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MANAGERIAL DECISION MAKING IN PROJECT ACCELERATION: THE ROLE OF PRODUCT INNOVATIVENESS AND ACCELERATION GOALS IN ACCELERATION STRATEGY CHOICE

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ABSTRACT

There is increasing recognition among new product development (NPD) scholars that not all drivers of faster product development are equally impactful under different conditions and that a universal approach to accelerating NPD is not very useful. This study investigates how project innovativeness, a major source of uncertainty in NPD, influences acceleration strategy choice, while also taking into account the extent of acceleration that is being sought to achieve. In the light of extant work on acceleration strategies, we distinguish between two alternative theoretical models (*compression strategy*, which involves the use of practices such as supplier involvement, computer-aided design (CAD) and overlapping steps; and *experiential strategy*, which resides on the implementation of multiple design iteration and testing cycles, frequent project milestones and a powerful project leader) with which to accelerate product development. We follow a 2x2 experimental design based on a hypothetical decision task in which participants are projected into the role of a product development manager embarking on a new project, and conduct two sets of Analysis of Covariance (ANCOVA) on data obtained from 88 NPD practitioners. The results offer support for our hypothesis that incremental NPD projects would utilise compression to a greater extent than highly innovative projects. As expected, the acceleration strategy of choice for highly innovative projects is the experiential strategy. We find that incremental and highly innovative projects respond differently to the hike in uncertainty due to an ambitious time reduction objective. Specifically, incremental projects merely increase their reliance on their default strategy of compression, highly innovative projects make complementary use of both experiential and compression strategies.

INTRODUCTION

There is increasing recognition among NPD scholars that not all drivers are equally impactful under different conditions and that a universal approach to understanding the drivers of speed may not be very useful (e.g., Eisenhardt and Tabrizi, 1995, Primo and Amundson, 2002, Song and Parry, 1999, Swink, 1999, Tatikonda and Montoya-Weiss, 2001, Terwiesch and Loch, 1999). One of the contingency factors to have received a lot of attention is uncertainty which, in the context of NPD, refers to the lack of knowledge about the precise means to execute the project (Tatikonda and Montoya-Weiss, 2001). This study investigates how project innovativeness, a major source of uncertainty in NPD, influences acceleration strategy choice, while also taking into account the extent of acceleration that is being sought to achieve. Its conceptual foundations reside on the work by Eisenhardt and Tabrizi (1995), who distinguish between two alternative theoretical models (i.e., *compression* and *experiential* strategies) with which to accelerate product development. Due to the differences in their underlying assumptions regarding the development process, these strategies are proposed to be suited for different levels of uncertainty (*compression* – low uncertainty; *experiential* – high uncertainty). However, this study departs from the work by Eisenhardt and Tabrizi (1995) and the later research that builds on the compression/experiential distinction in several respects, thereby contributing to NPD cycle time literature.

First, Eisenhardt and Tabrizi (1995) focus on the uncertainty arising from technological and market turbulence, and consider the extent to which projects are insulated from changing technologies and cater to stable and mature markets. The same holds for most of the later work involving compression and experiential constructs such as Sherman et al. (2000), Tatikonda and Montoya-Weiss (2001) and Rauniar et al. (2008). However, uncertainty in NPD is not attributable solely to degree of change in the industry or environment level. One of the major sources of uncertainty in NPD projects is product innovativeness, which relates to the new product's level of similarity with those already developed and marketed by the firm (Atuahene-Gima, 1995). Greater product innovativeness is accompanied by lower levels of relevant knowledge and experience, which, given the close link between uncertainty and the amount of information available for decision making (Chen et al., 2012), leads to greater uncertainty experienced by the development team (Sethi, 2000). Product innovativeness influences many aspects of the development process, such as the emphasis given to certain development tasks (Song and Montoya-Weiss, 1998) and the execution challenges experienced by team members (Tatikonda and Rosenthal, 2000). Surprisingly, whether it also influences acceleration strategy decisions has not yet been addressed.

Second, this study acknowledges the possibility that there may be multiple sources of uncertainty that influences acceleration strategy choice, and presents cycle time reduction objective as a source of uncertainty in addition to product innovativeness. Although it has been a decade since acceleration goal was suggested as a source of uncertainty in NPD (Swink, 2003), it has been largely ignored by later work. This is an important gap in literature because more often than not, acceleration tools and strategies are implemented with a specific time goal in mind. Furthermore, performance goals are highly influential on the choice of project design (Cardinal et al., 2011). In this study we examine how the magnitude of the desired time reduction influences the extent to which the compression and experiential strategies are utilised

Third, this study offers a descriptive, rather than prescriptive, account of how product innovativeness influences acceleration strategy choice and how project acceleration goals modify this relationship. Previous work involving compression and acceleration strategies (or their constituent acceleration tools) has concentrated on their performance implications (e.g., Carbonell and Rodriguez, 2006, Filippini et al., 2004, Parry et al., 2009, Sarin and McDermott, 2003). While establishing the effectiveness of acceleration strategies is crucial for offering prescriptive insight to practitioners to improve their NPD processes, establishing a thorough understanding the factors that shape practitioners' decisions to adopt them is equally important. Addressing the antecedents of acceleration strategy decisions in conjunction with the performance implications of these decisions will not only help create a more complete understanding of the phenomenon in question, but also allow scholars to formulate their recommendations such that they are better aligned with the realities of NPD practice (see Ketokivi and Schroeder, 2004 for a similar stance on total quality management (TQM)).

This article is organised as follows. First we introduce the conceptual background of the study and present our hypotheses. In the succeeding section we describe our data collection approach and variable operationalizations. We follow with a description of the analytical procedure and the presentation of our results. The paper closes with a discussion of findings, limitations and possible future research suggestions.

CONCEPTUAL BACKGROUND

Compression and experiential models of project acceleration

Eisenhardt and Tabrizi (1995) distinguish between two broad strategies with which the product development process can be accelerated: compression and experiential. The former operates on the principle of “rationalizing the steps of the product development process and then squeezing or compressing them together” (p.88). The latter involves “rapidly building intuition and flexible options so as to cope with an unclear and changing environment” (p.88). These strategies rest on different assumptions concerning the nature of NPD. The compression strategy is consistent with the conventional notion of NPD as “a predictable series of steps that can be compressed” (p.87), while the experiential strategy views it as “a very uncertain path through foggy and shifting markets and technologies” (p.88). According to Eisenhardt and Tabrizi (1995), while both strategies can promote faster product development, the differences in their underlying assumptions suggest that they are suited for different NPD contexts. The compression strategy assumes a familiar, rational process and is appropriate when technologies and markets are stable (i.e., low uncertainty). The experiential strategy, with its assumption of an unpredictable and intractable NPD process, the experiential strategy is better suited for turbulent technologies and markets (i.e., high uncertainty).

The sound theoretical foundations and intuitive appeal of the compression and experiential models of acceleration notwithstanding, the empirical evidence for their time performance implications are, at best, mixed. Indeed, Eisenhardt and Tabrizi (1995) themselves find only partial support for the two models, and the literature is particularly inconclusive regarding the influence of practices such as supplier involvement (e.g., Ittner and Larcker, 1997, Langerak and Hultink, 2005, Primo and Amundson, 2002) and CAD use (e.g., Dröge et al., 2000, Kessler and Chakrabarti, 1999, Swink, 2003). Even less is known about whether or not managers explicitly take uncertainty into account when deciding to implement these acceleration tools.

Product innovativeness and cycle time reduction objective as sources of uncertainty in NPD

Uncertainty refers to the perceived inability to predict accurately the consequences of an action or decision (Milliken, 1987) due to a gap between the amount of information required to make the decision or perform the action and the amount of information already possessed (Galbraith, 1973).

In the context of NPD projects, uncertainty manifests itself as the lack of knowledge about the precise means to execute the project (Tatikonda and Montoya-Weiss, 2001). In this study we propose two sources of uncertainty to shape practitioners' decisions to implement the compression and acceleration strategies: product innovativeness and cycle time reduction objective.

Project innovativeness

Project innovativeness refers to the degree of newness from the developing firm's and/or customers' perspective (Garcia and Calantone, 2002). In this study we adopt the firm's perspective of innovativeness and distinguish between incremental and new-to-the-firm projects (Danneels and Kleinschmidt, 2001). New-to-the-firm projects involve new technological approaches and types of marketing activities, and targets a market to which the developing firm is unfamiliar Danneels and Kleinschmidt (2001). Incremental projects, on the other hand, entail "the adaptation, refinement and enhancement of existing products and/or product delivery systems" (Song and Montoya-Weiss, 1998, p.126). Greater project innovativeness is accompanied by lower levels of relevant knowledge and experience, which, given the close link between uncertainty and the amount of information available for decision making (Chen, Reilly and Lynn, 2012), leads to greater uncertainty experienced by the development team (Sethi, 2000). Relative to incremental projects, highly innovative projects carry a greater degree of technological uncertainty, and technical and business inexperience (Green et al., 1995) because they require the use of substantially different technologies and marketing skills compared to the firm's existing products, introducing the need to develop and apply new technological knowledge and understand new markets. Their financial outcomes are also more difficult to predict (Schmidt et al., 2009). Since incremental projects do not require new technological and marketing skills since they involve only minor improvements to the existing technology (Garcia and Calantone, 2002), the tasks are comparatively simple and routine, and decision outcomes are more easily predicted in the light of existing knowledge and expertise. Team members are equipped with greater decision making capacity, which decreases the level of uncertainty they experience during the course of the project (Chen, Reilly and Lynn, 2012).

Cycle time reduction objective

Performance goals have an important influence on the choice of project design (Cardinal, Turner, Fern and Burton, 2011). Highly salient in the context of accelerated NPD is cycle time reduction objective, as reflected in the extent of time reduction sought. According to Sheremata (2002), large reductions in cycle time remove a source of resource slack and lead to time pressure. Because the need to execute projects faster leaves little time to predict the outcomes of decisions and actions, aggressive time goals exacerbate the level of uncertainty experienced by the development team (Swink, 2003). NPD literature has yet to investigate the influence of time pressure on acceleration strategy choice. However, extant work in psychology and behavioral science show that one of the ways in which individuals respond to time pressure is by changing their decision strategies (e.g., Payne et al., 1996, Svenson et al., 1990), typically in favour of simpler ones (Ben Zur and Breznitz, 1981) and those aimed at routine maintenance (Betsch et al., 1998). This is because deadlines limit how much information can be processed in a given time and make some normative strategies impossible implement (Keinan, 1987).

RESEARCH HYPOTHESES

Our research framework builds on the research outlined in the preceding section and offers product innovativeness and cycle time reduction objective as two distinct sources of uncertainty that drive practitioners' decisions to implement the compression and experiential strategies to speed up development. In this framework product innovativeness is the primary source of uncertainty because it is determined at the very outset of a development project and is a reflection of strategy (Griffin, 1997). Since product innovativeness is ascertained so early on in the project follows that any attempt to speed up development should first be aligned with the level of innovativeness. Therefore, the "default" acceleration strategy (i.e., the acceleration that would be implemented in the absence of other constraints such as an ambitious cycle time reduction objective) will be dictated by product innovativeness. We posit cycle time reduction objective (the secondary source of uncertainty in this framework) to have an indirect effect on acceleration strategy choice by *amplifying* the uncertainty arising from increased project content (i.e., product innovativeness). Because incremental and new-to-the-firm projects are characterised by different levels of uncertainty, variations in the amount of time reduction sought is expected to affect acceleration strategy choice differently across the two types of projects. Conceptualising radical product innovation under time pressure as "an ongoing process of crisis resolution" (p.393), Sheremata (2002) highlights that developing radical products under time pressure introduces new challenges to goal attainment and demands new project organization approaches for solving these problems. Because incremental product development does not suffer from these new challenges, we expect time reduction objective to compel managers to deviate from the default acceleration strategy only when the product being developed is highly innovative.

The role of product innovativeness on the implementation likelihood of compression and experiential strategies

When project innovativeness is low, NPD follows a predictable path so practitioners should seek to increase development speed mainly through compression because this strategy is better aligned with the character and demands of this kind of NPD context. For example, overlapping stages and/or activities better serves accelerating incremental NPD (Cordero, 1991, Eisenhardt and Tabrizi, 1995, Griffin, 1997, Loch and Terwiesch, 1998). This is because overlapping introduces additional informational requirements to the development project (Ahmad et al., 2013). When running tasks in parallel, teams often need to act without knowledge of previous steps (Chen et al., 2005) or rely on assumptions or preliminary data rather than concrete outcomes (Browning and Eppinger, 2002). Because incremental product development uses familiar product and/or process technologies and caters to familiar markets, acting in the absence of concrete outcome knowledge carries little risk.

When project innovativeness is high, the absence of relevant expertise and information concerning technologies and markets should prompt practitioners to follow an experiential strategy. Since these development contexts do not fit the traditional, linear pattern, they necessitate teams to improvise in real time, drawing on their own learning and experience (Clift and Vandenbosch, 1999) and to learn iteratively from the market and technology development (Song and Montoya-Weiss, 1998). For these reasons, we expect new-to-the-firm projects to make greater use of experiential approaches such as more iteration and testing, and greater frequency of milestones.

The development of new-to-the-firm products require more experimentation (Kessler and Chakrabarti, 1999), as well as probing and learning (Lynn et al., 1996). As vehicles for experimentation, iteration and testing are crucial for projects that use unfamiliar technologies because the lack of existing knowledge may lead to feasibility issues if designs are frozen prematurely (Chen, Reilly and Lynn, 2005). The need for iteration and testing is lower for incremental products since they involve familiar product technologies and markets teams can readily draw on previous insights. High levels of uncertainty is accompanied by high levels of risk, so it follows that developing new-to-the-firm products also require more extensive risk control. Milestones offer teams a methodological way of keeping track of a project by effectively breaking it into smaller, analyzable goals and components (Lewis et al., 2002). Given that introducing review point throughout the development process is a practice which organizations use for managing and controlling risk (Schmidt, Sarangee and Montoya, 2009), we expect more uncertain projects should make more extensive use of them. Together, the above lines of reasoning lead to the following hypotheses.

H1a Incremental projects use the compression strategy to a greater extent to accelerate product development than new-to-the-firm projects.

H1b New-to-the-firm projects use the experiential strategy to a greater extent to accelerate product development than incremental projects.

The role of cycle time reduction objective on the implementation likelihood of compression and experiential strategies

Hwang (1994) suggests that time pressure affects strategy selection not directly but by amplifying task difficulty. Given the greater task difficulty inherent in highly innovative NPD projects (ref), we posit that the influence of cycle time reduction objectives on acceleration strategy choice is contingent upon product innovativeness and is evident only in the case of highly innovative (i.e., high uncertainty) projects.

An ambitious cycle time reduction objective imposed on an incremental NPD project does not have a notable effect on task difficulty because these projects are characterised by low levels of task difficulty to begin with. Furthermore, as incremental new products typically require shorter development times (Adler et al., 1995, Griffin, 2002), increases in the desired level of acceleration does not lead to a misalignment between innovativeness and time performance objectives. The absence of misalignment, coupled with the predictable and routine nature of incremental projects, allows marked reductions in development times to be achieved by simply making greater use of the default strategy of compression. Furthermore, since these projects involve familiar technologies and markets, teams have more opportunity to also draw on previous insights and successes (Millson et al., 1992), eliminating the need engage in experiential activities. Therefore,

H2a Incremental projects use the compression strategy to a greater extent to accelerate product development when the cycle time reduction objective is ambitious than when the cycle time reduction objective is modest.

H2b Incremental projects use the experiential strategy in the same extent to accelerate product development regardless of whether the cycle time reduction objective is ambitious or modest.

The development of highly innovative products entails high levels of task difficulty, which is exacerbated with the introduction of an ambitious cycle time reduction objective. In addition, developing a highly innovative product and doing so in a short amount of time represent conflicting objectives which, according to Ethiraj and Levinthal (2009), can create significant managerial challenges. We posit that, in order to meet these challenges, managers reduce their use of the default acceleration strategy (i.e. experiential) and increase their use of the compression strategy.

Highly innovative projects rely heavily on probing and learning (Lynn, Morone and Paulson, 1996), which, under normal circumstances, can be achieved by an experiential approach. However, experiential tools such as iteration and testing require a certain level of slack time, which is not available when cycle times need to be reduced drastically (Sheremata, 2002, Swink, 2003). This imposes a cap on the extent to which experiential methods can be used, resulting in the experiential strategy being used to a lesser extent when development times need to be reduced by a significant amount.

In addition to reducing their reliance on the experiential strategy, we expect that practitioners involved in new-to-the-firm NPD projects increase their use of the compression strategy. First, elements of the compression strategy can help to *reduce* uncertainty experienced by the development team in contexts of high innovativeness and acceleration by providing a certain degree of structure and order to the project. One way in which this can be achieved is by having clear goals (Lynn et al., 1999), which is closely linked to planning, a compression approach. By extending this phase in which initial technology explorations are carried out, managers can ensure that the development team has a better understanding of the new technology and reduce the degree of uncertainty experienced by team members. Greater attention to planning should lead to clearer project priorities, which helps alleviate the uncertainty related to working with unfamiliar technologies and markets (McNally et al., 2010). Indeed, based on their finding that process technology novelty has a strong negative influence on time to market, Tatikonda and Montoya-Weiss (2001)recommend that managers try to reduce the level of novelty, offering the extension of the planning phase as a means to do so.

Second, activities typically associated with the compression strategy can help *deal with* uncertainty in contexts of high innovativeness and acceleration. The inability to engage more in experiential activities compels practitioners to increase their use of the compression strategy to deal with the high level of uncertainty in the development context. For instance, when extensive testing and iteration are not an option due to a demanding time goal, tools such as CAD can be a substitute. (Johnson, 2009) draws attention to how developments in advanced design tools such as CAD allow for many aspects of the development process to be assessed virtually and shows that these systems offer a more efficient means of risk assessment than prototyping and testing. Involving suppliers in the development process can also help compensate for the lack of time available for iteration and testing. By integrating suppliers into the development process, development teams can leverage their expertise and access more and better information (Petersen et al., 2005). They can therefore access to an external source of ideas and solutions with which they can facilitate the problem solving process (Eisenhardt and Tabrizi, 1995). These lines of reasoning lead us to the following hypotheses:

H2c New-to-the-firm projects use the compression strategy to a greater extent to accelerate product development when the cycle time reduction objective is ambitious than when the cycle time reduction objective is modest.

H2d New-to-the-firm projects use the experiential strategy to a smaller extent to accelerate product development when the cycle time reduction objective is ambitious than when the cycle time reduction objective is modest.

METHODOLOGY

Since this study aims to understand practitioners' choice of acceleration strategy, we chose to follow an experimental design. The use of scenario-based decision experiments is fairly rare in NPD research, particularly when NPD practitioners are the target respondents. This is hardly surprising, given the logistic issues around recruiting geographically dispersed people to participate in a laboratory setting. Practical difficulties notwithstanding, an experimental design is the best option when studying behavioural issues (Mantel et al., 2006). Data were collected using a scenario-based decision experiment with a 2 (innovativeness: high/low) x 2 (cycle time reduction objective : low/high) between-subjects design. The variables were manipulated using a complete block design, resulting in 4 conditions. All remaining scenario elements, such as company description and the role into which the respondent was projected, were the same across the conditions. The experiment was administered in pen-and-paper format under the guise of a research project in managerial decision making.

Respondents

The participants in this study were 88 NPD practitioners who, at the time of data collection, were involved in projects that received funding from an organisation that provides financial support for NPD projects in small to medium sized enterprises in a European country. With the help of a contact person from the organisation, we approached the respondents before their third quarterly progress meeting and asked for their cooperation in return for a report of major study findings. The participants and have sufficient NPD experience for the decision task. More than half of the participants were project managers, and the average length of NPD experience was 8 years (minimum 1 year, maximum 18 years). Engineering was the most represented functional background, followed by marketing, finance and administration.

Decision task

Participants were presented with a hypothetical NPD scenario which put them in the position of a Product Development Manager about to embark on a new project involving the development of a medicine dispenser. This product category was chosen because the participants would be less likely to have experience in the category. Participants were informed of a new, company-wide project acceleration programme that required projects be completed faster than in the past. They were then given descriptions of the ten acceleration tools (presented as “Courses of action” without any reference to acceleration) identified by Eisenhardt and Tabrizi (1995) and asked, based on the scenario, to evaluate their possible impact on product development speed and indicate how likely they would be to implement them. The acceleration tools were presented one by one, and participants were instructed to consider them independently of the other ones. They were assigned randomly to one of the four conditions. The data collection instrument also included questions on the perceived complexity of the development project, respondent characteristics such as length of NPD experience and functional background, and manipulation check questions for the independent variables (product innovativeness and cycle time reduction objective). The material was pretested with 17 graduate students in industrial design engineering. Modifications were made in the instructions and questions based on their feedback.

Independent variables

Manipulation of product innovativeness (INN). In the low innovativeness condition the new product was described as one that "offered a minor improvement over the company's existing product and that could, with some small modifications, be manufactured with the existing manufacturing process" (i.e., an incremental new product). In contrast, the new product in the high innovativeness condition was framed as one that "offered a significant improvement over existing products in the market due to its unique feature, and required extensive changes to the company's manufacturing process" (i.e., a new-to-the-firm product).

Manipulation of cycle time reduction objective (CTO). Participants in the low acceleration condition were told that they needed to "reduce cycle time by at least 10% compared to a similar project completed previously". The cycle time reduction objective in the high acceleration condition was 40%. In both conditions participants were given the aimed development time in absolute terms also (9 months for low acceleration aim and 6 months for high cycle time reduction objective).

Dependent variables

We used two dependent variables in this study: (1) implementation likelihood of the compression strategy and (2) implementation likelihood of the experiential strategy. To measure these variables we presented respondents with a brief description of ten acceleration tools. Consistent with the original work by Eisenhardt and Tabrizi (1995), six of these tools belonged to the compression strategy and four belonged to the experiential strategy. We took care to make the descriptions as close as possible to the way they were operationalized by Eisenhardt and Tabrizi (1995). The precise wording of the acceleration approaches are shown in Table 1. Following Mantel, Tatikonda and Liao (2006), we asked participants to report how likely they would be to implement each of the ten acceleration tools given the situation described in the scenario. To simplify the process participants were given an 11-point scale from 0% (definitely will not implement) to 100% (definitely will implement), with increments of 10%, with an even chance at 50%) (see Schmidt and Calantone, 2002 for a similar measure).

Since this study is interested in the broader acceleration strategies rather than their constituent acceleration tools it was necessary to arrive at indicators for the intention to implement the compression and experiential strategies. The operational definitions of the acceleration strategies discussed in the preceding sections are such that they can be best measured with a formative, rather than a reflective, approach. This is because each strategy encompasses a set of different acceleration tools which are not necessarily correlated (see Table 2 for correlations). Although the acceleration tools under a given strategy operate on the same basic assumption concerning the nature of product development, each one represents a distinct, actionable attribute of its corresponding strategy and is not interchangeable with another (see Diamantopoulos and Winklhofer, 2001 for a thorough discussion on the circumstances in which formative measurement is appropriate). To arrive at the indices for the intention to implement the compression and experiential strategies we followed (Claver-Cortes et al., 2012) and first carried out a Partial Least Squares (PLS) analysis using the procedure recommended by Chin and Newsted (1999). Using the outer path weights obtained from PLS as weights, we computed the two strategy indices as the weighted sum of the stated intentions to implement their constituent acceleration tools.

<<< Tables 1 and 2 about here >>>

Covariates

We included product complexity as a covariate due to its well-documented association with innovativeness complex (Clark and Fujimoto, 1991, Griffin, 2002, Langerak et al., 2008), development time time (Griffin, 1997, Griffin, 2002) and new product performance (Ahmad, Mallick and Schroeder, 2013). We measured complexity using a single item that asked respondents to evaluate the complexity of the project described in the scenario on a 7-point Likert scale where 1=”Not at all complex”; 7=Very complex”. By doing so, we heed the advice of Bergkvist and Rossiter (2007), who demonstrate single-item and multiple-item constructs to be equal in predictive validity, and argue for greater use of single-item measures. We use two covariates to account for differences in the respondents’ professional characteristics: NPD experience and professional background. Respondents’ NPD experience was measured by the number of years they had been involved in NPD. Respondent’s functional background (marketing, engineering, finance or administration) was assessed with three dichotomous variables (marketing, engineering and finance).

Manipulation checks

The two product innovativeness measures, technological and market, were adapted from Lynn and Akgün (1998): (1) the extent to which the new product incorporated a different technology compared to the company's existing offerings (1 = "not at all different"; 4 = "somewhat different"; 7 = "very different"), (2) the extent to which the market targeted by the product can be considered as new to the company (1= "not at all new"; 4 = "somewhat new"; 7 = "very new"). For the manipulation checks we used a two-way analysis of variance (ANOVA) with independent measures on both variables (innovativeness and cycle time reduction objective), as well as their interaction. Results indicated that participants rated the product in the high innovativeness condition to incorporate a significantly different technology ($M_{HighInn}$=5.25, M_{LowInn}=2.68; $F(1,88)=72.81$, $p<0.001$) and aim a significantly new target market ($M_{HighInn}$= 3.84, M_{LowInn}= 2.84; $F(1,88)=9.53$, $p<0.005$) than the product in the low innovativeness condition. Participants' evaluation of the cycle time reduction objective presented in the scenario was assessed using two items: (1) 1= "negligible"; 4 = "moderate"; 7 = "extreme", (2) 1= "not at all ambitious"; 4 = "somewhat ambitious"; 7 = "very ambitious". Two-way ANOVA results revealed that participants in the high acceleration condition viewed the cycle time reduction objective as significantly greater in magnitude (M_{LowAcc}= 3.66, $M_{HighAcc}$=5.50; F(1,88)=61.05, $p<0.001$) and more ambitious (M_{LowAcc}=3.57, $M_{HighAcc}$=5.48; F(1,88)=60.98, $p<0.001$) than those in the low acceleration condition. Together, the results suggest that the manipulations were successful.

ANALYSIS AND RESULTS

We tested our hypotheses using a combination of two-way analysis of covariance (ANCOVA) and planned contrast tests (PCT). The ANCOVA models examined product innovativeness (*INN*) and cycle time reduction objective (*CTO*) as fixed factors, and product complexity, respondents' NPD experience (in years) and respondents' functional background as covariates. Dependent variables were: (1)

implementation likelihood of the compression strategy and (2) implementation likelihood of the experiential strategy. Table 3 shows the cell means and standard deviations for the dependent variables.

<<< Table 3 about here >>>

Hypothesis1a, which posited that low product innovativeness would lead to the more extensive use of the compression strategy, was tested via a two-way ANCOVA, with the Compression Strategy index as the dependent variable (see Table 4 for results). The analysis produced a significant main effect of product innovativeness, with respondents in the incremental new product condition favouring the compression strategy more than those in the new-to-the-firm product condition ($F(1, 88)=25.15$, $p<0.001$; $M_{LowINN}=74.66$, $M_{HighINN}=53.37$). The same procedure, this time with the Experiential Strategy Index as dependent variable, was employed to test the claim that high product innovativeness would lead to the more extensive use of the experiential strategy (Hypothesis 1b). The analysis revealed, in line with expectations, a significant main effect of product innovativeness, with respondents in the new-to-the-firm product condition favouring the experiential strategy more than those in the incremental new product condition ($F(1, 88)=10.78$, $p<0.001$; $M_{LowINN}=35.75$, $M_{HighINN}=53.33$). Both hypotheses regarding the role of product innovativeness on the implementation likelihood of different acceleration strategies were therefore supported. Table 4 also shows a statistically significant main effect of cycle time reduction objective on the implementation likelihood of the compression strategy, with respondents indicating greater inclination to implement the compression strategy when facing an ambitious, rather than modest, acceleration goal ($F(1, 88)= 8.29$, $p<0.005$; $M_{LowCTO}=57.11$, $M_{HighCTO}=70.92$). However, there was no significant main effect of cycle time reduction objective on the implementation likelihood of the experiential strategy ($F(1, 88)=0.26$; $M_{LowCTO}=42.80$, $M_{HighCTO}=46.27$).

<<< Table 4 about here>>>

Hypothesis 2a and b maintained that practitioners involved in incremental NPD projects would respond to greater cycle time reduction objectives by increasing their use of the compression strategy and displayno change in how much they used the experiential strategy, respectively. Hypothesis 2c suggested that practitioners involved in new-to-the-firm projects would respond to greater cycle time reduction objectives by decreasing their use of the default strategy for new-to-the-firm projects (experiential). Hypothesis 2d proposed that this decrease would be matched with an increase in the use of the compression strategy. These expectations were tested using planned contrasts (see Table 5 for results). Consistent with H2a, the contrast estimate of -14.04 is significantly different from 0 (p=0.047), showing, for incremental projects, the implementation likelihood of the compression strategy increases with a more ambitious cycle time reduction objective ($M_{LowINNLowCTO}$=67.28, $M_{LowINNHighCTO}$=82.04). In line with H2b, there was no significant change in the implementation likelihood of the experiential strategy ($M_{LowINNLowCTO}$=34.92, $M_{LowINNHighCTO}$=36.57). Both hypotheses concerning the influence of cycle time reduction objective on acceleration strategy choice in incremental NPD projects were therefore supported by the planned contrast analysis.

The hypotheses concerning the influence of cycle time reduction objective on acceleration strategy choice in new-to-the-firm NPD projects received only partial support from the planned contrast analysis. The contrast estimate -14.02 for the compression index was significantly different from 0 (p=0.039, $M_{HighINNLowCTO}$=46.94, $M_{HighINNHighCTO}$=59.80), confirming our expectation that new-to-the-firm projects would make greater use of the compression strategy as the greater cycle time reduction objectives became more ambitious (H2c). However, the analyses did not validate H2d, which claimed that new-to-the-firm projects would make less use of the experiential strategy with a more ambitious cycle time reduction objectives ($M_{HighINNLowCTO}$=50.69, $M_{HighINNHighCTO}$=55.97).

<<< Table 5 about here >>>

DISCUSSION AND IMPLICATIONS

In this study we assessed the extent to which product innovativeness influences practitioners' decisions to implement the compression and experiential strategies of acceleration proposed by Eisenhardt and Tabrizi (1995) and documented the differential effect of cycle time reduction objective on acceleration strategy choice for incremental and new-to-the-firm projects. The analyses showed that acceleration strategy choice was heavily dependent on product innovativeness and that the effect of cycle time reduction objective on strategy choice was contingent on product innovativeness.

We hypothesized that when product innovativeness is low, NPD follows a predictable path so practitioners should seek to increase development speed mainly through compression. The main effect results of the ANCOVAs offer support for our expectation that incremental NPD projects would utilise compression to a greater extent than highly innovative projects. As expected, the acceleration strategy of choice for highly innovative projects was the experiential strategy. These results suggest that practitioners are mindful of product innovativeness when selecting acceleration strategies, and resonate with existing work that showed project management styles to be shaped, albeit partially, by the project's level of uncertainty (Shenhar, 2001). The second source of uncertainty examined in this study was cycle time reduction objective. We found that incremental and highly innovative projects responded differently to the hike in uncertainty due to an ambitious time reduction objective. As expected, incremental projects merely increased their reliance on their default strategy of compression when development times needed to be reduced drastically. For new-to-the-firm projects we had a hypothesised that time pressure would compel managers to reduce their reliance of the experiential approach, but this was not supported by the analysis. However, we found support for our claim that ambitious time goals would lead to greater use of the compression strategy in innovative projects. These results indicate that, when faced with an ambitious time reduction objective, highly innovative projects make complementary use of both experiential and compression strategies rather than simply moving away from their default acceleration strategy (i.e., experiential).

To explain this unexpected finding, we refer to the stream of organisational learning literature on the concept of ambidexterity. Defined briefly as the simultaneous use of exploitative and explorative learning activities (e.g., Raisch et al., 2009), ambidexterity is increasingly recognised as a learning capability critical for enhancing firms' ability to respond to uncertainty (Patel et al., 2012). Many studies indicate that high levels of uncertainty requires firms to engage in both exploitation and exploration activities (e.g., Lubatkin et al., 2006, Voss et al., 2008). By doing so, firms not only balance the maintenance of established routines with the incorporation of novel ideas and processes (Patel, Terjesen and Li, 2012), but also avoid the risks and pitfalls associated with pure exploitation and exploitation (Cao et al., 2009). Our results suggest that the notion of ambidexterity is not limited to seemingly contradictory learning strategies (i.e., exploitation and exploration), but extends to acceleration strategies (i.e., compression and experiential) too.

The simultaneous use of compression and experiential strategies for accelerating highly innovative projects may have been driven by practitioners' desire to mitigate any negative effects of the increased use of compression not just on development speed but on other dimensions of NPD performance as well. Some scholars maintain that the compression strategy, in isolation, is ill-advised for innovative NPD because it can lead to diseconomies in the form of increased costs (Chen, Reilly and Lynn, 2012) or, as in the case of time-based rewards, compromised product quality. Rewarding development staff for time performance can make development staff focus on schedules at the expense of product performance (Lambert and Slater, 1999), prompting them to shorten or skip key processes, pay less attention to performance specifications and technological content (Lukas et al., 2002). While the prioritization of deadlines may not have serious repercussions in incremental product development, it greatly reduces teams' ability to address the challenges of highly innovative projects. However, implementing compression practices alongside the experiential strategy can balance out their negative effects while benefiting from its positive contributions to cycle time reduction. A related possibility is that practitioners continue to use the experiential strategy under conditions of high acceleration not because of their time implications, but their importance for other dimensions of NPD performance such as lower costs, higher quality and greater product advantage. For instance, having frequent interim goals can promote team coordination and ensure that projects do not absorb any unnecessary resources (Lewis, Welsh, Dehler and Green, 2002), helping keep development costs under control.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

This study sought to understand how uncertainty associated with project innovativeness influenced practitioners' choice of acceleration strategy and how cycle time reduction objective moderated this relationship. While its findings indicate notable differences in acceleration strategy choice that are attributable to the variables of interest, they must be considered in the light of the study's limitations. First, we focused only on the acceleration practices in Eisenhardt and Tabrizi (1995)'s compression and experiential strategies. There are many other antecedents of development speed for which the contingency effects of innovativeness and acceleration goal may be manifest (see Chen et al., 2010 for a meta-analytic investigation of development speed antecedents). Second, although we controlled for the influence of respondents' professional characteristics relevant to the decision task by including the length of their NPD experience and their functional background as covariates in the analysis, we did not control for any personal characteristics such as risk-taking that have been shown to affect the likelihood of engaging in speed-to-market activities (Calantone et al., 2003). Finally, the dataset is fairly small, with 22 observations per cell. While this number is sufficient to conduct the analyses, using a larger dataset may have increased the generalizability of our findings.

This study was only a first step in understanding how product innovativeness and acceleration goal influences practitioners' choice of acceleration strategy, and there are plenty of ways in which it can be extended. First, time to market is only one factor that feeds into the commercial and financial performance of new products. Development costs and product quality are equally important influences on the market and financial performance of new products (Tatikonda and Montoya-Weiss, 2001). Faced with the challenge of balancing time, cost and quality objectives, managers need to assess the implications of their decisions and actions with respect to all of these dimensions. In fact, as Swink et al. (2006) demonstrate, making trade-offs between different performance metrics is a pressing concern for more than half of NPD projects. Future studies could accommodate for these tradeoffs by looking into how the presence of cost and quality objectives (in addition to time objectives) affect acceleration strategy choice. One could also examine how practitioners' propensity to use certain acceleration approaches change over time. In their longitudinal study of project management styles, Lewis, Welsh, Dehler and Green (2002) find that while the use of most project management practices decline over time. However, it is emergent, improvised activities that decline in use more than planned ones. While said research did not directly concern management of accelerated product development, its findings nevertheless lead one to wonder if a similar pattern holds for acceleration practices. Such a longitudinal approach would also lend itself to examine how interim performance feedback influences the choice of acceleration approaches. Cardinal, Turner, Fern and Burton (2011) document that, while project design influences NPD performance, the opposite relationship also holds (i.e., project design evolves as a function of NPD performance). Given that operational NPD outcomes such as adherence to schedule, budget and quality targets are measurable during the course of a project, it would be interesting to see how performance feedback provided during projects affect acceleration strategy choice.

Table 1. Acceleration tool descriptions in data collection instrument

Compression strategy	
1. Predevelopment	Increasing the percentage of total development time allocated for ***predevelopment activities*** (e.g., idea screening, preliminary technical and market assessments, detailed market studies, and the detailed business and financial analysis) relative to similar past projects.
2. Supplier involvement	Having at least one employee from the ***major supplier(s) as a recognized member of the product development team***, actively participating in team meetings during the course of the entire project.
3. CAD	Increasing the extent to which design engineers working on the project utilise ***computer-aided design systems*** relative to similar past projects.
4. Overlapping	Increasing the extent of ***overlap between different project activities/stages*** (e.g., design and manufacturing, marketing and engineering) relative to similar past projects.
5. CFT	Increasing the ***number of departments represented by full-time members in the product development team*** relative to similar past projects.
6. Time-based rewards	***Rewarding development personnel*** for meeting the schedule deadlines (e.g., offering a proportion of total base pay as a bonus for schedule attainment).
Experiential strategy	
7. Iteration	Increasing the ***frequency and number of design iterations*** (i.e., modifications of more than 10% of product components) made prior to stable volume production relative to similar past projects.
8. Testing	Increasing the ***percentage of total development time spent testing designs*** relative to similar past projects.
9. Milestones	Decreasing the ***time (i.e., number of weeks) between official project review meetings*** relative to similar past projects.
10. Leader	Assuming ***direct authority over and responsibility for all aspects of the project*** (e.g., project budget, team composition, project timetable, project management approach).

Table 2. Bivariate correlations between the implementation likelihood of individual acceleration tools

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Predevelopment	1	0.16	0.06	-0.01	0.02	0.02	0.15	**0.27***	**0.25***	0.19
2. Supplier involvement	0.16	1	**-0.32****	-0.08	**-0.25***	**-0.32****	0.04	0.10	-0.16	-0.15
3. CAD use	0.06	**-0.32****	1	**0.27***	**0.24***	**0.53****	-0.15	-0.16	0.07	**0.24***
4. Overlapping	-0.01	-0.08	**0.27***	1	0.07	**0.22***	-0.16	-0.16	0.01	-0.08
5. CFT use	0.02	**-0.25***	0.24*	0.07	1	0.11	0.04	0.08	0.14	0.10
6. Time-based rewards	0.02	**-0.32****	**0.53****	**0.22***	0.11	1	**-0.25***	**-0.22***	-0.15	0.02
7. Iteration	0.15	0.04	-0.15	-0.16	0.04	**-0.25***	1	**0.53****	**0.22***	0.21
8. Testing	**0.27***	0.10	-0.16	-0.16	0.08	**-0.22***	**0.53****	1	**0.31****	0.20
9. Milestones	**0.25***	-0.16	0.07	0.01	0.14	-0.15	**0.22***	**0.31****	1	**0.24***
10. Leadership	0.19	-0.15	**0.24***	-0.08	0.10	0.02	0.21	0.20	**0.24***	1

Table 3. Cell means, standard deviations for dependent variables *

	Low INN		High INN	
Dependent variable	Low CTO	High CTO	Low CTO	High CTO
Compression Index	67.28 (21.35)	82.04 (23.09)	46.94 (23.69)	59.80 (19.20)
Experiential Index	34.92 (24.01)	36.57 (18.44)	50.69 (22.84)	55.97 (20.29)

* Standard deviations are in parantheses.
Cell sizes are N=22.

Table 4. ANCOVA results for compression and experiential strategy models (Hypotheses 1a and 1b)

Dependent variable:	**Compression strategy**			**Experiential strategy**		
Source of variation	*F*	*df*	Sig.	*F*	*df*	Sig.
Project innovativeness (*INN*)	250.15	1	0.000	100.78	1	0.002
Cycle time reduction objective (*CTO*)	80.29	1	0.005	0.26	1	0.611
Product complexity	10.56	1	0.216	0.83	1	0.366
Respondent NPD experience	0.92	1	0.340	0.16	1	0.695
Respondent background dummy: Marketing	0.63	1	0.432	0.37	1	0.547
Respondent background dummy: Engineering	0.14	1	0.707	0.97	1	0.327
Respondent background dummy: Administrative	0.00	1	0.960	0.08	1	0.782

Table 5. Planned contrast test results for compression and experiential strategy models (Hypotheses 2a-d)

Hypothesis	**Dependent variable**	**Studied groups***	**Expected relationship**	**Contrast estimate (SE)**	**Sig.**
H2a	Compression	LI-LCTO vs. LI-HCTO	LI-LCTO <. LI-HCTO	-14.04 (6.97)	0.047
H2b	Experiential	LI-LCTO vs. LI-HCTO	LI-LCTO = LI-HCTO	-0.75 (6.91)	0.914
H2c	Compression	HI-LCTO vs. HI-HCTO	HI-LCTO < HI-HCTO	-14.02 (6.68)	0.039
H2d	Experiential	HI-LCTO vs. HI-HCTO	HI-LCTO > HI-HCTO	-4.18 (6.63)	0.530

***** LI-LCTO: Low project innovativeness, low cycle time reduction objective; LI-HCTO: Low project innovativeness, high cycle time reduction objective; HI-LCTO: High project innovativeness, low cycle time reduction objective; HI-HCTO: High project innovativeness, high cycle time reduction objective.

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