers. When behavior is under close scrutiny, organizational members will feel pressure to avoid making mistakes and "play it safe" (Cardinal, 2001). Therefore, we propose:

H2. Process supervision is (a) positively to product quality and (b-c) negatively related to adherence to budget and schedule, and product novelty.

2.2. Effect of process rewards on job satisfaction and new product performance

Process-based rewards are the degree to which rewards are tied to procedures, behaviors, or other means of achieving desires outcomes, e.g. completion of certain phases in the development process. Rewards might play an important motivational role. Path-goal theory suggests that people are satisfied with supervisors who administer rewards (House and Desller, 1974). With rewards, people have a clear indication of the benefit they can expect (Podsakoff et al, 1984; Schul et al., 1990). Also, from an agency theory perspective, it has been argued that process-based rewards reduce the pressure to produce outputs, since the organization rather than the employees assumes much of the performance risk (Anderson and Oliver, 1987; Cravens et al., 1993). As Anderson and Oliver (1987) argued, when the supervisor relies on process-based rewards, employees feel committed and grateful; because the supervisor assumes risk for them and provides them a more nurturing climate.Therefore, we expect process rewards to be positively related to job satisfaction.

H3. Process rewards are positively related to job satisfaction.

Rewards can have a positive effect on new product performance by encouraging cross-functional cooperation (Kessler and Chakrabarti, 1996), improving the coordination of goal-oriented activities (Bonner et al., 2002), reducing the potential for dysfunctional behavior within work groups, and influencing positively knowledge sharing (Poskela and Martinsuo, 2009; Bartol and Srivastava, 2002). This is because employees are likely to consider cooperation, coordination and knowledge sharing as instrumental mechanisms in achieving the rewards (Bartol and Srivastava, 2002).

There is limited evidence on the impact of process-based rewards on new product performance. On one hand, it has been suggested that process-based rewards help ensure predictability in behaviors, activities and procedures deem critical to success (Cardinal, 1990). On the other hand, process-rewards have been associated with reduced risk-taking behavior (Bartol and Srivastava, 2002; Jenkins et al., 1998: Ramaswami, 1996; Simons, 1995; Snell, 1992), lower product quality and market performance (Sarin and Mahajan, 2001). Given, however, that most of the arguments support the existence of beneficial effects of rewards, we expect process rewards to be positively related to performance.

H4. Process rewards are positively related (a) to adherence to budget and schedule and (b) to product quality, (c) product novelty.

2.3. Interaction effects between process supervision and process rewards

Though discussion to this point examines each dimension of process control separately, a combination of these dimensions is likely to be in use at the same time. The interrelation between dimensions has been recognized for some time (Oliver and Anderson, 1994), but very little empirical work has been done. However, examining a single dimension in isolation may distort the "true" magnitude of its effect.

As we have already said, process rewards are used to attain optimal levels of employee motivation and productivity as well as to promote employee compliance with behavioral norms that are desirable from the perspective of the organization. Although rewards motivate team performance, it is contended that motivation alone may be insufficient to produce the desired outcomes. It is necessary to align procedures and rewards to enhance the effect on the outcomes. As pointed out by Tyagi (1990), overreliance on compensation may prove to be expensive, and worse yet, less effective than a balanced approach that takes into account the other dimension of control. In a similar vein, it is unclear if simple process supervision is sufficient to focus the employees' attention on the task. For example, if a product manager specifies, determines and supervises the procedures, but fails to tightly link rewards, it is less probable that the process supervision may motivate the team (Challagalla and Shervani, 1996). Consequently, we propose:

H5. There is an interaction positive effect of process supervision and process rewards on job satisfaction.

H6. There is an interaction positive effect of process supervision and process rewards on (a) adherence to budget and schedule, (b) product quality, and (c) product novelty.

3. Methodology

3.1. Sample and data collection

The data used in this research were gathered using a cross-sectional survey methodology. The initial sampling frame included 1403 innovative Spanish firms operating in different sectors: consumer products, chemical products, machinery and transport devices and electric and electronic machinery. Data were collected through a web-based questionnaire sent to a key informant. A total of 197 complete questionnaires were received, yielding an effective response rate of 14.04%. Although this response rate is not as high as one might wish, it is consistent with other studies on new product development. To test for nonresponse bias, early (first quartile) with late (fourth quartile) respondents were compared as suggested by Armstrong and Overton (1977). No significant differences were found in firm size and in the constructs examined in this study at $p<0.05$.

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 ensure that they had sufficient data on the product performance. 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 knowledge level on the new product selected. Respondents were offered a free summary of the most relevant findings of the study for their response.

We employed three procedures to empirically examine the possibility that common method bias could threaten the interpretation of our results: the Harman one-factor test, the confirmatory factor-analytic approach to Harman one-factor test and the Lindell and Whitney's (2001) technique. Results from these tests suggest that common method bias is not a serious threat.

3.2. Measures

A pool of items was generated for measuring each of the constructs using literature and interviews with practitioners. Process supervision 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 the NPD team followed the established procedures (Jaworski and MacInnis, 1989, Bonner et al., 2002). Process rewards were measured with an item relative to the degree of process-based rewards established by upper management. The team's job satisfaction scale measured satisfaction with regard to recognition, responsibilities, supervision and opportunities (Sarin and Mahajan, 2001). Adherence to budget and schedule, and market performance were measured with six and five items, respectively from Sarin and Mahajan (2001). Product quality was measured using eight items adapted from Garvin (1987) and product novelty with four items borrowed from Sarin and Mahajan (2001).

As we said before, output control, professional control and participative decision-making were included as control variables because of prior work suggesting a relationship between these variables and adherence to budget and schedule, product quality and new product performance. Output control was measured with four items that captured the extent to which upper management specified, monitored, provided feedback and based rewards on the extent the team achieved project objectives (Jaworski and MacInnis, 1989). Professional control measured the degree of interaction, feedback and evaluation among members in the NPD team (Jaworski and MacInnis, 1989). Decision-making participation was measured with five items that reflected 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 variables are shown in Table 1. The psychometrics properties of the scales were analyzed using widely accepted procedures (Fornell and Larcker, 1981; Anderson and Gerbing, 1988; Bagozzi and Yi, 1988). Overall, tests results suggest that the reflective scales used in this study possess sufficient unidimensionality, reliability and validity.

Table 1

Construct definition and measures

Construct name	Construct measurement	Mean (S.D.)
Process supervision (α=.91, CR=.91, AVE=.64)	During the NPD process, upper management:	
	• Specified the processes and procedures to be used by the team.	4.45 (1.52)
	• Supervised the extent to which team 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 team followed established procedures.	4.57 (1.45)
Process rewards	During the NPD process, upper management based rewards on the extent the NPD team followed established procedures	3.38 (1.64)
Job satisfaction (α=.91, CR=.91, AVE=.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)
Adherence to budget and schedule (α=.89, CR=.86, AVE=.54)	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)
	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)
Product quality (α=.88, CR=.87, AVE=.48)	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)
	This product delivers benefits to the customers that are not currently available	5.26 (1.32)
	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)
	This product offers an important competitive advantage.	5.46 (1.24)
Product novelty (α=.88, CR=.89, AVE=.66)	The product includes improvements on existing technology.	4.73 (1.67)
	It is based on a revolutionary change in technology.	3.58 (1.81)
	Represents a radical improvement over existing products.	4.34 (1.80)
	It is very new compared to the industry average.	4.60 (1.55)

Market performance (α=.94, CR=.91, AVE=.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=.84, CR=.91, AVE=.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)
	• Rewarded team based on goal attainment.	3.94 (1.74)
Professional control (α=.94, CR=.94, AVE=.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=86, CR=.86, AVE=.55)	During the NPD process, the team participated in (played an important role in):	
	• Defining the project's goals and objectives	5.07 (1.43)
	• Specifying project's deadlines	5.09 (1.48)
	• Selecting team member's	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.

3.3. Preliminary results

Preliminary analyses using path analysis (AMOS 7.0) indicate a negative effect of process supervision on job satisfaction and adherence to budget and schedule, and a positive effect on product quality. Process rewards are positively related to job satisfaction and negatively related to product quality. Additionally, there is a negative interaction effect of process rewards on the relationship between process supervision and adherence to budget and schedule, and two positive interaction effects of process rewards on the relationship between process supervision and product quality and process supervision and product novelty.

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