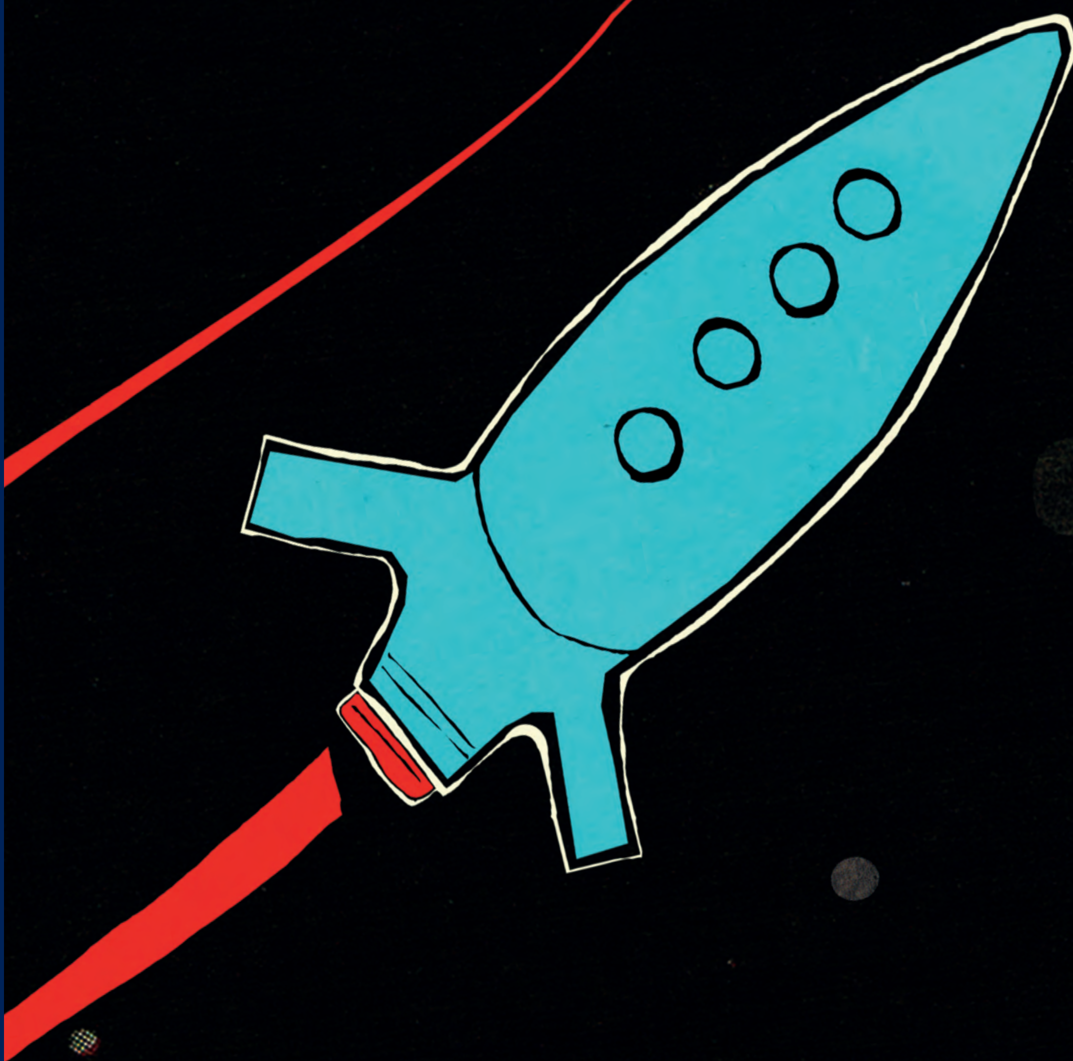
P. CANKURTARAN

Essays On Accelerated Product Development



ESSAYS ON ACCELERATED PRODUCT DEVELOPMENT

ESSAYS ON ACCELERATED PRODUCT DEVELOPMENT

Thesis

to obtain the degree of Doctor from the
Erasmus University Rotterdam
by command of the
rector magnificus

Prof.dr. H.A.P. Pols

and in accordance with the decision of the Doctorate Board.

The public defence shall be held on
Thursday 18 September at 11:30 hrs

by

PINAR CANKURTARAN

born in Ankara, Turkey.

ERASMUS UNIVERSITY ROTTERDAM

Doctoral Committee

Promotor: Prof.dr. F. Langerak
Prof.dr.ir. G.H. van Bruggen

Other members: Prof.dr.ir. A. Smidts
Prof.dr. G.M. Duijsters
Prof.dr.ir. J.C.M. van den Ende

Erasmus Research Institute of Management – ERIM
The joint research institute of the Rotterdam School of Management (RSM)
and the Erasmus School of Economics (ESE) at the Erasmus University Rotterdam
Internet: http://www.erim.eur.nl

ERIM Electronic Series Portal: http://hdl.handle.net/1765/1

ERIM PhD Series in Research in Management, 317
ERIM reference number: EPS-2014-317-MKT
ISBN 978-90-5892-371-4

Design: B&T Ontwerp en advies www.b-en-t.nl

This publication (cover and interior) is printed by haveka.nl on recycled paper, Revive®.
The ink used is produced from renewable resources and alcohol free fountain solution.
Certifications for the paper and the printing production process: Recycle, EU Flower, FSC, ISO14001.
More info: http://www.haveka.nl/greening

FSC

TABLE OF CONTENTS

LIST OF FIGURES .... **V**

LIST OF TABLES .... **VI**

INTRODUCTION **1**

AN INTRODUCTION TO LITERATURE IN NEW PRODUCT DEVELOPMENT SPEED 3

RESEARCH FOCUS AND MAIN RESEARCH QUESTIONS 5

RESEARCH STUDIES 6

Consequences of new product development speed: A meta-analysis (Study 1) *7*

Organizational experience spillovers, project uncertainty, and new product development project cycle time (Study 2) *8*

Managerial decision making in project acceleration: The role of project innovativeness and acceleration goals in acceleration strategy choice (Study 3) *9*

DISSERTATION OVERVIEW 10

CONSEQUENCES OF NEW PRODUCT DEVELOPMENT SPEED: A META-ANALYSIS 13

INTRODUCTION 15

DEVELOPMENT SPEED AND NEW PRODUCT SUCCESS 17

Dimensions of new product performance *18*

Operational outcomes of development speed *20*

Development costs 20
Proficiency in market entry timing 21
Technical product quality 22
Product competitive advantage 23

External outcomes of development speed *23*

Customer-based outcomes 23
Financial outcomes 24

Speed-success relationship summary *25*

METHODOLOGY 25

Database development *25*

Variable classification and coding *27*

Meta-analytic calculations......28

RESULTS......29

Main effects......29

Heterogeneity analysis......31

Moderator effects......32

ANTECEDENTS OF NEW PRODUCT DEVELOPMENT SPEED......38

DISCUSSION......42

IMPLICATIONS......48

LIMITATIONS AND FURTHER RESEARCH......49

ORGANIZATIONAL EXPERIENCE SPILLOVERS, PROJECT UNCERTAINTY, AND NEW PRODUCT DEVELOPMENT PROJECT CYCLE TIME 51

INTRODUCTION......53

BACKGROUND LITERATURE......55

Learning from experience......55

Specialized versus related experience......56

CONCEPTUAL FRAMEWORK......57

Specialized organizational experience and NPD project cycle time......57

Related organizational experience and NPD project cycle time......58

Project uncertainty as a source of heterogeneity in learning rates......59

METHODOLOGY......61

Empirical context......61

Measures......63

Dependent variable: Project cycle time......63
Independent variables: Specialized and related organizational experience......63
Moderating variable: Project uncertainty......63
Control variables......64

Estimation procedure......65

ANALYSIS AND RESULTS......66

Hierarchical regression analyses......66

Robustness tests and additional analyses......68

Multicollinearity......68
Simultaneity bias......68

Comparing the effects of specialized and related organizational experience 69
Progress ratios 69

DISCUSSION 70

Theoretical implications *70*

Managerial implications *72*

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH............72

MANAGERIAL DECISION MAKING IN PROJECT ACCELERATION: THE ROLE OF PROJECT INNOVATIVENESS AND ACCELERATION GOALS IN ACCELERATION STRATEGY CHOICE 75

INTRODUCTION 77

CONCEPTUAL BACKGROUND 80

Compression and experiential models of project acceleration *80*

Project innovativeness and cycle time reduction objective as sources of uncertainty in NPD ..*84*

Project innovativeness 84
Cycle time reduction objective 85

RESEARCH HYPOTHESES 85

The effect of project innovativeness on the implementation likelihood of compression and experiential strategies *86*

The effect of cycle time reduction objective on the implementation likelihood of compression and experiential strategies *88*

METHODOLOGY 90

Respondents *91*

Decision task *92*

Independent variables *92*

Dependent variables *93*

Covariates *95*

Manipulation and realism checks *96*

ANALYSIS AND RESULTS 97

The effect of project innovativeness on the implementation likelihood of compression and experiential strategies *98*

The effect of cycle time reduction objective on the implementation likelihood of compression and experiential strategies *98*

DISCUSSION AND IMPLICATIONS 101

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH.. 103

CONCLUSION 107

SYNOPSIS.. 109

SUMMARY OF STUDY FINDINGS AND CONCLUSIONS 109

IMPLICATIONS 112

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH.. 114

BIBLIOGRAPHY 117

APPENDIX 135

APPENDIX A META-ANALYTIC DATABASE (CONSEQUENCES) 137

APPENDIX B META-ANALYTIC DATABASE (ANTECEDENTS) 141

APPENDIX C META-ANALYTIC DATABASE (BIBLIOGRAPHY)... 147

APPENDIX D ROBUSTNESS TESTS OF MULTICOLLINEARITY 153

APPENDIX E SCENARIO DESCRIPTIONS 154

SUMMARY 157

SAMENVATTING 159

ACKNOWLEDGEMENTS 161

ABOUT THE AUTHOR 162

ERIM PH.D. SERIES 163

LIST OF FIGURES

Figure 1.1 Dissertation structure 11

Figure 2.1 Consequences of new product development speed 19

Figure 3.1 Proposed conceptual model and hypotheses 62

Figure 4.1 Effect of project innovativeness on the use of compression and experiential acceleration strategies (Hypotheses 1a and 1b) 99

LIST OF TABLES

TABLE 2.1 PREVIOUS META-ANALYTIC STUDIES INVOLVING DEVELOPMENT SPEED 16

TABLE 2.2 MAIN EFFECT RESULTS 30

TABLE 2.3 POTENTIAL MODERATORS OF THE SPEED-PERFORMANCE RELATIONSHIP 33

TABLE 2.4 MODERATOR ANALYSIS RESULTS FOR RESEARCH DESIGN CHARACTERISTICS 34

TABLE 2.5 MODERATOR ANALYSIS RESULTS FOR SPEED MEASUREMENT CHARACTERISTICS...................36

TABLE 2.6 MODERATOR ANALYSIS RESULTS FOR CONTEXTUAL CHARACTERISTICS 37

TABLE 2.7 ANTECEDENTS OF DEVELOPMENT SPEED - MAIN EFFECTS AND HETEROGENEITY ANALYSIS SUMMARY COMPARISON...40

TABLE 2.8 RESULTS ACROSS META-ANALYTIC STUDIES...43

TABLE 2.9 MODERATORS THAT REDUCE MAIN EFFECT CORRELATIONS TO INSIGNIFICANCE 46

TABLE 3.1 DESCRIPTIVE STATISTICS AND CORRELATIONS 65

TABLE 3.2 ESTIMATED COEFFICIENTS FOR MODELS PREDICTING NPD PROJECT CYCLE TIME 67

TABLE 4.1 ACCELERATION TOOLS BY STRATEGY 80

TABLE 4.2 SELECTED STUDIES DOCUMENTING THE TIME PERFORMANCE IMPLICATION OF COMPRESSION AND EXPERIENTIAL ACCELERATION TOOLS 81

TABLE 4.3 SAMPLE DESCRIPTION 91

TABLE 4.4 ACCELERATION TOOL DESCRIPTIONS IN DATA COLLECTION INSTRUMENT 94

TABLE 4.5 BIVARIATE CORRELATIONS BETWEEN THE IMPLEMENTATION LIKELIHOOD OF INDIVIDUAL ACCELERATION TOOLS 95

TABLE 4.6 CELL MEANS, STANDARD DEVIATIONS FOR DEPENDENT VARIABLES 98

TABLE 4.7 ANCOVA RESULTS FOR COMPRESSION AND EXPERIENTIAL STRATEGY MODELS (H_{1A-B}) 99

TABLE 4.8 PLANNED CONTRAST TEST RESULTS FOR COMPRESSION AND EXPERIENTIAL STRATEGY MODELS (H_{2A-D})...100

TABLE 4.9 SUMMARY OF RESULTS 102

1

INTRODUCTION

AN INTRODUCTION TO LITERATURE IN NEW PRODUCT DEVELOPMENT SPEED

New product development (NPD) speed refers to the ability to move quickly from ideas to actual products (Kessler and Bierly III 2002). Increased speed is achieved by decreasing development cycle time, the elapsed time from the beginning of idea generation to market introduction. Time-to-market (Tatikonda and Montoya-Weiss 2001), product development time (Lilien and Eunsang 1989), innovation time (Mansfield 1988), lead time (Ulrich, Sartorius, Pearson and Jakiela 1993), project completion time (Terwiesch and Loch 1999) and total time (Griffin 1993) also denote the same concept.

The last three decades have witnessed more and more companies adopting time-based strategies and acceleration techniques to increase NPD speed (e.g., Barczak, Griffin and Kahn 2009; Griffin 1997b; Stalk 1988). The increasing emphasis on speed is driven primarily by the contention that faster product development brings first mover advantages (Dröge, Jayaram and Vickery 2000; Lieberman and Montgomery 1988; Stalk Jr and Hout 1990). As first movers, firms can establish technology and industry standards (Meyer 1993), pre-empt scarce resources and suppliers (Lee, Smith, Grimm and Schomburg 2000), gain a competitive edge over later entrants (Chen, Reilly and Lynn 2005) and secure favourable market positions (Smith and Reinertsen 1991). Speed also allows firms to adapt more readily to dynamic business environments and quickly address changes in consumer demand (Eisenhardt and Tabrizi 1995). Argued to set the stage for new product success in a business environment characterized by shrinking product life cycles, rapidly changing customer demands and ever intensifying competition (Chen, Reilly and Lynn 2012), these benefits have propelled faster product development into becoming a crucial element in the management of innovation in organizations.

The industry's desire to increase NPD speed has been matched by extensive academic interest in the area, leading to two main streams of literature. The first stream focuses on the consequences of NPD speed (i.e., how does speed relate to new product success?), while the second stream is concerned with its antecedents (i.e., what are the factors underlying faster product development?).

The majority of empirical work on the consequences side appears to document a positive effect of speed on new product success (Carbonell and Rodriguez 2006b; Chen et al. 2005; González and Palacios 2002; Johnson, Piccolotto and Filippini 2009; Kessler and Bierly III 2002; Lynn, Skov and Abel 1999b). However, there is a considerable number of studies that do not find evidence of a relationship between speed and success at all (e.g., Griffin 2002; Meyer and Utterback 1995). New product success is a multidimensional construct encompassing distinct, yet related outcomes such as development costs, product quality, market entry timing, product advantage, market performance and financial performance (Tatikonda and Montoya-Weiss 2001). At first glance, one may attribute the lack of consistency to the vague conceptualization of new product. However, even the use of narrow, well-defined measures of NPD performance (as opposed to an overall success measure) does little in the way of producing consensus, as evident from the divergent theoretical standpoints and empirical findings regarding the relationship between speed and development costs (e.g., Kessler and Bierly III 2002; Meyer and Utterback 1995; Murmann 1994), technical product quality (e.g., Calantone and Di Benedetto 2000; Clark and Fujimoto 1991; Rosenthal and Tatikonda 1993), product advantage (e.g., Carbonell and Rodriguez 2006b; Mallick and Schroeder 2005), market performance (e.g., Calantone, Vickery and Dröge 1995; Langerak, Rijsdijk and Dittrich 2009) and financial performance (e.g., Jayaram and Narasimhan 2007; Swink and Song 2007). In sum, notwithstanding the great deal of research effort that has gone into understanding how speed relates to new product performance, a clear and unified picture is yet to emerge.

The second stream of work seeks to identify the antecedent factors that underlie variations in NPD speed and the practices that promote faster development. Collectively, this line of inquiry has revealed a diversity of factors that influence development speed, including (but not limited to) cross functional team use (e.g., Clark and Fujimoto 1991; Eisenhardt and Tabrizi 1995; Griffin 1997a; Zirger and Hartley 1996), team dedication (e.g., Adler, Mandelbaum, Nguyen and Schwerer 1995; Hoegl, Weinkauf and Gemünden 2004), participation of the project leader (e.g., McDonough III and Barczak 1991; Rauniar, Doll, Rawski and Hong 2008a), goal clarity and stability (e.g., Hong, Nahm and Doll 2004; Kessler and Chakrabarti 1999; Lynn, Abel, Valentine and Wright 1999a), concurrent development (e.g., Clark and Fujimoto 1991; Kessler and Chakrabarti 1999; Millson, Raj and Wilemon 1992), shifting problem identification and problem solving activities to the early phases of the development process (e.g., Thomke and Fujimoto 2000) and organizational learning (e.g., Akgün and Lynn 2002; Sarin and McDermott 2003; Sherman, Souder and Jenssen 2000).

Much like its consequences counterpart, the antecedents stream of NPD speed research has produced conflicting results. To illustrate, Ittner and Larcker (1997) find that involving suppliers in the design process actually slows down development. In contrast, Dröge et al. (2000), Filippini, Salmaso and Tessarolo (2004), Primo and Amundson (2002), Sherman et al. (2000) and Zirger and Hartley (1996) indicate that supplier involvement is not related to development time at all. Similar inconsistent results have been produced concerning other proposed drivers such as interfunctional integration (Brettel, Heinemann, Engelen and Neubauer 2011), concurrent development (Dröge et al. 2000; Filippini et al. 2004), time-based rewards (Callahan and Moretton 2001; Carbonell and Rodriguez 2006a), and extensive testing and iteration (Kessler and Chakrabarti 1999; Terwiesch and Loch 1999). Further complicating matters is the 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; Tatikonda and Montoya-Weiss 2001; Terwiesch and Loch 1999). The recent meta-analysis by Chen, Damanpour and Reilly (2010) has gone a long way towards integrating the extant work on the antecedents of development speed. It has also identified four methodological characteristics (temporal design, level of analysis, data source and speed measurement) that explain some of the variation in the reported findings. However, variations in findings are not attributable solely to methodological differences across studies. The existence of currently underexplored contingency factors that impinge upon the usefulness of acceleration practices signals a pressing need for more research in the area.

RESEARCH FOCUS AND MAIN RESEARCH QUESTIONS

It is clear from the brief literature review in the previous section that both streams of work on NPD speed have yet to achieve consistency in conceptual arguments and empirical results. The divergent findings produced by the consequences stream are concerning because speed is not an end in itself, but a means to ultimate product success. Unless NPD speed is indeed a contributor to NPD performance, there is little point in investigating how it can be promoted. Before one sets out to explore how faster product development can be achieved, it is imperative to first ascertain whether faster development contributes to NPD success in the first place. Therefore, the first main question this dissertation seeks to answer is:

- What is the effect of accelerated cycle time on performance (given the inconsistencies in the empirical findings)?

Establishing the character and magnitude of speed's relationship with NPD performance is perquisite ingredient for a thorough investigation of NPD speed, but in order to arrive at a holistic view of the topic one must also pay attention also to its drivers while also acknowledging the contingency factors that influence their usefulness. The contingency factor of interest in this dissertation is uncertainty, which, in the context of NPD projects, refers to the lack of knowledge about the precise means to execute the project (Tatikonda and Montoya-Weiss 2001), and has been shown to have a marked influence on project management practices (Shenhar 2001) as well as development speed itself (Chen et al. 2005). Against this backdrop, the second main research question of this dissertation is:

- How can cycle time effectively be reduced, taking into account uncertainty as a contingency factor?

RESEARCH STUDIES

This dissertation consists of three studies, each of which approach development speed from a different angle and investigate it in different theoretical domains, each time using a different methodological approach. Study 1 focuses on the consequences of development speed, and uses meta-analytic methods to shed light into how development speed relates to new product success, taking into account its different dimensions. Studies 2 and 3 direct the attention to the antecedents of development speed, and explore the moderating role of uncertainty. The majority of the drivers identified by previous work are organizational practices that managers can utilize with the express purpose of speeding up development (e.g., concurrency, use of cross-functional teams, time-based rewards). While accelerated product development can be achieved situational use of such acceleration practices, it can also be a continuous process. Organizational learning, which Chen et al. (2010) have shown to have one of the strongest association with development speed, is one such factor with the potential to offer continuous improvements in time performance. Study 2 treats acceleration as a continuous process that is a by-product of the firm’s prior NPD experience (which itself is a product of organizational learning). Study 3, on the other hand, views acceleration as achievable primarily by active management intervention in the form of acceleration strategies. While Study 2 utilises objective company data, Study 3 employs a scenario-based decision experiment. Collectively, the three studies seek to provide satisfactory answers to the two research questions specified above, and ultimately, contribute to the scholarly understanding of NPD speed and its successful management. The remainder of this section briefly introduces these studies.

Consequences of new product development speed: A meta-analysis (Study 1)

Innovation speed is not an end in itself, but a (possible) means to ultimate product success. Therefore, it is necessary to establish the character and magnitude of speed's relationship with success before embarking on an investigation of its antecedents. The first question in need of a definitive answer is not how faster product development can be achieved, but whether faster development contributes to NPD success in the first place. The study described in this chapter addresses precisely this question. Using meta-analytic statistical techniques, it advances scholarly knowledge of the relationship between development speed and new product success.

Six meta-analyses that involve the concept of new product development speed have been published on the topic of new product development. Four of these studies (Evanschitzky, Eisend, Calantone and Jiang 2012; Henard and Szymanski 2001; Montoya-Weiss and Calantone 1994; Pattikawa, Verwaal and Commandeur 2006) sought to identify the determinants of new product development success, and treated new product development speed as one of these antecedents. The other two studies (Chen et al. 2010; Gerwin and Barrowman 2002) treated new product development speed as the dependent variable with the aim of identifying its antecedents. The research reported in this chapter extends previous empirical generalizations in this domain by using a meta-analytic methodology to understand the link between new product development speed and new product success at a more granular level. It differs from previous meta-analyses involving development speed in that it (1) treats development speed as the focal variable *and* (2) investigates in detail its antecedent relationships to various dimensions of new product performance. Specifically, it considers the relationship with different dimensions of success as measured overall or compositely, operationally (i.e., the process measures of decreasing development costs and proficiently managing market entry timing and the product measures of technical product performance and product competitive advantage), and relative to external success outcomes (i.e., customer-based and financial success).

The results indicate that, in general, new product development speed is associated with improved NPD performance outcomes. However, those relationships diminish or even disappear depending upon a number of methodological design decisions and research contexts. A subsequent meta-analysis of the antecedents of development speed provides a more holistic picture of development speed, yielding results broadly consistent with those produced by another recent meta-analytic investigation of the issue (Chen et al. 2010). Together, these findings have important implications for academics pursuing further research in this domain, as well as for managers considering implementing a program to increase new product development speed.

Organizational experience spillovers, project uncertainty, and new product development project cycle time (Study 2)

Recent meta-analytic research (Chen et al. 2010) indicates that learning, a key NPD competency, is one of the strongest antecedents of NPD speed (Chapter 2 of this dissertation arrives at a similar conclusion). This is hardly surprising, given that NPD itself is widely acknowledged as a process of organizational learning characterized by the acquisition, dissemination and utilization of knowledge (Day 1994; Moorman 1995). Learning in NPD can take many forms, with sources such as customers, competitors and research centres are valuable external sources of knowledge for the NPD process (Grant 1996). However, the organization itself is also a notable repository of knowledge, and the organizations' own product development experience is one of the ways in which this repository is created (Huber 1991). Prior NPD experience helps safely bypass unnecessary development steps and enables team members to identify more easily what is compatible or not with the attainment of specific project goals (Swink, Talluri and Pandejpong 2006). Yet, previous research has focused solely on experience available within the team executing the NPD project, which is undoubtedly an important factor but also ignores recent learning-by- doing research (e.g., Easton and Rosenzweig 2012; Reagans, Argote and Brooks 2005) that shows that organizational experience outside work teams can affect performance at the project level.

This study investigates how NPD experience accumulated by organizational members that are not part of a given NPD project might spill over to the focal project and affect its cycle time. It distinguishes two dimensions of organizational experience based on the domain from which it originates: *specialized* (experience gained within focal organizational unit) and *related* (experience gained in other organizational units). It then proceeds to assess whether the cycle time implications of these experience dimensions depends on the focal project's level of uncertainty, which has so far escaped scrutiny as a contingency factor in the extent to which time performance improvements from prior NPD experience are realized. To answer these questions it adopts the learning curve framework, which provides a sound methodological foundation for quantifying performance improvements as a consequence of increased experience.

The analyses, which are based on objective data on 169 NPD projects taking place over a seven-year span in multiple units of a single organization, reveal that both specialized and related organizational experience help decrease project cycle times, but related experience is more influential for highly uncertain projects than less uncertain ones. Furthermore, for uncertain projects, related organizational experience is more important for cycle time reduction than its specialized counterpart. The study contributes to NPD literature by (1) expanding the scope of research on the experience-time performance relationship to include organizational experience accumulated outside the project; (2) providing deeper insights into the role of project uncertainty in cycle time reduction; and (3) demonstrating that organizational experience effects are generalizable to the unstructured nature of NPD projects (Thomke 2003). From a managerial perspective, this study shows that NPD projects can be accelerated not only by installing experienced project teams but also by drawing from different sorts of organizational experience that are available outside the teams.

Managerial decision making in project acceleration: The role of project innovativeness and acceleration goals in acceleration strategy choice (Study 3)

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 (*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.

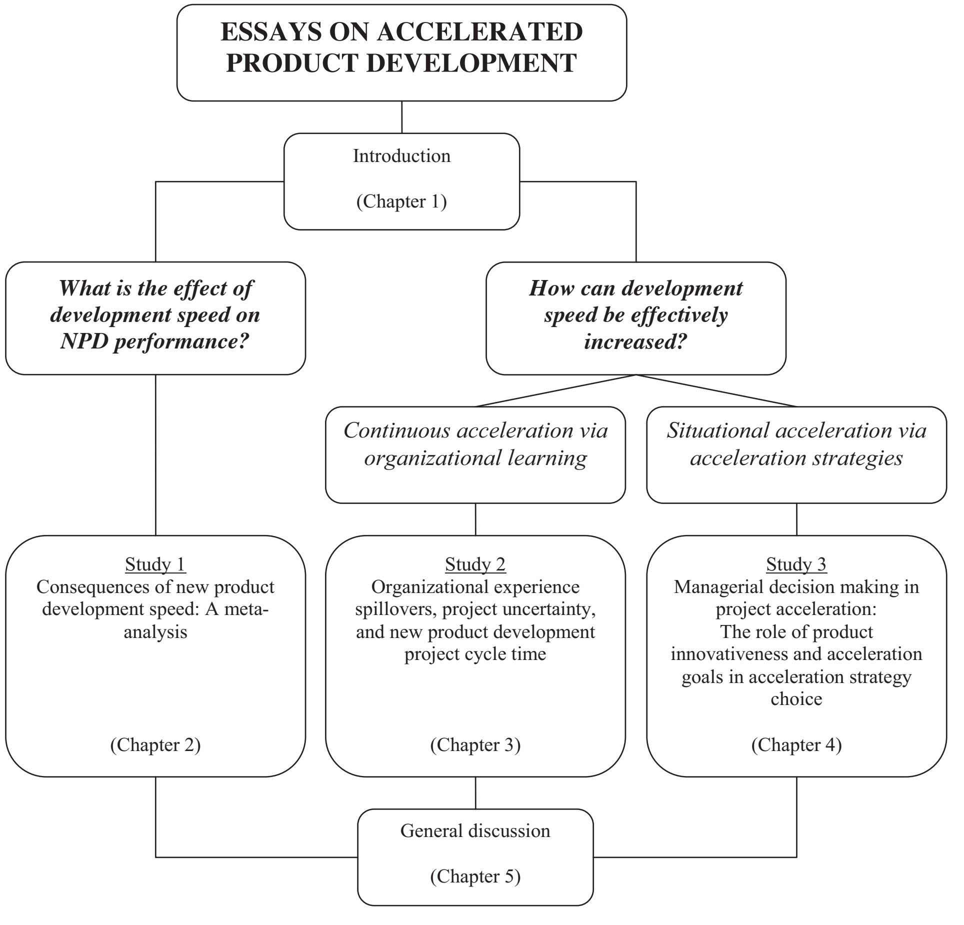
While the compression/experiential acceleration strategy constructs have received considerable attention in literature, the present study differs from previous work in several respects. First, it focuses on the uncertainty associated with the nature of the project itself rather than external sources of uncertainty such as technology and market turbulence (e.g., Eisenhardt and Tabrizi 1995; Rauniar, Doll, Rawski and Hong 2008b; Sherman et al. 2000; Tatikonda and Montoya-Weiss 2001). Second, it acknowledges the possibility that there may be multiple sources of uncertainty that influences acceleration strategy choice and investigates two distinct sources of project-related uncertainty (i.e., its level of innovativeness and the cycle time reduction objective imposed by management). Third, it looks at the compression and experiential strategies in their entirety, rather than approaching them in a piecemeal manner and fourth, it offers a descriptive, rather than prescriptive, account of how product innovativeness influences acceleration strategy choice and how project acceleration goals modify this relationship.

This research departs from previous work also in its methodological approach. Since our aim is to understand practitioners' choice of acceleration strategy, we chose to 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. Presented with the acceleration practices in the Eisenhardt and Tabrizi (1995) framework, participants are asked how likely they were to implement practice given the NPD scenario. Two sets of Analysis of Covariance (ANCOVA) are conducted 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. As expected, incremental projects merely increase their reliance on their default strategy of compression, highly innovative projects make complementary use of both experiential and compression strategies.

DISSERTATION OVERVIEW

The dissertation is organized as follows. After this introductory chapter, it proceeds to elaborate on each of the aforementioned studies (Chapters 2-4). Chapter 5 concludes the dissertation with a brief summary of the empirical studies presented in Chapters 2-4, with special emphasis on their conclusions and theoretical contributions. It also provides recommendations for future research in the area. The structure of the dissertation is shown in Figure 1.1.

Figure 1.1 Dissertation structure



2

CONSEQUENCES OF NEW PRODUCT DEVELOPMENT SPEED: A META-ANALYSIS [1]

[1] This chapter has been published as Cankurtaran, P., F. Langerak, A. Griffin. 2013. Consequences of new product development speed: A meta-analysis. *Journal of Product Innovation Management* **30**(3) 465–486. Earlier versions have been presented as Cankurtaran, P., Langerak, F., Griffin, A. 2010. Consequences of new product development speed: A meta-analysis. *Proceedings of the 32nd INFORMS Marketing Science Conference*, Cologne, Germany and Cankurtaran, P., Langerak, F., Griffin, A. 2011. Consequences of new product development speed: A meta-analysis. *Proceedings of the 18th International Product Development Management Conference*, Delft, The Netherlands.

INTRODUCTION

The performance implications of development speed have received plenty of scholarly attention. While some accounts portray speed as a key ingredient for creating successful new products, empirical evidence for the speed-success relationship is, at best, mixed (Griffin 2002; Ittner and Larcker 1997; Kessler and Bierly III 2002). Specifically, there exists insufficient – and often conflicting - evidence regarding how speed relates to the different dimensions of new product success, such as development cost, product quality, market share and profitability. Since speed is not an end in itself, but a means to ultimate product success, it is necessary to first establish the character and magnitude of speed's relationship with success prior to focusing attention on its antecedents. The question in need of a definitive answer is not how faster product development can be achieved, but whether faster development contributes to NPD success in the first place.

Four meta-analytic reviews of new product performance antecedents, which also include speed as an antecedent, have been published (Evanschitzky et al. 2012; Henard and Szymanski 2001; Montoya-Weiss and Calantone 1994; Pattikawa et al. 2006). Treating speed as one aspect of the development process, they all reveal a small-to-medium positive link between speed and performance. While these studies point to a speed-performance relationship, speed is not the focal variable and they do not provide detailed insight into how this relationship is manifest for different dimensions of NPD performance. While Gerwin and Barrowman (2002) and Chen et al. (2010) adopt speed as the focal variable, it is the dependent variable, and thus a detailed investigation of the speed-product success relationship remains outside their scope.

This study advances scholarly knowledge of the relationship between development speed and new product success using meta-analytic statistical techniques. It differs from the above meta-analyses in that it (1) treats development speed as the focal variable *and* (2) investigates in detail its antecedent relationships to the various different dimensions of new product performance. To provide a more holistic picture of development speed, it also presents a comprehensive meta-analysis of its antecedents using a larger database and a similar, yet more fine-grained, variable classification scheme than that used by Chen et al. (2010). Table 2.1 illustrates the key differences between this research and previous meta-analytic investigations involving development speed.

Table 2.1 Previous meta-analytic studies involving development speed

	Montoya-Weiss and Calantone (1994)	Henard and Szymanski (2001)	Pattikawa et al. (2006)	Evanschitzky et al. (2012)	Gerwin and Barrowman (2002)	Chen et al. (2010)	Present Study
Focal variable(s)	New product performance	New product performance	New product project performance	New product success	Development time and goal failure	NPD speed	Development speed
NPD outcome variables analysed in relation to NPD speed	New product performance (overall)	New product performance (overall)	New product project performance (overall)	New product success (overall)	None (focus on antecedents of development time and goal failure)	None (focus on antecedents of NPD speed)	7 NPD outcomes: • Development costs • Technical quality • Product advantage • Market entry timing • Marketplace success • Financial success • New product success
# of studies in database reporting NPD speed - outcome relationship [a]	1 (47)	6 (41)	7 (47)	42 (204)	None	None	56 (56)
Antecedents analysed in relation to NPD speed [b]	None	None	None	None	6 antecedents: • NPD Process (2) • Product definition (1) • Organizational context (1) • Teaming (2)	17 antecedents: • Strategy (3) • Project (2) • Process (4) • Team (8)	42 antecedents: • Product (6 • Process (9) • Team (10) • NPD competencies (5) • Firm (8) • Environment (4)
# of studies in database reporting antecedent – NPD speed relationship [a]	None	None	None	None	26 (26)	70 (70)	56 (56)
Effects corrected for artefacts?	No	Yes	Yes	Yes	Yes	Yes	Yes
Effects tested for moderators?	No	Yes	No	Yes	No	Yes	Yes

[a] total number of studies in database indicated in parentheses;
[b] number of meta-factors analysed indicated in parentheses.

A detailed speed-success meta-analysis closes a major gap in the literature because NPD success is a multifaceted construct that can be defined in a variety of ways and measured with a diversity of indicators (Griffin and Page 1993, 1996). At least some of the conflicting speed-success relationship findings likely are due to employing different success measures and variations in the theoretical underpinnings offered to explain their relationships with speed. Interrelationships between the various success measures Brown and Eisenhardt (1995), as manifest in the synergies and trade-offs between them (Cohen, Eliashberg and Ho 1996), further confound the relationship between speed and new product success. Hence, it is important to understand more precisely the way in which development speed relates to different success dimensions.

The next section presents the opposing viewpoints on the speed-success relationship, details the ways in which this relationship is manifest for different measures of new product performance, and overviews the existing empirical work on this topic. The subsequent section explains the data collection protocol and database formation. This is followed by a description of the meta-analytic estimation procedures, which use the Pearson product-moment correlation for effect size as it emerged as the most commonly reported effect size, and a presentation of main-effects results. The subsequent section describes the moderator analysis procedure and presents those results. Then the article proceeds with the main effects and heterogeneity analysis results of the antecedents meta-analysis, albeit in less detail since a thorough discussion of development speed antecedents is beyond the scope of this study. It closes with a discussion of the main findings, limitations of the study, and future research directions.

DEVELOPMENT SPEED AND NEW PRODUCT SUCCESS

The increasing emphasis on speed is driven primarily by the contention that faster product development brings first mover advantages (Dröge et al. 2000; Lieberman and Montgomery 1988; Stalk Jr and Hout 1990). As first movers, firms can establish technology and industry standards (Meyer 1993), pre-empt scarce resources and suppliers (Lee et al. 2000), gain a competitive edge over later entrants (Chen et al. 2005) and secure favourable market positions (Smith and Reinertsen 1991). Speed also allows firms to adapt more readily to dynamic business environments and quickly address changes in consumer demand (Eisenhardt and Tabrizi 1995). These benefits of faster product development are argued to set the stage for new product success.

While several empirical studies have documented a positive effect of innovation speed on new product success (Carbonell and Rodriguez 2006b; Chen et al. 2005; González and Palacios 2002; Johnson et al. 2009; Kessler and Bierly III 2002; Lynn et al. 1999b), it has not received unanimous empirical support. For example, neither Griffin (2002) nor Meyer and Utterback (1995) find any relationship between development time and performance. There also is evidence that the speed-success relationship, when it does exist, may not be straightforward due to contextual differences. Ittner and Larcker (1997), for instance, document a positive relationship between average firm-level cycle time and perceived overall success for the computer industry, but find no such association for the automobile industry. Another source of disagreement pertains to the role of environmental uncertainty on the speed-success link. While Kessler and Bierly III (2002) document a stronger association under conditions of low market uncertainty, Chen et al. (2005) find the opposite. Given this lack of consensus, there is a clear need for a systematic integration of findings in the form of a meta-analysis.

Dimensions of new product performance

New product success is a multidimensional construct that can be defined and measured at the firm, program, and project levels Griffin and Page (1993). Indeed, while many studies adopt a "global" success measure such as "overall performance" Hoegl et al. (2004) and "NPD effectiveness" Rusinko (1999), others investigate the NPD speed relationship with narrower sub-dimensions of NPD performance, revealing markedly different patterns of association. This literature suggests that, as with research on other new product success antecedents Hart (1993), the definition and operationalization of product success will influence the findings for its relationship with development speed.

Managerially useful and/or empirically significant success dimensions vary with respect to stakeholder interests (Lipovetsky, Tishler, Dvir and Shenhar 1997), organizational goals (Venkatraman and Ramanujam 1986), managerial relevance, and even when after launch success is measured (Hultink and Robben 1995). Furthermore, despite the multidisciplinary character of NPD projects, most empirical research on the speed-performance link uses only a single functional perspective of success (i.e., marketing or finance), frequently producing results incompatible with those from other functional perspectives (Tatikonda and Montoya-Weiss 2001). Consequently, understanding the mechanisms underlying the speed-success link warrants a finer-grained meta-analytic approach that considers the performance implications of development speed in relationship to the different dimensions of new product success.

The NPD literature is rife with categorizations of product success dimensions (Cooper and Kleinschmidt 1987; Griffin and Page 1993, 1996; Hart 1993; Tatikonda and Montoya-Weiss 2001). This research uses the project-level classification by Tatikonda and Montoya-Weiss (2001), who distinguish between operational and external outcome indicators (see Figure 2.1). Each of the other categorizations' project-level dimensions fit into this typology.

Operational success measures assess product development from an internal perspective, including both product and process aspects. Product aspects include the achievement of goals set for technical product performance and product competitive advantage. Process aspects measure development costs and proficiency in market entry timing. External measures reflect the commercial success of new products. Since new products are designed to address customer needs, one way in which success is manifest is in customer-based measures such as market share, sales volume, revenue, customer satisfaction and acceptance. Financial measures, reflecting the extent to which economic goals are fulfilled, include profitability, margin, return on assets and investment and break-even time (Venkatraman and Ramanujam 1986). While both external dimensions capture commercial success outcomes, they nevertheless represent different aspects (Griffin and Page 1993). Success in one dimension does not necessarily imply success in the other. For instance, a product capturing a large market share may be unprofitable due to its cost structure (Mallick and Schroeder 2005).

Figure 2.1 Consequences of new product development speed

Operational outcomes		**External outcomes**
• Development costs	Process	• Customer-based outcomes
• Market entry timing		• Financial outcomes
• Technical product quality	Product	
• Product competitive advantage		

Implied in this multi-dimensional typology of NPD success is a hierarchical structure: operational outcomes can be viewed as fundamental elements of success; financial measures are the ultimate goal (Huang, Soutar and Brown 2004); and customer-based measures link the internal, operational outcomes of the NPD process to their financial implications. The typology also reflects a temporal measurement sequence (Hultink and Robben 1995). While operational outcomes are manifest in the short-term, external outcomes become visible only in the longer term, with customer success manifesting itself faster than financial success. The following sections present the conceptual arguments and empirical evidence relating each group of indicators to speed.

Operational outcomes of development speed

Speed is both a competitive capability (Jayaram and Narasimhan 2007) and an intermediate outcome of the NPD process (Ali, Krapfel and LaBahn 1995). However, development time is not the only intermediate NPD outcome. Development costs, market introduction timing, product quality and product superiority also have crucial implications for achieving favourable customer-based and financial outcomes. Development cost and market entry timing proficiency, for instance, are associated with lower and higher levels of profitability, respectively (Langerak, Hultink and Griffin 2008). Technical product quality and product competitive advantage contribute significantly to both market and financial success (Li and Calantone 1998; Zirger and Maidique 1990).
Together, these five performance indicators (speed, cost, market entry, technical quality and product advantage) comprise the NPD process' operational outcomes. As these outcomes are interrelated (Meyer 1993; Smith and Reinertsen 1991), whether they can be simultaneously achieved remains a heated debate. Some studies portray a synergistic relationship, and suggest that procedures and programs targeting faster development speed also limit overhead costs, promote productivity (Davis, Dibrell and Janz 2002), and facilitate developing high quality, competitively superior products (Kessler and Bierly III 2002). Adherents of the trade-off school, on the other hand, maintain that success of one occurs at the expense of others (Jayaram and Narasimhan 2007), arguing that that time-based strategies direct attention away from controlling costs and achieving quality (Crawford 1992; Eisenhardt and Tabrizi 1995).

Development costs

Development speed affects profitability through its impact on development cost (Gupta, Brockhoff and Weisenfeld 1992), which includes all monetary and human resources needed to develop a new product (Kessler and Bierly III 2002). Conflicting viewpoints exist regarding the precise link. On the one hand, faster development has been argued to promote efficient resource use by limiting the time allocated to peripheral activities and providing a cap on man-hours (Eisenhardt and Tabrizi 1995;

Kessler and Chakrabarti 1996; Rosenthal 1992). Increased activity paralleling to promote speed also fosters higher team communication, cohesion and learning (Brown and Eisenhardt 1995). These, in turn, not only reduce errors and thus rework, but also help eliminate redundancies and overlaps which elevate development costs with little return in productivity (Clark and Fujimoto 1991; Meyer 1993). Shorter cycle times also require lower levels of inventory and working capital, reducing costs and boosting productivity (Davis et al. 2002). These arguments find empirical support from Meyer and Utterback (1995).

In contrast, others maintain that faster product development is costly, with potentially serious consequences. Fast-paced development may require developing highly complex networks, which can be costly to coordinate and manage (Calantone and Di Benedetto 2000; Kessler and Chakrabarti 1999). With teams pushed to the limit of their capabilities, firms may incur expenses for adding personnel, materials and equipment to meet aggressive schedules (Murmann 1994). Finally, rather than increasing productivity by reducing costly mistakes, acceleration efforts can in fact increase their occurrence through eliminating critical process steps (Murmann 1994).

Recent empirical work suggests that there may be a U-shaped association between development time and cost (Langerak et al. 2008), consistent also with the results of other experiments (Gupta et al. 1992) and models (Bayus 1997).While these results somewhat reconcile the two opposing camps, there still is little consensus regarding the true nature of the relationship. The issue becomes even less clear when one considers studies that find no evidence of a significant link between NPD speed and cost, such as Kessler and Bierly III (2002).

Proficiency in market entry timing

Underlying many companies' acceleration efforts are the first-mover advantages attributed to shorter NPD cycles. However, firms entering a market prematurely or with an underdeveloped product also may not be able to exploit a product's strategic window (Lilien and Eunsang 1989). Proficient market-entry timing thus refers to the firm's ability to get the market-entry timing "right": neither too early nor too late (Langerak and Hultink 2006).

Development speed and market-entry timing are closely related, yet distinct, intermediate NPD process outcomes. Speed precedes market-entry timing because only when the product is developed can a firm decide when to enter the market and - potentially - exploit a strategic product window (Ali

2000). With increased strategic flexibility brought about by faster NPD (Eisenhardt and Tabrizi 1995), firms have more freedom to determine the time of market entry and make better entry decisions. Empirical studies that examine the speed-market entry timing link are relatively rare. A notable exception is Langerak et al. (2008), which found that longer development time was significantly negatively associated with market entry timing proficiency.

Technical product quality

Technical quality is the product's ability to perform its primary function (Mallick and Schroeder 2005). This definition is consistent with conformance quality, a product's conformance to design and operating specifications (Jayaram and Narasimhan 2007). Also characterized by opposing perspectives is the relationship between speed and technical product quality.

Exclusively focusing on speed may compromise adherence to product specifications (Eisenhardt and Tabrizi 1995). Further, substantially improving product performance may run directly counter to acceleration goals (Cohen et al. 1996). Emphasis on compressing time-to-market prevents broadly considering alternatives and leaves little time to explore ways to improve product specifications (Sethi 2000). Prematurely freezing specifications to compress development time can prevent the incorporation of newer technologies that could increase performance (Rosenthal 1992). Finally, eliminating process steps in pursuit of speed also can increase product defects and manufacturing problems (Crawford 1992). These arguments are supported by one qualitative study showing that a majority of the case projects had to trade off speed to obtain the desired technical performance (Rosenthal and Tatikonda 1993).

However, there is considerable empirical evidence that faster development does not necessarily lead to poor technical product quality. For example, both Calantone and Di Benedetto (2000) and Kessler and Bierly III (2002) found that greater speed is positively correlated with product performance. Similarly, Harter, Krishnan and Slaughter (2000) show that shorter cycle time in software products is associated with higher quality. On the other hand, Clark and Fujimoto (1991) report no association between speed to market and product performance. In sum, the nature of the speed-technical quality link remains unresolved.

Product competitive advantage

Closely related to product quality is the extent to which a new product is perceived by consumers as being superior with respect to benefit, innovativeness, or function (Montoya-Weiss and Calantone 1994). The speed/competitive advantage relationship is a topic of debate. Some scholars maintain that products that reach the market more quickly are more likely to be viewed by consumers as containing cutting edge technologies (Atuahene-Gima 2003; Carbonell and Rodriguez 2006b). Market and technology forecasts are more accurate with faster development (Smith and Reinertsen 1991), contributing further to perceived customer fit (Kessler and Bierly III 2002; Tatikonda and Montoya-Weiss 2001). However, fast development also can adversely affect competitive advantage. The absence of adequate time to study customer needs and experiment with alternative concepts can prevent developing products offering superior solutions (Mallick and Schroeder 2005). Accelerated projects may thus fail to adequately align with market demand, or be limited to incremental innovations (Crawford 1992).

Empirical studies of the speed-competitive advantage relationship also fail to provide unanimous support for either viewpoint. Both Ali et al. (1995) and Carbonell and Rodriguez (2006b) find that faster NPD is linearly associated with increased competitive advantage. However, Lukas and Menon (2004) found evidence of an inverted U-shaped effect of NPD speed on advantage: faster product development results in more highly advantaged products, up to some level of acceleration, with detrimental effects after that.

External outcomes of development speed

Customer-based outcomes

Favourable customer-based outcomes depend on the firms' ability to transform customer needs into products that are perceived by customers as delivering value (Mallick and Schroeder 2005). The prevailing position points to a positive relationship between speed and marketplace success. In this logic, speed achieves market share objectives by allowing firms to capture unchallenged markets and establish customer loyalty early (Stalk Jr and Hout 1990). It also extends product life in the marketplace (Smith and Reinertsen 1991), increasing sales by reducing a firms' reliance on obsolete products (Cordero, 1991). Empirical studies support this logic (Calantone et al. 1995; García, Sanzo and Trespalacios 2008). Jayaram and Narasimhan (2007) even find that time-to-market surpasses both cost and product quality in their positive association with market share.

However, speed may not consistently contribute to marketplace success, nor does speed necessarily impact all indices of customer-based success in the same way. For example, (Ali 2000) empirically finds that shorter development times positively influence achieving initial revenue goals for minor innovations, but not for major ones. Tatikonda and Montoya-Weiss (2001) report a strong association between shorter development times and increased customer satisfaction, but none for achieving sales objectives. Langerak et al. (2009) find that development time is not a significant predictor of overall sales volume.

Financial outcomes

Profitability and return on assets or investment reflect the bottom-line implications of NPD, as does break-even time, the time it takes for a firm to start making a profit from a new product (Jayaram and Narasimhan 2007). The prevailing view on the speed-financial success link is a synergistic relationship: faster speed increases financial success. Because fast development increases the likelihood that a firm enters a market with fewer competitors, they can follow a skimming pricing strategy, which positively impacts profits (Vandenbosch and Clift 2002). Larger market shares and loyal customer bases achieved through early market penetration enhances profitability (Dröge et al. 2000). These arguments find empirical support from Jayaram and Narasimhan (2007), with respect to profitability, Calantone et al. (1995) and Langerak and Hultink (2005) for ROI and ROA, and Ali et al. (1995) for shorter break-even times.

The above research notwithstanding, an increasing number of studies reveal that this relationship also is far from straightforward. At least one study reports no link between project length and ROI (Swink and Song 2007). Ali (2000) finds that the speed-profitability relationship is moderated by product innovativeness. Langerak and Hultink (2006) document an inverted U-shaped relationship, suggesting there is an “optimal” development speed with the greatest financial returns. Finally, Adams-Bigelow and Griffin (2005) report a negative relationship between speed and profitability. These conflicting results illustrate the potential hidden costs of accelerating development (Crawford 1992), and highlight the fact that cycle time reduction may not necessarily have favourable financial outcomes.

Speed-success relationship summary

In sum, neither conceptual arguments nor empirical research on how development speed relates to operational and external measures of NPD performance have converged to a consensus. This study addresses these inconsistencies and advance scholarly knowledge of these relationships, using use meta-analytic techniques. This allows us to systematically integrate empirical findings from existing research with the methodological and contextual characteristics of the primary studies responsible for the divergent findings.

METHODOLOGY

Database development

The search procedures employed in this investigation to create a comprehensive list of relevant studies were consistent with those utilized by previous meta-analyses in marketing and management (Brown and Peterson 1993; Joshi and Roh 2009; Kirca, Jayachandran and Bearden 2005). It involved first conducting computerized database searches (ABI/INFORM Global, EBSCO, EconLit, JSTOR, ScienceDirect and Web of Science) using keywords and phrases such as “product development,” “cycle time,” “innovation speed,” “time-to-market” and “lead time.” The Social Science Citation Index was also consulted for identifying the most-cited articles in NPD speed research (Griffin 1997a; Kessler and Chakrabarti 1996). These steps were supplemented with a manual search of the following innovation, marketing and management journals: *Academy of Management Journal, IEEE Transactions on Engineering Management, Journal of the Academy of Marketing Science, Journal of Engineering-Technology Management, Journal of Marketing, Journal of Marketing Research, Journal of Operations Management, Journal of Product Innovation Management, Management Science, Marketing Science, R&D Management and Strategic Management Journal*. References from previous meta-analyses (Chen et al. 2010; Gerwin and Barrowman 2002; Henard and Szymanski 2001; Montoya-Weiss and Calantone 1994; Pattikawa et al. 2006) also were reviewed. Finally, to access new or unpublished work, forthcoming articles were requested from scholars known to be engaged in cycle time research.

Two criteria determined whether or not to include a study in the meta-analytic database. First, it had to be published (or forthcoming) in a peer-reviewed, ISI-rated journal. This criterion carries the risk of publication bias, which arises from the tendency of published work to report greater effect sizes than unpublished work, thus producing inflated meta-analytic estimates. However, the extent to which the meta-analytic estimates suffered from this bias was assessed using file drawer analysis, and the findings reported in the results section. Second, it had to be an original quantitative empirical study of NPD speed. Articles presenting theoretical models (e.g., Emmanuelides 1993; Hitt, Hoskisson and Nixon 1993; Zirger and Maidique 1994), methodology development (e.g., Boer and Logendran 1999), analytical models lacking empirical testing (e.g., Bayus, Jain and Rao 1997; Cohen et al. 1996; Loch and Terwiesch 1998; Morgan, Morgan and Moore 2001) and purely qualitative studies (e.g., Flint 2002; Millson et al. 1992; Rabino and Wright 1993; Vesey 1992; von Braun 1990) were discarded. Articles that operationalized development speed as predictions (e.g., Moorman and Miner 1998; Rindfleisch and Moorman 2001) also were excluded from the database.

Each study also had to provide the following pieces of information: (1) a correlation-based effect size statistic for the relationship between development speed and at least one NPD performance dimension; (2) the number of observations (sample size) on which the correlation was based; and (3) reliabilities for both constructs (where applicable). Articles in which development speed was treated as part of a composite NPD performance measure were discarded (e.g., Ancona and Caldwell 1992; Kusunoki, Nonaka and Nagata 1998; Rochford and Rudelius 1992; Salomo, Weise and Gemünden 2007; Schulze and Hoegl 2006; Song, Montoya-Weiss and Schmidt 1997; Tatikonda and Rosenthal 2000b). If an otherwise eligible study did not report one or more of these pieces of information, authors were requested to provide them. Of the 17 authors contacted, 9 supplied meta-analysable data.

Finally, the following rules were employed to ensure an acceptable level of independence for the correlations in the database: (1) If a publication reported results from multiple independent samples separately, their results were included as independent samples (Geyskens, Steenkamp and Kumar 2006); (2) If multiple publications were based on the same or on partially overlapping datasets, they were treated as a single study and correlations entered between two identical variables only once (Franke and Park 2006; Geyskens et al. 2006)[2]. These efforts yielded a database of 52 independent samples obtained from 56 articles published between 1989 and 2009, three of which were forthcoming

[2] As also noted by an anonymous reviewer, the generalised least squares approach of Gleser and Olkin (1994) offers a theoretically and statistically advanced way of addressing dependent effect sizes. However, this approach required knowing the covariance or correlation between dependent effect sizes, which, in a large number of instances were not available. Therefore, in the interest of consistency, the more conservative approach using dependent effect sizes was performed.

when data collection was finalized in April 2009 (See Appendix A).

Variable classification and coding

A preliminary coding protocol that specified the information to be extracted from each study was prepared to reduce errors and ensure coding consistency (Lipsey and Wilson 2001; Stock 1994). One-third of the studies were first coded independently by two of the authors based on this coding protocol, yielding an overall coding consistency of 91%[3]. Discussion resolved disagreements and ambiguities in the coding scheme. The remaining studies were coded by the first author on the basis of the revised scheme. The final version of the database was verified by the second author.

All of the success indicators were classified into either operational or external NPD outcomes, based on Tatikonda and Montoya-Weiss (2001), and then further classified into the six sub-categories of Figure 2.1. Following Damanpour (1991) and Geyskens, Steenkamp and Kumar (1998), effect sizes were assigned to performance categories based on how constructs were operationalized. In the majority of instances, there was no discrepancy between construct name and specific variable operationalization. However, due to the limited number of studies investigating certain constructs (e.g., customer satisfaction, ROI/ROA, break-even time), all specific variable operationalisations were collapsed under the umbrella construct for that category (e.g., ROI/ROA and break-even time both became externally-determined financial outcomes).

Because a number of studies either used a single item measure without explicitly specifying the NPD performance dimension examined (Larson and Gobeli 1989), or collapsed multiple different items into a single general measure (e.g., Aronson, Reilly and Lynn (2006)'s 'NPD project performance'; Rusinko (1999)'s 'NPD effectiveness'), an 'overall NPD performance' construct was created to accommodate for these studies. Effect sizes were reverse-coded for studies that operationalized speed as development time. Finally, information on a number of potential contextual and methodological study characteristics was coded for moderator analysis.

The following actions were taken to minimize bias that may occur due to multiple counts of dependent

[3] The inter-coder agreement per meta-factor was as follows: New product success 91%, development costs 90%, market entry timing 100%, technical product quality 95%, product competitive advantage 86%, customer-based success measures 93%, and financial success measures 86%.

effect size estimates. First, when an article reported correlations for sub-samples but not for the total sample, each pair of correlations involving the same variables was averaged (Gerwin and Barrowman 2002). Second, for articles reporting multiple variables for the same relationship or measuring the same variable at different times, the average correlation was entered in the meta-analysis (Brown and Peterson 1993; Crosno and Dahlstrom 2008). Coding yielded 84 harvested effect sizes. Sample sizes ranged between 29 and 692. The average and total sample sizes were 163 and 13,163, respectively.

Meta-analytic calculations

As with other recently published meta-analyses (Chen et al. 2010; Gerwin and Barrowman 2002) this study adhered to Hunter and Schmidt (1990)'s analytic approach. This approach provides clear guidelines to correct for statistical artefacts that cause effect sizes to deviate from the true population effect size and avoids the statistical power difficulties associated with testing when the number of studies is small (Gerwin and Barrowman 2002). Finally, it allows investigation of the moderating role of study characteristics and the determination of conditions under which certain effects are manifest (Chen et al. 2010).

The biasing effect of both sampling and measurement error were corrected for prior to analysis. To correct for sampling error, the weighted-mean correlation (*r-bar*) was calculated by weighing each correlation with its corresponding sample size and its standard deviation. To correct for measurement error, each reported correlation was divided by the square root of the reliabilities of the two constructs. For averaged correlations, an average reliability coefficient also was computed (Gerwin and Barrowman 2002). When reliability information was not provided, the mean reliability from the other articles investigating the same relationship was used as the best estimate of the missing reliability coefficient (Balkundi and Harrison 2006). The true score correlation (ρ) was reached by computing the weighted average of the reliability-corrected correlations.

In calculating the variability in effect size estimates once they have been averaged across studies, the fixed-effects (FE) model attributes variability in findings to sampling error variance only, implicitly assuming that studies are otherwise homogeneous. The random effects (RE) model (Franke and Park 2006; Rodriguez Cano, Carrillat and Jaramillo 2004), on the other hand, treats the variability as arising from two sources: (1) study sampling (between-studies variance), and (2) the sampling of individuals within studies (sampling error variance). This article thus adopted the RE approach, since it is more conservative and is less susceptible to Type I errors (Hunter and Schmidt 2000).

RESULTS

Main effects

Table 2.2 reports the main effects results, giving the number of correlations (k), combined sample size (N), sample-weighted uncorrected correlation (*r-bar*), estimated true correlation corrected for sampling error and unreliability (ρ) for each effect size. 95% confidence intervals were constructed around *r-bar* for each relationship using the random effects standard error formula (Hunter and Schmidt 2000). If this confidence interval does not include zero, the r-bar estimates are not significantly different from zero. As some of these confidence intervals are fairly large due to the use of the random effects model, the resulting conclusions are fairly conservative.

Also, since published studies tend to report greater effect sizes than unpublished ones (the "file drawer problem" or "availability bias"), the exclusion of unpublished work may lead to inflated meta-analytic estimates and erroneous conclusions (Lipsey and Wilson 2001). The last column thus reports the *fail-safe k*, or number of additional unpublished studies that would be needed to reduce the effect size to below statistical significance ($p < 0.05$), to address potential concerns of this bias (Orlitzky, Schmidt and Rynes 2003). Larger *fail-safe k*'s, such as these, indicate the absence of a serious threat to the validity and reliability of meta-analytic findings.

The results indicate a significant positive correlation between the development speed - overall new product success constructs (ρ = 0.309, $p < 0.05$), with a failsafe k sufficiently large to alleviate potential file drawer concerns.

Of the relationships between development speed and the four operational NPD outcomes, all but one is statistically significant. First, shorter development times are significantly associated with lower development costs and increased proficiency in market entry timing, the two process-related success constructs. With effect estimates of ρ = -0.47 and ρ = 0.65, respectively (both $p < 0.05$), the associations can comfortably be classified as strong (Cohen 1992). The speed and technical product quality relationship fails to reach significance. Finally, development speed is positively and

Table 2.2 Main effect results

	k	*N*	*avN*	*min r*	*max r*	*r_obs*	*r-bar*	*ρ*	*SDE r-bar*	*LB*	*UB*	Var_{obs}	Var_{samp}	Var_{rel}	Var_{expl}	*Q-stat*	*df*	*Fail-safe k*
New Product Success:																		
Overall/composite	22	3907	178	-0.56	0.79	0.34	0.25	**0.31** *	0.08	0.10	0.40	0.13	0.01	0.00	**5.28%**	**579.33***	21	114
Operational Outcomes:																		
Process measures																		
Development costs	19	3032	160	-0.63	0.55	-0.34	-0.42	**-0.47** *	0.06	-0.53	-0.32	0.06	0.00	0.01	**16.52%**	**283.53***	18	159
Market entry timing	3	217	72	0.41	0.45	0.43	0.42	**0.65** *	0.06	0.31	0.53	0.00	0.01	0.01	100.00%	0.05	2	36
Product measures																		
Technical product quality	17	2114	124	-0.34	0.65	0.22	0.13	-0.15	0.08	-0.02	0.28	0.10	0.01	0.00	**8.50%**	**212.63***	16	n/a
Product competitive advantage	15	2157	144	-0.66	0.49	0.21	0.25	**0.30** *	0.05	0.15	0.34	0.04	0.01	0.00	**1.63%**	**88.03***	14	75
External Outcomes:																		
Customer-based	13	1768	136	-0.12	0.60	0.21	0.24	**0.28** *	0.05	0.14	0.35	0.04	0.01	0.00	**2.25%**	**74.94***	12	60
Financial	8	1789	224	0.02	0.38	0.23	0.22	**0.29** *	0.04	0.14	0.30	0.02	0.00	0.00	**7.61%**	**31.55***	7	39

* $p < 0.05$;

k: number of correlations analysed; ***N:*** combined sample size; ***avN:*** average sample size (N/k); ***min r:*** minimum reported correlation; ***max r:*** maximum reported correlation; ***r_obs:*** simple average of reported (uncorrected) correlations; ***r-bar:*** sample-weighted average of reported (uncorrected) correlations; ***ρ:*** estimated true correlation corrected for sampling error and unreliability; ***SDE r-bar:*** sampling error variance of the mean observed correlation (random effects formula); ***LB:*** lower bound of 95% confidence interval around the r-bar; ***UB***: upper bound of 95% confidence interval around the r-bar; var_{obs}: observed variance in effect sizes; var_{samp}: variance due to sampling error; var_{rel}: variance due to differences in reliability of construct measurement; var_{expl}: percentage of observed variance explained by sampling and measurement errors (when < 75%, search for moderators); ***Q-statistic***: Q statistic for heterogeneity (when significant, search for moderators); ***df:*** degrees of freedom for *Q*-statistic (*k*-1); ***Fail-safe k:*** number of additional unpublished or overlooked studies that would need to be included in the database to reduce the effect size to ρ = 0.05.

significantly associated with increased product competitive advantage ($\rho = 0.30$, $p < 0.05$). *Fail-safe k* values ($k = 36$-159, 6-12 times the number of correlations included in the meta-analyses) for the three significant relationships suggest that, if included, new or unpublished studies are unlikely to influence the results.

For the two external outcomes, financial and customer-based measures, the estimated true correlation coefficient for both constructs in relation to speed is positive, significant, and moderate in magnitude ($\rho = 0.29$ and $\rho = 0.28$, $p < 0.05$, respectively). The fail-safe *k* values (4-5 times the number of correlations included in the meta-analysis) also suggest that these relationships appear resistant to unpublished null effects.

Together, these results generally support the contention that NPD speed promotes success. The findings for development cost and proficiency in market entry timing, the two process-related aspects of operational success, are in line with the synergistic accounts (faster is better) of their association with speed as is the relationship between speed and the product-related operational construct of product competitive advantage - faster development is associated with more competitively advantaged products. However, the results suggest no significant association between speed and technical product quality, and thus are unable to establish the superiority of either a synergistic (faster is better) or trade-off perspective (faster is worse) for that relationship.

Development speed also is significantly and moderately strongly linked both to increased customer-based and financial new product outcomes, the external measures of new product success. If success measures are hierarchical in nature, with customer-based success acting as one possible link between operational process and product measures of success and the ultimate goal of creating financially successful products, as suggested by Langerak et al. (2008), then these findings suggest that NPD speed must be considered as at least one of the factors that managers will want to manage to achieve these external success measures.

Heterogeneity analysis

Although the main effect results indicate a generally synergistic relationship between development speed and NPD outcomes, these relationships may not necessarily be manifest similarly across all 52 independent samples. That is, substantial variance across independent samples may have remained even after correcting for artefacts (i.e., sample size and reliability).

The generalizability of the main effects findings was assessed in two ways. The Q statistic (Lipsey and Wilson 2001), assesses the homogeneity of the effect size distribution (Hedges and Olkin 1985). A significant Q suggests a likely presence of effect size heterogeneity, warranting a search for moderators to explain it. The second method used was the 75% rule (Hunter and Schmidt 1990). According to this rule, when statistical artefacts (sampling and measurement errors) explain 75% or more of the observed variance, moderators are unlikely to have caused variation and the effect size can be considered homogeneous across studies. The methods yielded consistent results for all seven relationships.

Only the speed-market entry timing proficiency relationship proves to be homogeneous: its Q statistic is not statistically significant and virtually 100% of observed variance is accounted for by sampling and measurement errors. The other six speed/success relationships display heterogeneity. It was thus necessary to search for moderating variables for these success dimensions.

Moderator effects

Potential moderators were chosen based on previous NPD research (Griffin 2002; Kessler and Chakrabarti 1996; Mallick and Schroeder 2005) and meta-analyses (Chen et al. 2010; Henard and Szymanski 2001). Moderators were coded only when information was unambiguous in the text (Damanpour 1991). Moderation was tested only when at least 3 observations were present for each category to ensure estimate stability (Geyskens et al. 2006).[4]

Table 2.3 lists the characteristics considered in the moderator analysis.

For moderators coded as categorical variables, the ANOVA-analogue test was used to assess their influence on effect size (Lipsey and Wilson 2001). This method splits the effect sizes into the moderator categories and tests for between- and within-group category differences, yielding two test statistics: (1) the between-group goodness-of-fit statistic Q_b, and (2) the within-group goodness-of-fit

[4] Consequently, investigating the role of several of the initially coded moderating variables was not possible, including: (1) key informant versus senior management response data, (2) primary versus secondary data; (3) survey versus other forms of data collection; (4) cross-sectional versus longitudinal research design; (5) industrial versus consumer markets; (6) single versus multiple organization response data; and (7) US versus non-US sample.

statistic Q_w (Aguinis and Pierce 1998). When Q_b is statistically significant, the mean effect size differs for the two groups and the moderator is significant (Joshi and Roh 2009). To compare estimated true population correlations of moderator categories, separate meta-analyses were conducted for each category. 95% confidence intervals were constructed around the uncorrected weighted mean correlation for each category to see whether it includes zero. Since year of data collection was coded as a continuous variable, its moderating role was assessed by treating it as the independent variable in a simple regression for predicting effect sizes for each meta-factor. Since they are more accurate representations of true effect size than reported correlations (Hunter and Schmidt 1990), this study adhered to the approach used by Henard and Szymanski (2001) and Troy, Hirunyawipada and Paswan (2008) and conducted the moderator analysis on reliability-corrected correlations. Results from these procedures are presented in Tables 2.4 (research design moderators), 2.5 (speed measurement moderators) and 2.6 (contextual moderators).

Table 2.3 Potential moderators of the speed-performance relationship

Study design characteristics	
1. Organizational sampling procedure	random versus non-random sampling
2. Scope of measurement	project-level versus program-level scope
3. Number of informants	Single versus multiple informants
4. Year of data collection	the year in which the data used in the study was collected ('publication year-3' if not specified)
Speed measurement characteristics	
5. Number of items	single-item versus multi-item scales
6. Absolute versus relative measures	actual development speed versus speed compared to initial plans or similar past projects
7. Objective versus subjective measures	development speed obtained from company database versus respondents' perceptual assessment of development speed
Contextual characteristics	
8. Type of innovation	products only versus products and services
9. Number of industries represented in sample	single industry versus multiple industries

Table 2.4 Moderator analysis results for research design characteristics

	1. Selection of organizations			**2. Level of analysis**			**3. Number of informants**			**4. Year of Data Collection**
	Rand *ρ (k)*	*nRand* *ρ (k)*	Q_b	*Proj* *ρ (k)*	*Progr* *ρ (k)*	Q_b	*Single* *ρ (k)*	*Multi* *ρ (k)*	Q_b	*β (SE)*
New Product Success										
Overall/composite	-0.10 (5)	**0.51** * **(10)**	319.10 *	0.30 * (18)	0.37 * (4)	3.026	0.31 * (19)	0.31 * (3)	0.96	**0.03** * (0.01)
Operational Outcomes										
Process measures										
Development costs	-0.39 * (3)	**-0.52** * **(14)**	12.58 *	- (19)	- (1)	-	**-0.50** * **(13)**	-0.22 * (6)	23.61 *	0.03 (0.04)
Product measures										
Technical product quality	0.09 (5)	**0.25** * **(12)**	13.21 *	- (16)	- (1)	-	0.13 (17)	0.22 * (5)	2.76	**0.03** * (0.01)
Product competitive advantage	**0.48** * **(5)**	0.22 * (10)	28.95 *	- (15)	- (2)	-	- (14)	- (1)	-	0.03 (0.02)
External Outcomes										
Customer-based	**0.40** * **(5)**	0.15 (8)	26.84 *	- (11)	- (2)	-	- (11)	- (2)	-	0.01 (0.01)
Financial	0.25 * (3)	0.32 * (5)	1.78	- (6)	- (2)	-	- (7)	- (1)	-	0.02 (0.02)

*$p < 0.05$;

ρ: estimated true correlation corrected for sampling error and unreliability for moderator category subset; ***k:*** number of correlations analysed in moderator category subset; ***Rand:*** random selection of organizations; ***nRand:*** non-random selection of organizations; ***Proj:*** project-level success; ***Prog:*** program-level success; ***Single:*** one respondent; ***Multi:*** multiple respondents; ***β:*** multiple regression coefficient estimate for year of publication; ***SE:*** standard error of coefficient estimate for year of publication.

Bolded numbers indicate which of the 2 subgroups had a significantly larger effect size when Q_b is significant.

As shown in Table 2.4 by the significant Q_b statistics, organizational sampling criteria significantly moderated all relationships, except for the speed-financial outcomes link. Randomly selected samples had larger effect sizes for customer-based and competitive advantage outcomes than did those not reporting such a selection procedure. Non-random samples had higher effect sizes for composite success, development costs, and technical product quality outcomes. Sampling procedure was particularly influential on the development speed-composite success link, with a very high Q_b (319.1) and markedly different mean effect sizes: $\rho_{random} = -0.099$ (n.s.) versus $\rho_{non\text{-}random} = 0.510$ ($p < 0.05$).

Since the overwhelming majority of studies engaged in project-level as opposed to program-level data collection (46 versus 6), the only relationship for which a sufficient number of observations per moderator category was available was speed-composite success. However, a non-significant Q_b statistic indicated no between-category difference in mean effect size.

The moderating role of the number of informants was assessed for 3 relationships. Q_b was significant for only the speed-cost link ($Q_b = 23.61$, $p < 0.01$), where the single-respondent mean effect size was markedly larger than its multiple-respondent category counterpart, and both effects were significant ($\rho_{single} = -0.50$, $\rho_{multiple} = -0.22$, $p < 0.05$).

Finally, as indicated by their small but statistically significant regression coefficients (both 0.03, $p < 0.05$), more recent studies report greater effect sizes regarding the speed-success and speed-technical performance links.

The role of speed measurement characteristics on the meta-analytic estimates was examined next (Table 2.5). It was possible to test all six success dimensions for the moderating effect of the number of items in the speed measure. Only customer-based outcomes showed no moderation ($Q_b = 2.40$, $p > 0.10$). For the remaining five relationships, studies using multi-item scales report correlations noticeably greater in magnitude than those using single-item scales.

Whether speed was operationalized in absolute or relative terms was a significantly moderating influence for both external success outcomes. When measured in relative terms, there was a significant relationship between speed and customer- and financial-based success. However, these relationships reduced to insignificance when studies used absolute speed measures. The same result occurred for the speed-product competitive advantage relationship. The speed-technical product quality link showed no moderation by this variable, while the other success dimensions had insufficient numbers of cases for testing.

Table 2.5 Moderator analysis results for speed measurement characteristics

	5. Number of items			6. Absolute vs. relative			7. Objective vs. subjective		
	Single *ρ (k)*	*Multi* *ρ (k)*	Q_b	*Abs* *ρ (k)*	*Rel* *ρ (k)*	Q_b	*Obj* *ρ (k)*	*Subj* *ρ (k)*	Q_b
New Product Success									
Overall/composite	-0.11 (8)	**0.50** **(14)**	318.35 *	- (2)	- (20)	-	- (1)	- (14)	-
Operational Outcomes									
Process measures									
Development costs	-0.34 * (8)	**-0.61** * **(7)**	54.11 *	- (2)	- (17)	-	- (2)	- (17)	-
Product measures									
Technical product quality	0.12 (14)	**0.41** **(3)**	16.66 *	-0.124 * (5)	0.16 (23)	0.29	0.15 (4)	0.16 (13)	0.40
Product competitive advantage	0.13 (6)	**0.39** * **(9)**	30.82 *	-0.027 (3)	**0.41** **(12)**	76.20 *	- (1)	- (14)	-
External Outcomes									
Customer-based	0.26 * (7)	0.32 * (6)	2.40 *	0.067 (5)	**0.37** * **(8)**	32.15 *	- (2)	- (11)	-
Financial	0.16 * (8)	**0.53** * **(3)**	55.16 *	0.071 (4)	**0.46** * **(4)**	67.22 *	- (1)	- (7)	-

* $p < 0.05$;

ρ: estimated true correlation corrected for sampling error and unreliability for moderator category subset; ***k:*** number of correlations analysed in moderator category subset; ***Single:*** single-item scale; ***Multi:*** multiple-item scale; ***Abs:*** absolute measure of speed (months); ***Rel:*** relative measure of speed; ***Obj:*** objective measure of speed; ***Subj:*** subjective measure of speed.

Bolded numbers indicate which of the 2 subgroups had a significantly larger effect size when Q_b is significant.

A thorough investigation of the objective versus subjective development speed operationalization was infeasible due to an insufficient number of studies using objective measures for all relationships except for the technical product quality success dimension. Even then, however, the results did not suggest any moderating role of this variable.

Finally, the roles of two contextual study characteristics on the meta-analytic estimates were assessed. Table 2.6 shows that whether or not studies focused on products (physical goods) only or a combination of products and services significantly moderated only the effect of development speed on composite success, (Q_b = 65.48, $p < 0.01$), with the mixed category reporting greater correlations ($\rho_{products}$ = 0.22 and ρ_{mixed} = 0.48).

Table 2.6 Moderator analysis results for contextual characteristics

	8. Innovation type			9. Number of industries		
	Prod ρ (k)	Serv ρ (k)	Q_b	Single ρ (k)	Multi ρ (k)	Q_b
New Product Success						
Overall/ composite	0.22 (18)	**0.48** * **(4)**	65.48*	- (1)	- (21)	-
Operational Outcomes						
Process measures						
Development costs	- (17)	- (2)	-	-0.45 * (6)	-0.47 * (13)	0.19
Product measures						
Technical product quality	- (17)	- (1)	-	0.13 (5)	0.16 (12)	0.15
Product competitive advantage	- (15)	- (2)	-	- (2)	- (13)	-
External Outcomes						
Customer-based	0.27 * (10)	0.31 * (3)	0.56	0.34 (4)	0.27 * (9)	1.53
Financial	- (8)	- (0)	-	- (1)	- (7)	-

* p<0.05;

ρ: estimated true correlation corrected for sampling error and unreliability for moderator category subset; ***k:*** number of correlations analysed in moderator category subset; ***Prod:*** physical good or product; ***Serv:*** service; ***Single:*** one industry context; ***Multi:*** multiple industries in survey.

Bolded numbers indicate which of the 2 subgroups had a significantly larger effect size when Q_b is significant.

Three development speed relationships assessed whether studies using single-industry data differed from those using data from multiple industries: customer-based outcomes, development costs and technical product quality. However, number of industries was not a significant moderator for any of the studied effects (Q_b = 0.19, 0.15 and 1.53, respectively).

In sum, although a comprehensive moderator analysis of several potential moderators was not feasible due to data limitations, a number of factors were identified that do contribute to a lack of cross-situational consistency in speed/success relationships.

ANTECEDENTS OF NEW PRODUCT DEVELOPMENT SPEED

To provide a holistic view of NPD speed and validate the results reported by Chen et al. (2010), a meta-analysis of NPD speed antecedents was also performed following the analytic procedures described above. The database, which consisted of 75 independent samples from 86 publications, yielded 354 effect sizes spread across 42 meta-factors[5]. Sample sizes ranged from 11 to 692. The average and total sample sizes were 136 and 46,354, respectively.

Although this study adopted a more fine-grained approach to variable classification (for instance, distinguishing between firm and market perspectives of innovativeness) and considered additional influences (e.g., NPD competencies, firm characteristics and environmental factors), its meta-factor groupings corresponded broadly with the Chen et al. (2010) study. The antecedents analysed are as follows. The number of independent samples which reported correlations with development speed (*k*) is indicated in parentheses. Project characteristics: complexity (14), firm perspective of innovativeness (19), market perspective of innovativeness (9), composite/not specified perspective of innovativeness (5), project newness (5), project size (3); Process characteristics: standardization (10), supplier involvement (12), customer involvement (10), use of other outside assistance (11), goal effectiveness (15), formal process use (9), process concurrency (13), iteration frequency (5), testing (3); NPD team characteristics: cross-functional team use (9), extent of functional diversity (7), organizational integration (12), teamwork quality (13), team size (14), team stability (4), team commitment (4), management style (11), team leader strength (10), team co-location (7); NPD competencies: planning proficiency (4), marketing proficiency (11), technical proficiency (9), problem solving proficiency (4), team learning (6); Firm characteristics: alignment with core competencies (7), resource availability (4), organizational support (8), speed emphasis (6), time-based incentives (4), project priority (6), company size (13), innovative organizational climate (5); Environmental characteristics: technology turbulence (12), market turbulence (12), competitive intensity (4), market attractiveness and ease of entry (5).

---

[5] Chen et al. (2010) used a smaller database of 217 effect sizes spread across 17 meta-factors, harvested from 74 independent samples which appeared in 70 publications.

The results, particularly those pertaining to the meta-factors with population correlation coefficients greater than 0.30 (‘salient’ antecedents of development speed) were consistent with Chen et al. (2010).

No project characteristic emerged as a significant antecedent to development speed. Goal effectiveness was the only salient ($\rho > 0.3$) process characteristic, with a corrected population correlation estimate of 0.38. Also contributing to faster product development were process concurrency (ρ = 0.28), customer involvement (ρ = 0.28), formal process use (ρ = 0.25), testing (ρ = 0.24), supplier involvement (ρ = 0.15) and standardization (ρ = 0.14). The link between these 7 process-related antecedents and development speed was cross-situationally consistent.

Of the 10 NPD team characteristics analysed, team stability (ρ = 0.39) and team leader strength (ρ = 0.33) are salient contributors to development speed. Neither the chi-square test nor the 75% rule suggested heterogeneity in their relationship with development speed. Team commitment and management style were also significant and cross-situationally consistent antecedents pertaining to the NPD team. Organizational integration (ρ = 0.26), teamwork quality (ρ = 0.23), team commitment (ρ = 0.21), management style (ρ = 0.19) and cross-functional team use (ρ = 0.18) were also significant, albeit not salient, features of the NPD team associated with faster development.

With regard to NPD competencies, marketing proficiency (ρ = 0.37), problem solving proficiency (ρ = 0.33) and team learning (ρ = 0.32) were salient determinants of development speed. Technical proficiency was also a significant, but not quite salient, contributor to speed (ρ = 0.29). However, all of these competencies displayed heterogeneity in their relationship with development speed.

Innovative firm climate (ρ = 0.38), organizational support (ρ = 0.34) and availability of resources (ρ = 0.31) were the firm characteristics displaying the strongest association with faster NPD. Emphasis on speed (ρ = 0.25), project priority (ρ = 0.14) and company size (ρ = 0.08) were also significant meta-factors. None of these meta-factors, except for availability of resources and facilities, were cross-situationally consistent.

None of the 4 environmental characteristics analysed proved significant.

Table 2.7 summarizes the main effects and heterogeneity analysis results and compares it to those reported by Chen et al. (2010). The results generally validate the previous findings, discrepancies attributable to differences in variable classification and database size.[6]

Table 2.7 Antecedents of development speed - Main effects and heterogeneity analysis summary comparison

Present Study			***Chen et al. (2010)***		
Antecedent	***ρ (k)***	***Htg.***	***Antecedent***	***ρ (k)***	***Htg.***
Project characteristics					
Complexity	-0.10 (14)	N	Complexity	-0.13 (18)	N
Firm perspective of innovativeness	0.01 (19)	N	Newness	0.06 (27)	N
Market perspective of innovativeness	0.07 (9)	N			
Mixed/unspecified perspective of innovativeness	0.12 (5)	N			
Project newness	0.01 (5)	Y			
Project size	-0.19 (3)	N	n/av	-	-
Process characteristics					
Standardization	**0.14** * (10)	Y	Process formalization	**0.23** * (12)	Y
Formal process use	**0.25** * **(9)**	N			
Supplier involvement	**0.15** * (12)	N	External integration	**0.29** * (18)	N
Customer involvement	**0.28** * (10)	N			
Use of other outside assistance/information	0.08 (11)	N			
Goal effectiveness	***0.38*** * (15)	Y	Goal clarity	***0.38*** * (12)	N
Process concurrency	**0.28** * (13)	Y	Process concurrency	***0.34*** (12)	Y
Iteration/build frequency	-0.12 * (5)	N	Iteration	***0.32*** * (6)	Y
Testing	**0.24** * (3)	Y			
NPD team characteristics					
Cross functional team use	**0.18** * (9)	N	Internal integration	***0.38*** * (36)	N
Organizational integration	**0.26** * (12)	N			

[6] Since a development speed antecedent meta-analysis is not a central aim of this study, the results are not reported in as much detail as those pertaining to NPD performance.

Table 2.7 (cont.) Antecedents of development speed - Main effects and heterogeneity analysis summary comparison

Present Study			*Chen et al. (2010)*		
Antecedent	***ρ (k)***	***Htg.***	***Antecedent***	***ρ (k)***	***Htg.***
Teamwork quality	**0.23** * (13)	N			
Functional diversity	0.07 (7)	N	Functional diversity	0.09 (6)	N
Team size	-0.02 (14)	N	(n/av)	-	-
Team stability	***0.39*** * (4)	Y	Team dedication	***0.36*** * (10)	N
Team dedication and commitment	**0.21** * (4)	Y			
Management style	**0.19** * (11)	Y	Team empowerment	**0.22** * (10)	N
Strength and influence of team leader	***0.33*** * (10)	Y	Team leadership	***0.37*** * (10)	N
Team proximity/ same site location	0.04 (7)	N	Team co-location	0.04 (8)	N
NPD competencies					
Up-front planning proficiency	0.11 (4)	N	(n/av)	-	-
Marketing proficiency	***0.37*** * (11)	N	(n/av)	-	-
Technical proficiency	**0.29** * (9)	N	(n/av)	-	-
Problem solving proficiency	***0.33*** * (4)	N	(n/av)	-	-
Team learning	***0.32*** * (6)	N	Learning	**0.27** * (11)	Y
Firm characteristics					
Experience & alignment with core competencies	0.16 (7)	N	Team experience	***0.38*** * (5)	Y
Availability of resources and facilities	***0.31*** * (4)	Y	Top management support	**0.29** * (10)	N
Organizational support	***0.34*** * (8)	N			
Project priority	**0.14** * (6)	N	(n/av)	-	-
Speed emphasis	**0.25** * (6)	N	Emphasis on speed	0.19 (7)	N
Presence of time-based rewards and incentives	0.08 (4)	Y			
Company size	**0.08** * (13)	N	(n/av)	-	-
Innovative firm climate	***0.38*** * (5)	N	(n/av)	-	-

Table 2.7 (cont.) Antecedents of development speed - Main effects and heterogeneity analysis summary comparison

Present Study			***Chen et al. (2010)***		
Antecedent	***ρ (k)***	***Htg.***	***Antecedent***	***ρ (k)***	***Htg.***
Environmental characteristics					
Technological turbulence	0.07 (12)	N	(n/av)	-	-
Market/demographic turbulence	0.01 (12)	N	(n/av)	-	-
Competitive intensity	0.02 (4)	N	(n/av)	-	-
Market attractiveness/ ease of entry	0.09 (5)	N	(n/av)	-	-

* $p < 0.05$;

ρ: estimated true correlation corrected for sampling error and unreliability; ***k***: number of correlations analysed; ***Htg***: Result of heterogeneity analysis based on the 75% rule and significant Q_b (Y=cross-situationally consistent; N=heterogeneous).

Bolded numbers indicate statistically significant antecedents ($p < 0.05$);

Bolded and italicized numbers indicate salient antecedents ($\rho > 0.3$).

DISCUSSION

The main finding of this meta-analysis is that, at first glance, development speed is associated with increased new product success. These findings are independent of whether success is measured overall, as an operational outcome, or as an external outcome.

Table 2.8 shows how the results of this study compare to previous meta-analytic studies. As none of the previous meta-analyses investigated new product success as a multi-dimensional construct, their main effect findings are comparable only to those produced by the studies in our meta-analytic database that used just an “overall” or “composite” measure of success (Table 2.2, row 1).

The main effect size estimate of the present research is just larger than the average of the effect sizes found previously, and thus corroborates previous findings. Interestingly, as these data also show, both Henard and Szymanski (2001) and Pattikawa et al. (2006) found that the observed variance explained

Table 2.8 Results across meta-analytic studies

Study	Montoya-Weiss and Calantone (1994)	Henard and Szymanski (2001)	Pattikawa et al. (2006)	Present study
Speed Effect Size	0.18	**0.22***	**0.39***	**0.31***
Heterogeneity	Not tested: Small # of studies; need replication	Variation explained by sampling and measurement < 75% (test for moderators)	Variation explained by sampling and measurement < 75% (test for moderators)	Variation explained by sampling and measurement < 75% AND *Q* statistic significant (test for moderators)
Moderators tested	• None	• Level of respondent • # Success items • Objective/subjective success measure • Innovation type • Sample geography	• None	• Sample selection • Analysis level • # informants • # speed items • Absolute/relative speed measure • Objective/subjective speed measure • Innovation type • # industries
Moderation found		• Objective/subjective success measure		• Sample selection • # informants • # speed items • Absolute/relative speed measure • Innovation type

* $p < 0.05$.

by sampling and measurement errors was less than 75%, suggesting that non-random cross-situational heterogeneity exists in the data and that the corrected population effect size yielded by the main effects analysis may not be generalizable onto certain groups of studies.[7] Investigating the moderating influences on effect size and the speed relationships for the different dimensions of success is the unique contribution of this research to extant knowledge in the field.

Closer inspection of the meta-analytic estimates for the speed-performance associations for the different success dimensions studied reveals that faster product development is linked to favourable outcomes in all but one dimension. Improved technical product quality is not associated with how fast the NPD process is completed. On the one hand, this makes sense. Sometimes, achieving technical product quality goals is just more difficult than initially envisioned, and thus takes longer than

[7] With only one correlation, Montoya-Weiss and Calantone (1994) could not perform this analysis.

originally expected (Cohen et al. 1996). And one of the ways in which firms sometimes meet commercialization date targets or shorten cycle times is through compromising product performance specifications (Rosenthal and Tatikonda 1993). On the other hand, a number of previous studies have found significant and positive relationships between speed and technical quality (Calantone and Di Benedetto 2000; Harter et al. 2000; Kessler and Bierly III 2002) What may thus have occurred in this dataset then, are some studies with positive and some studies with negative correlations, with each cancelling the other out, and the overall general empirical result being no significant relationship. These opposing results also may indicate a nonlinear association between the two variables, which cannot readily be inferred from these bivariate correlations.

Decreasing NPD cycle time has the largest correlation with proficiently managing market entry timing. Furthermore, two separate tests suggest that this finding (and only this finding) is robust across research design decisions and contexts. Thus, from a managerial perspective, explicitly managing NPD speed is most important for products and industries that have very narrow strategic windows of opportunity, where, if one misses the window, the product likely will not return the firm's investment in it. A recent example of this is Motorola in the smart phone market, which, with a Droid 2009 market share of 9.7%, lags significantly behind Research in Motion (49.2%), and Apple (23.1%).[8] Even with a number of quality-differentiating features,[9] forecasters predict that the Droid will not overtake the market pioneers.

The remaining four success indicators – development costs, product competitive advantage, and customer-based and financial success – all show statistically significant main effect correlations with NPD speed. Faster development is associated with favourable outcomes in these indicators. At first glance, these findings stand in stark contrast to the literature that emphasizes the unintended consequences of NPD speed on other operational outcomes (e.g., Crawford 1992; Lilien and Eunsang 1989; Smith and Reinertsen 1991). Instead, they align with the synergistic view on the link between operational NPD outcomes. Rather than posing an additional burden on firm resources (Rosenthal 1992), developing products faster allows firms to limit expenditures such as man-hours. Similarly, products that are moved to market quickly benefit from more accurate forecasts, such that they are better aligned with the rapidly changing needs of consumers (Smith and Reinertsen 1991). The synergy account also enjoys theoretical support from a learning perspective, in that faster product development allows for more learning loops and fosters NPD competencies which, in turn, translate

[8] http://seekingalpha.com/article/194442-predicting-2010-north-american-smartphone-market-share

[9] http://www.pcworld.com/article/174609/verizon_droid_5_standout_features.html

into a more efficient development process (Eisenhardt and Tabrizi 1995).

It is important to note however, that these meta-analysis findings should not necessarily be interpreted as refuting the possibility of trade-offs between success dimensions. As highlighted by Swink et al. (2006), trade-offs are more apparent in highly efficient projects than in those operating with suboptimal levels of efficiency. This is because projects operating with low efficiency have more scope to utilize processes, techniques and resources to achieve improvements on multiple fronts. Efficient projects, on the other hand, have already exhausted these possibilities and cannot increase efficiency further in the absence of additional resources. It is therefore reasonable to suggest that the lack of meta-analytic evidence for performance trade-offs can be due to the disproportionate representation of inefficient projects in the primary studies.

Results of the heterogeneity analyses conducted also are indicative of a more complex speed-performance relationship than indicated by the main effects results alone. Proficiency in market entry timing aside, no other performance measure displays heterogeneity in its relationship with development speed. Thus, it is possible for the trade-off and synergy scenarios to both be applicable, depending upon the features of the research and the setting in which it was conducted. The moderator analyses conducted for the heterogeneous relationships provide detailed insight on how research design features, choice of speed measure and study context bear on the findings. As Table 2.8 shows, none of the previous development speed meta-analyses included potential moderators.

Worthy of particular attention are the moderating influences on the speed-technical product performance link, the main effect estimate for which failed to reach significance. However, close inspection of Tables 2.4-2.6 reveals that the relationship is in fact statistically significant for certain subgroups of studies. In particular, research design and speed variable measurement decisions can change this insignificant main effect relationship into a significant one through moderation.

First, while random samples generated no significant relationship between the two variables, correlations for the purposively drawn (non-random) samples were significant and moderately strong (Cohen, Cohen, West and Aiken 1983). An implication of this finding is that there may be some specific industries, as Harter et al. (2000) found for software development, or other specific contexts for which the general tendency of the relationship will be positive, and yet other contexts exist in which it is not. Academics, then, in future research need explicitly to state whether the sample was randomly chosen (and thus they would not expect a relationship between speed and technical product quality), or whether they are purposively choosing a sample for which speed might be associated with performance for some theoretical or empirical reason. Potential contexts to test further include industry (software has already shown this effect), technology dependency, and services versus products.

Second, when speed is measured with just a single item, there is no significant speed-technical product quality relationship. However, when speed is measured by multiple items, the correlation is significant and large (ρ = 0.41, $p < 0.05$). This pattern aligns with the notion that multi-item scales capture the different facets of constructs better (Henard and Szymanski 2001) and yield larger effect sizes than single-item scales (Kirca et al. 2005).

As noted earlier, the other five success dimensions – composite success, development costs, product competitive advantage, customer-based success and financial success – all show statistically significant main effect correlations with NPD speed. However, and more importantly, the correlations for all five of these success dimensions also are cross-situationally heterogeneous. In other words, the magnitude of those correlations can differ depending upon research decisions and contexts. Furthermore, it is surprising how many initially statistically significant main effect correlations reduce to complete insignificance for different relationship moderators, as shown in Table 2.9.

Table 2.9 Moderators that reduce main effect correlations to insignificance

	Sampling procedure	# of speed items	Speed measure	Product type
New Product Success				
Overall/ composite	Random	Single		Physical products
Operational Outcomes				
Product measures				
Technical product quality	Random	Single		
Product competitive advantage		Single	Absolute	
External Outcomes				
Customer	Non-random		Absolute	
Financial			Absolute	

The three most important moderating variables are sample randomness, number of items in the speed measurement scale, and whether the study used absolute or relative measures of speed (Tables 2.4 and 2.5), all methodological decisions. Using random samples, multi-item scales and absolute measures reflect current standards for achieving methodological rigor in social science research. Random samples produce true empirical generalizations that hold across all contexts (which meta-analysis strives to uncover). As noted above, multiple items allow a measure to reflect all of a construct's various facets. Finally, using absolute measures of speed eliminates comparative judgment influences on outcomes.

Interestingly, as Table 2.9 shows, using random samples and absolute measures of speed, although more methodologically rigorous, is more likely to produce insignificant speed/success relationships – while the less methodologically rigorous choices of non-random samples and relative speed measures produce more statistically significant relationships. The only success measure that differs from these results is customer-based success, where the relationship with speed is just the opposite – insignificant for non-random samples, and significant for random ones. Using multiple items for measuring speed (the methodologically more rigorous decision) always produces higher correlations with success than using a single measurement item (statistically significantly higher in six of seven success dimensions), and for three dimensions, the single-item relationships become insignificant.

Of the previous meta-analyses that have investigated the NPD speed/success relationship, none have included potential moderators associated with measurement decisions for the speed construct. Furthermore, only Henard and Szymanski (2001) investigated any research design or contextual moderators that overlapped with the analyses performed from the data available for this research. Both studies investigated differences in the relationship that depended upon whether the sub-samples included physical goods versus services (Henard and Szymanski 2001) or goods versus a mix of goods and services (this investigation). Henard and Szymanski (2001) found no significant moderation, while this study's results show an increase in the speed/success relationship when both goods and services constitute the sample, reinforcing the recommendation above concerning context and sampling randomness as control variables in future research.

IMPLICATIONS

The moderating findings have important implications both for academics pursuing research in NPD success and cycle time as well as for practitioners developing new products. From an academic perspective, the results of this research (along with moderation findings by Pattikawa et al. (2006) and Chen et al. (2010)) show that methodological differences are very important in understanding potential NPD speed-success relationships. For example, Pattikawa et al. (2006) concluded from their moderation analysis on antecedent-performance relationships that the number of items in the speed measure, and whether it was absolute or relative and objective (versus subjective) all were important differentiators of their magnitude. In addition to absolute versus relative and the number of indicators in the speed measure, the results of this investigation also indicate that sample randomness matters. Most notably, these four methodological decisions do not always produce results in the same direction for all speed relationships.

Academics are confronted with a series of methodological decisions shaped not only by the demands of the research question but also by practical constraints. It is not the aim of this research to delineate what the “correct” courses of action are in relation to these decisions. However, the moderating effects of these decisions, as well as the directional inconsistencies in the way they are manifest in different speed relationships highlights the importance of clear communication. In this way, one can better assess the accuracy, meaningfulness and cross-sectional generalizability of empirical findings regarding NPD speed.

Furthermore, given the large percentage of variability in effect sizes which remained after sampling and measurement errors are corrected for, there is every chance that there were statistically significant moderators which could not be included in the analyses because of data limitations. This possibility further echoes the need for study characteristics to be reported clearly, accurately and completely for results to be meaningfully interpretable. Therefore, despite the main effects results pointing overwhelmingly to a positive association between speed and NPD performance, it is possible that these results do not necessarily validate synergistic accounts at the expense of trade-off arguments. On the contrary, the subsequent moderator analyses suggest the validity of both perspectives under different conditions.

For managers, the results of this study suggest that there may be some divisions or product categories in their firms for which decreasing NPD cycle time may increase success, but others for which it may not. Before setting off on a unilateral corporate program to reduce NPD cycle time, therefore, they may want to analyse archival data for their different divisions to discern which ones have historical results that support implementing such a program.

Additionally, based on the results concerning market entry timing proficiency, they should consider cycle time reduction programs for product categories with the narrowest windows of opportunities first. Cycle time reduction may not be as important to hit windows of opportunity for slowly evolving categories.

Also worthy of emphasis is the possibility of relationships being manifest differently under different organizational contexts. Although an extensive analysis of moderators pertaining to the organizational context was infeasible due to data limitations, the sheer amount of unexplained variance remaining after artefact correction may be indicative of different organizational settings favouring different speed-performance associations.

The results also do not afford any inference of outcome directionality, as sufficient data to create and test a meta-analytic structural model for these constructs was unavailable. This last point underlines an important implication for managers, as well as one area of critical need for future research. From this analysis, indeed from the sum of the previous research done on NPD cycle time and success, it is unclear which construct, speed or success, is the cart, and which is the horse. We cannot conclude whether faster development speed leads to improved NPD success, or whether companies that are more successful at developing new products also become speedier than others due to their development capabilities. There is no evidence to show which capability leads, and which follows: nor does any other study, to the best of our knowledge, have any evidence to this. This is an important point for practitioners.

LIMITATIONS AND FURTHER RESEARCH

As with all research, this study has a number of limitations which should be taken into account when interpreting and evaluating its results. As is typical of meta-analytic reviews, a construct could be considered for synthesis only if the minimum recommended number of three studies reported it. To include as many effect sizes as possible, some related specific success items were collapsed under broader construct headings. While the classification of NPD success measures used in this study has solid grounding in previous conceptual and empirical work and the use of broader meta-factors serves the interest of parsimony, it is possible that this approach may have prevented us from uncovering certain additional nuances in the speed-success relationship.

Similarly, not all of the empirical work initially identified as relevant provided the information necessary for quantitative synthesis. It was possible to obtain the necessary missing information for only a subset of the studies from authors. The absence of information on study characteristics such as moderator variables and a lack of sufficient variability across studies with regard to some characteristics posed a major constraint on the extent to which a comprehensive assessment of moderating factors could be conducted and also limited the number of relationships for which the effect of a particular moderator could be examined.

A final limitation is that this study used bivariate correlations between development speed and new product success, as did Henard and Szymanski (2001) and Chen et al. (2010). Therefore, these results do not reflect any potentially nonlinear relationships between these variables (e.g., Langerak and Hultink 2006; Langerak et al. 2008; Lukas and Menon 2004).

This study has taken the first step towards a systematic review of development speed which brings together the antecedents and consequences. The complementary use of meta-analysis and structural equation modelling methods such as path analysis (Viswesvaran and Ones 1995), which this study was unable to implement due to the large number of empty cells in the pooled meta-analytical correlation matrix, would be invaluable for comprehensive synthesis provided that its practical challenges are overcome.

3.

ORGANIZATIONAL EXPERIENCE SPILLOVERS, PROJECT UNCERTAINTY, AND NEW PRODUCT DEVELOPMENT PROJECT CYCLE TIME [10]

[10] This chapter is currently under review. An earlier version has been presented as Cankurtaran, P., Langerak, F., Rijsdijk, S.A. 2008. Cycle time reduction and the learning curve. *Proceedings of the 32nd PDMA Academic Research Forum*, Orlando, USA.

INTRODUCTION

As product life cycles shorten, it becomes increasingly important for firms to identify ways to reduce new product development (NPD) project cycle times (Chen et al. 2010; Perols, Zimmermann and Kortmann 2012). Firms with shorter cycle times have greater strategic flexibility and can choose to pursue first-mover and fast- follower strategies (Brown and Eisenhardt 1995; Swink et al. 2006). Also, shorter cycle times are associated with lower development costs and greater product quality (Langerak and Hultink 2005), which enable firms to satisfy their customers faster while supporting higher sales prices and earning higher margins (Tatikonda and Montoya-Weiss 2001). Overall then, shorter cycle times contribute substantially to a firm's sustainable competitive advantage.

Recent meta-analytic research indicates that experience is an important determinant of NPD cycle time (Chen et al. 2010). Experience helps safely bypass unnecessary development steps and enables team members to identify more easily what is compatible or not with the attainment of specific project goals (Swink et al. 2006). Yet previous research focuses solely on experience available within the team executing the NPD project, which is undoubtedly an important factor but also ignores recent learning-by- doing research that shows that organizational experience outside work teams can affect performance at the project level. Easton and Rosenzweig (2012) find that the experience of organizational members other than specific project team members is a key antecedent of Six Sigma project success, and Reagans et al. (2005) note that organizational experience accumulated outside surgical work teams exerts a unique effect on procedure completion time. These studies offer evidence that accumulating experience in certain activities endows firms with relevant knowledge, which becomes embedded in various repositories, such as organizations' technology, structure, and employees (Argote and Miron-Spektor 2011). Later projects can benefit from this accumulated knowledge, which can be reactivated and reinterpreted to address the particular demands of new projects.

This study investigates whether and how NPD experience accumulated by organizational members that are not part of a given NPD project might spill over to the focal project and affect its cycle time. It distinguishes two dimensions of organizational experience, according to the domain from which it originates: specialized or related. Specialized organizational experience results from cumulative NPD activity within the same domain as the focal project (Boh, Slaughter and Espinosa 2007). Repeated activity within a specific domain increases the organization's understanding of that domain and may improve performance. Related organizational experience is an outcome of cumulative NPD activity in other domains that relate to the focal domain (Boh et al. 2007), such that problem-solving activities in one domain can benefit from experience accumulated in other, related domains (Schilling, Vidal, Ployhart and Marangoni 2003).

In turn, the present study assesses whether specialized and related organizational experience affect the cycle time of current NPD projects, then investigates whether the importance of these experience dimensions for cycle time depends on the focal project's level of uncertainty. Uncertainty pertains to the lack of knowledge about the exact means for accomplishing the project (Naveh 2007) and relates closely to the alignment between the project and the firm's capabilities. Because NPD projects vary in the extent to which their technological aspects are known to the developing firm and their level of fit with existing resources and capabilities (Tatikonda and Rosenthal 2000a), this study postulates that project uncertainty moderates the relationship between NPD experience and project cycle time, through its influence on the extent to which projects reuse their knowledge base, problem-solving capabilities, and practices within their own technological domain, as well as how widely they can draw on resources obtained in other domains (Brockman and Morgan 2003; McDermott and O'Connor 2002). As the conceptual framework outlines, this study proposes that specialized organizational experience is more important for reducing the cycle time of projects with limited uncertainty, whereas related organizational experience should be more important for reducing the cycle time of projects that are more uncertain.

This study offers three contributions to NPD literature. First, it broadens understanding of ways to reduce NPD project cycle times. Previous research on the experience–cycle time relationship focuses predominantly on project team experience, whereas studies in other empirical contexts, such as systems development and Six Sigma improvement team projects (Boh et al. 2007; Easton and Rosenzweig 2012) indicate that organizational experience accumulated outside the project team may be relevant. If wider organizational experience is important in an NPD context, managers should deliberately facilitate experience transfer to their teams, to ensure that the organizational experience base is available for everyone.

Second, this study provides deeper insights into the role of project uncertainty in cycle time reduction. The mixed findings regarding the association between project uncertainty and cycle time reported in prior empirical studies imply that project uncertainty has no direct effect on cycle time but influences the effects of other factors on cycle time (Chen et al. 2010). By focusing on project uncertainty, this study addresses the question of whether uncertainty strengthens or weakens the effects of organizational experience on project cycle times. Finding such interactions would suggest that the importance of organizational experience dimensions depends on the level of project uncertainty.

Third, this study investigates the extent to which organizational experience effects are generalizable to the unstructured nature of NPD projects (Thomke 2003). Previous learning-by-doing research in the field of operations management has addressed relatively structured work, such as manufacturing activities (McCreery, Krajewski, Leong and Ward 2004), quality improvement projects (Lapré, Mukherjee and van Wassenhove 2000), surgical procedures (Reagans et al. 2005), and Six Sigma improvement team projects (Easton and Rosenzweig 2012). Whereas previous studies focus on the benefits of related experience for individuals or groups who have gained this related experience themselves (Boh et al. 2007; Schilling et al. 2003), the present study addresses whether similar benefits might accrue from related experience gained by others.

This article begins with a description of the theoretical background and presentation of hypotheses. Section 4 details the empirical methodology used to test the hypotheses; Section 5 contains the results, and Section 6 outlines the implications of these results for theory and practice. Section 7 concludes by addressing some limitations and suggesting directions for further research.

BACKGROUND LITERATURE

Learning from experience

The concept of learning from experience (or "learning-by-doing") originates from studies that document that people require less time to fulfil tasks when they have more experience (Thurstone 1919). The underlying mechanism, as noted by Anzai and Simon (1979), is the system's ability to acquire knowledge about the effectiveness of its choices and use that knowledge to modify itself. A defining feature of such studies is that they assume learning follows the shape of a learning curve, which represents the relationship between cumulative past experience and some performance measure (Yao, Kohli, Sherer and Cederlund 2013). In a typical learning curve, performance improves with increased experience, though the rate of improvement gradually declines over time (Argote 1999; Schilling et al. 2003). The capacity to learn from experience, according to this pattern, is not limited to individuals but also applies to teams (Easton and Rosenzweig 2012), organizational units (Boh et al. 2007), and organizations as a whole (Stock and Tatikonda 2008). As experience increases, these entities come to better understand certain cause-and- effect relationships and can use their stock of knowledge, accumulated through actual experience, to modify their courses of action, discover process problems that cause gaps between realized and potential performance (Pisano 1994), and select activities that promise the desired effects most consistently and effectively (Levitt and March 1988; Nelson and Winter 1982).

Whereas early learning-by-doing research focused on a single level of experience, more recent work has explained project team performance by considering different types of experience simultaneously and at different levels of analysis. Reagans et al. (2005) investigate which experience dimensions reduce the completion time of surgical procedures and cite the proficiency of individual workers (individual experience), their ability to leverage knowledge accumulated by others (organizational experience), and their experience working together (team familiarity). Similarly, Huckman, Staats and Upton (2009) find that the experience people gain in their roles as team managers or team members, and the degree to which team members are familiar with one another, are associated with teams' operational performance. In their assessment of the importance of experience for Six Sigma project performance, Easton and Rosenzweig (2012) show that team leader experience and organizational experience have the strongest effects on project performance, overwhelming the effects of individual team member experience and team member familiarity. These combined results hint strongly at the relevance of experience gained at the organizational level for NPD cycle time at the project level.

Specialized versus related experience

The preceding studies distinguish different dimensions of organizational experience; other studies investigate the degree of relatedness between experience and the focal task. To gain specialized experience, it is necessary to conduct activities within a given domain, such as a specific software system (Boh et al. 2007), a particular problem-solving game (Schilling et al. 2003), or a unique diagnostic category, such as endocrine, nutritional, and metabolic diseases and disorders in medicine (Clark and Huckman 2012). Conducting work within a single domain enables individuals, teams, and organizations to complete a particular problem multiple times and gain a deep understanding (Schilling et al. 2003); such specialized experience also benefits productivity, because work in one domain over time produces task-related knowledge that can improve performance (McDermott and Stock 2011; Staats and Gino 2012).

Related experience refers to the accumulation of experience in other problem domains that are relevant to a focal domain. People might develop a new understanding of a problem by transferring knowledge from one domain to another, and knowledge from one problem domain can provide an analogous solution in another problem domain (Schilling et al. 2003). For example, Boh et al. (2007) measure specialized experience as the number of modification requests organizational members had handled in a particular customer billing support system; they assessed related organizational experience as the number of modification requests handled in a customer call support system that shared common data with the customer billing support system. Schilling et al. (2003)similarly investigate related experience by assessing whether teams that played the game Reversi showed improved performance playing the related game Go (both games are played on a non-chequered grid with stones, emphasize spatial strategy, and seek to controlling territory). Finally, Clark and Huckman (2012) operationalize related experience as the extent to which hospital organizations gain experience in a related medical specialty (e.g., cardiology), beyond their focal specialty (e.g., endocrinology). Collectively, these studies demonstrate that problem- solving activities in a domain can benefit from experience accumulated in one or more related domains.

Both specialized and related experience can be gained *within* individuals or teams, by exposing them to a range of specific or related activities over time (see Boh et al. 2007; Schilling et al. 2003). Both types of experience also can be gained *across* individuals or teams, through the transfer of experience from others exposed to a range of activities to a focal individual or team (Clark and Huckman 2012).

CONCEPTUAL FRAMEWORK

Specialized organizational experience and NPD project cycle time

Past organizational experience in NPD is associated with the efficient design of technologically similar products and general management of the NPD process (Pisano 1994). The development of new products endows firms with a substantial body of NPD-related knowledge, which becomes embedded in various repositories, such as the organization’s technology, structure, or employees (Argote and Miron-Spektor 2011). Subsequent NPD projects then can enjoy shorter cycle times, once the accumulated knowledge is reactivated and reinterpreted to address the particular demands of new projects.

Knowledge accumulated within a certain technological domain is not necessarily exclusive to the particular project from which it originates and is a readily available resource for future NPD projects within that same technological domain (Danneels 2002). Technologies, solutions, and components developed for one product can be used directly, or with minimal modification, in future products, which enables future project teams to economize on the time needed for extensive design, engineering, and manufacturing activity. Specialized organizational experience also acts as a valuable source of problem- and solution-related information that can promote problem-solving efficiencies and shorten project cycle times for future projects in the same domain (Thomke 2003). Extant work on organizational learning has established that specialized knowledge, accrued from past experience, becomes embedded in formal and informal routines and standard operating procedures of the organization, such as in the form of information sharing mechanisms and ways to organize project work (Cyert and March 1963; Eisenhardt and Tabrizi 1995; Leonard-Barton 1995). Rather than creating modes of conduct from scratch, NPD project teams can draw on an existing repertoire of routines and practices that exists for their specific domain and identify those applied successfully in the past. Then NPD teams can tailor routines and practices to the project at hand, to economize on the time and resources expended (Madhavan and Grover 1998). For these reasons, we expect specialized organizational experience accumulated within a certain technological domain to facilitate cycle time reduction, and we hypothesize:

H_1 Specialized organizational experience reduces NPD project cycle time.

Related organizational experience and NPD project cycle time

Because NPD projects do not exist in isolation but are positioned within a larger organizational context (Scarbrough, Swan, Laurent, Bresnen, Edelman and Newell 2004), a wide potential scope exists for knowledge transfer between NPD projects carried out in different technological domains. The related organizational experience generated in other domains, by developing products using different technologies, can be exploited effectively by a project team operating within a given domain. Related experience grants project teams a pool of NPD knowledge, distinct from their own (Reagans et al. 2005), and thus access to a rich, diverse set of skills and information that can be applied to the project at hand but that otherwise would have been unavailable. Project teams use this external knowledge, which is complementary to their own internally accumulated knowledge base, to create new insights and solve development problems. Although products in different domains may vary in their technical features, the NPD process likely displays similarities in the kinds of problems to be addressed or the ways project activities get organized. By borrowing technical solutions embodied in other organizational units' existing hardware and software components for example,(Hansen 2002), NPD teams can avoid repeating certain tasks or making similar mistakes and complete projects more quickly. These arguments suggest that NPD projects in a particular domain can learn from the knowledge accumulated in other domains and reduce cycle time. Noting that related organizational experience refers to experience accumulated in other technological domains, we hypothesize:

H_2 Related organizational experience reduces NPD project cycle time.

Project uncertainty as a source of heterogeneity in learning rates

Project uncertainty refers to the lack of knowledge about the exact means for accomplishing the project (Naveh 2007); it is closely linked to the extent to which technological aspects of products are familiar to the developing firm and fit with its existing resources and capabilities (Tatikonda and Rosenthal 2000a). Organizations typically have a portfolio of development projects, with varying levels of uncertainty (Chao and Kavadias 2008). On the one hand, some projects involve "the adaptation, refinement and enhancement of existing products and/or product delivery systems" (Song and Montoya-Weiss 1998, p.126) and do not require new skills, because they demand only minor improvements to existing technology. Because they entail extensions of, or improvements over, existing products, these projects are characterized by low levels of uncertainty. On the other hand, projects may be relatively new and require technological approaches that have not been tried before (Swink 1999). These projects invoke greater uncertainty, because they require the use of substantially different skills and introduce the need to develop and apply new knowledge.

Variation in learning rates also may depend on the level of project uncertainty, in that uncertainty influences the extent to which projects can reuse the knowledge base, problem-solving capabilities, and practices of their own domain or draw on such resources from other domains to accelerate their own NPD. Specialized organizational experience gained within a domain represents a unique, specific stock of knowledge and is therefore likely to be rich in detail but narrow in scope (Schilling et al. 2003). More certain projects involve technologies, materials, and processes with well-understood constraints and limitations, because they are variations of (or improvements over) prior offerings (Kim, Kumar and Kumar 2012). Consequently, existing technological specifications and blueprints originating from NPD activity within the domain can be applied in a relatively straightforward manner, to meet the demands of current projects. Because they are being developed using familiar technologies, tasks also should be carried out more expediently, in light of the in-depth, relevant knowledge accumulated within the organization.

In contrast, uncertain projects explore unfamiliar domains and are characterized by greater risk than their incremental counterparts (Swink 1999). Uncertainty arises from a poor understanding of technologies, which increases ambiguity about not only the solution of technical problems but also the identification of which problems need to be solved (Brockman and Morgan 2003). Considering the specificity of specialized organizational experience, projects with greater levels of uncertainty have less scope for using knowledge, in the form of existing components and processes, to reduce cycle time. The greater degree of uncertainty likely renders the organization’s problem-solving experience within the same technological domain less adequate for addressing the issues that arise during their development (De Carolis 2003), because ambiguity surrounding uncertain projects demands greater reconsideration of existing modes for managing the NPD process and reducing the immediate applicability of existing routines and practices. Because uncertain projects have little or no input carried over from previous generations (Griffin 1997a), the organization’s knowledge of a given domain likely falls short of the level of providing components or blueprints to build on or technologies to be readily extended. In light of these arguments, we hypothesize:

H_3 Specialized organizational experience reduces NPD project cycle time more for low uncertainty projects than for high uncertainty projects.

Related organizational experience instead delivers an opportunity to see problems or tasks from a different perspective (Tortoriello, Reagans and McEvily 2011). Although the information requirements of projects with limited uncertainty are characterized by depth (McDermott and O'Connor 2002), teams engaged in uncertain projects require a wider array of informational inputs and different expertise that can stimulate the generation of fresh insights (Brockman and Morgan 2003). Consequently, teams engaged in uncertain projects are more likely than those engaged in familiar projects to benefit from relevant solutions obtained from other domains. Drawing on related organizational experience accumulated in other domains introduces teams to new knowledge elements, which increases the variety of informational input they have at their disposal to combine in productive ways (Katila and Ahuja 2002) and provides them with extensive choices for solving new problems (March 1991). Even when technical solutions are not directly applicable, perhaps due to differences in their technological architecture, they can be decoupled from their original domain and applied to the project context, whether by abstracting away from the particular project in which the competence is embedded and identifying the competence in its own right or by linking that existing competence with a new competence to achieve time efficiencies (Danneels 2002).

This diversity of problem-solving approaches can emerge from other sources in the organization and help development teams overcome the challenges associated with uncertain projects (Yan and Dooley 2013). In turn, interaction with employees operating in other domains enhances the focal team's problem solving and learning (Nonaka 1994), ultimately contributing to a more efficient, timely project execution. Teams engaged in low uncertainty projects should have less need for additional informational input or problem-solving capabilities from other domains to achieve timely project completion. These projects predominantly benefit from high levels of relevant technological knowledge, problem-solving capabilities, and modes of conduct forged by past NPD activity within their own domains. In short, the time efficiency benefits of using related organizational experience is smaller for projects characterized by low uncertainty than for those with high uncertainty, because the content of transferred knowledge may not apply readily to the current project. As such, we hypothesize:

> **H_4** Related organizational experience reduces NPD project cycle time more for high uncertainty projects than for low uncertainty projects.

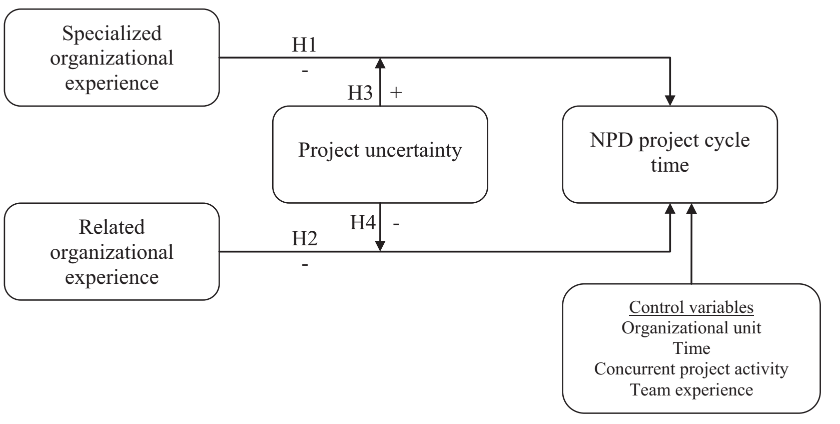
The conceptual model summarising the four hypotheses is shown in Figure 3.1.

METHODOLOGY

Empirical context

We tested the hypotheses using a data set that consisted of 169 product development projects, conducted in different organizational units of the plastics division of a large corporation. Four characteristics qualified this context as appropriate for our research. First, the data span a sufficient time period for learning to occur (7 years and 4 months), a key requirement for applying the learning curve approach and discerning its effects on cycle time reduction (e.g., Easton and Rosenzweig 2012).

Figure 3.1 Proposed conceptual model and hypotheses



Second, the data permit a clear distinction between specialized and related experience, with the 169 projects spread across seven organizational units, each of which employed a different technology platform. The NPD experience gained by a given organizational unit represents specialized experience related to a specific technology; the NPD experience gained by other organizational units represents related experience, because it involves other technologies. Third, the organizational context lends itself well to knowledge transfer across units. Employees work in separate units, but those units all are located in the same plant, facilitating communication across units. Since the start of the period reflected by our data set, the company has also made extensive use of an internal database, which contains a "log file" for each project. Project members add and update information regularly during their product development activity and at completion. Information about all projects is available to anyone in the company involved in NPD, regardless of the unit to which the project belongs, such that it provides a convenient resource for intra- organizational knowledge transfer (Heim and Peng 2010; Setia and Patel 2013). Fourth, the firm's database contained information about the organizational unit in which each development project took place, the commencement and completion dates, and the project membership of two core team members. Thus it was possible to measure objectively specialized organizational experience, related organizational experience, and project cycle time. Objective measures also controlled for the level of project team experience, the number of projects running parallel to a focal project, and differences between the organizational units.

Measures

Dependent variable: Project cycle time

As described previously, the firm's database contained each project's commencement and completion dates and the organizational unit to which it belonged. Project cycle time (CT_{ij}) was operationalized as the number of weeks between the commencement and completion dates for project i run by organizational unit j.

Independent variables: Specialized and related organizational experience

The measure of specialized organizational experience relied on experience accumulated from prior NPD activity within the organizational unit to which the project belongs. Related organizational experience was the prior NPD activity accumulated in other units. Learning curve studies typically operationalize past experience as a cumulative output (Easton and Rosenzweig 2012; Heim and Ketzenberg 2011). Applying the same logic to this study context, experience available to project i would equal the cumulative number of projects completed prior to the start of project i, which would disregard the possibility that teams learn from ongoing projects. That is, a great deal of learning in NPD takes place during the course of the project (Scarbrough et al. 2004). To ensure that the variables capture prior NPD experience as fully as possible, this study operationalizes experience as the completed portion of ongoing projects, together with fully completed projects (see Argote, Beckman and Epple (1990) for a similar approach). The specialized organizational experience variable $EXPSP_{ij}$ thus included the number of completed projects within project i's organizational unit j, plus the completed proportion of projects ongoing in unit j when project i began. Similarly, the related organizational experience variable $EXPREL_{ij}$ was the sum of the number of completed projects in the other six units and the completed portion of ongoing projects in these units.

Moderating variable: Project uncertainty

Project newness is a main source of project uncertainty (Chen et al. 2005; Tatikonda and Rosenthal 2000a). Projects for developing incrementally new products are associated with less uncertainty than projects that focus on new-to-the-firm products (Naveh 2005). Product newness therefore provided the indicator of project uncertainty. Data on product newness came from each product manager, who in face- to-face interviews classified the focal project as *incrementally new* or *new to the firm*.

Because the managers had to evaluate multiple projects, this study used a dichotomous measure of product newness, which is logically appealing and effective for collecting data retrospectively, particularly when, as in this case, objective information is impossible to obtain. The widely used dichotomous approach also has proven reliable and valid (Henard and Szymanski 2001). The dummy variable PU_{ij} equals 1 if project *i* in unit *j* of the project entails high uncertainty and 0 if the project induced low uncertainty.

Control variables

Several control variables helped isolate the effect of cumulative past experience from other potential factors. First, indicator variables ($UNIT_{ij}$) in all models removed the confounding effects of any unobserved differences at the unit level, such as unit size or the level of resources available. Allowing each unit to have its own starting point on the learning curve also eliminated any confounding effects of relevant experience that might have accumulated within the unit, beyond the time frame of the data set (see Ingram and Simons 2002).

Second, $TIME_{ij}$ captured unobserved confounding factors, such as changes in the organization's innovation strategy, structure or resources that occurred during the study period and may have affected project cycle time. In line with Boh et al. (2007), the operationalization of $TIME_{ij}$ used the start date of project *i* in organizational unit *j*, expressed in weeks, where 1 is the start date of the first project in the data set.

Third, concurrent project activity also might confound the relationship between past NPD experience and cycle time, captured by the variable CPA_{ij} and operationalized as the number of projects in the company running parallel with project *i*. Higher levels of concurrent project activity likely are associated with longer cycle times, because the company's resources are spread more thinly across projects (Datar, Jordan, Kekre, Rajiv and Srinivasan 1997; Kessler and Chakrabarti 1996). Because the number of concurrent projects shrinks consistently toward the end date, the computation of concurrent project activity included only those projects that finished before the end date of the focal project, to avoid right truncation concerns.

Fourth, controlling for team experience ensured that the specialized organizational experience variable captured only experience gained by organizational members *outside* the given project team. All project teams consisted of four to six members, including a product manager and technology manager.

Records for other members were not available, but records for the two managers were. The total number of projects the managers had started before the focal project began thus provided a proxy for team experience. For 9 of the 169 projects, the names of the managers were not documented, so the missing values were replaced with the mean value of the team experience variable. The descriptive statistics and correlations among the main variables are shown in Table 3.1.

Table 3.1 Descriptive statistics and correlations

Variable	Mean	SD	1	2	3	4	5	6
1. Project cycle time	66.42	51.84						
2. Specialized organizational exp.	9.12	9.08	-0.70***					
3. Related organizational exp.	51.03	43.77	-0.82***	0.73***				
4. Project uncertainty	0.50	0.50	-0.04	0.07	0.09			
5. Time	234.48	69.12	-0.65***	0.65***	0.82***	0.10		
6. Concurrent project activity	54.94	36.62	0.39***	-0.07	-0.14*	0.05	-0.10	
7. Team experience	1.77	0.74	-0.48***	0.54***	0.48***	0.24***	0.41***	0.07

*$p < 0.10$;** $p < 0.05$; *** $p < 0.01$.

Estimation procedure

In most learning curve applications, the relationship between past experience and performance takes the form $y = ax^{-b}$, where y is the performance measure (i.e., cycle time), x is the measure of cumulative experience (i.e., number of projects), a is a constant, and b is the learning rate (e.g., Darr, Argote and Epple 1995). For estimation purposes, a common practice takes the natural logarithm of both sides of the equation, to rewrite it as $\ln y = a - b\ln x$. Implicit in this log–log formulation is the assumption that performance cannot improve at a linear rate indefinitely. Rather, it improves with increased experience but at a decreasing rate, as it becomes more difficult for the organization to extract value from its experience base. Thus, the learning curve is steep at early stages of activity but gradually loses this steepness, until it reaches a plateau. This widely used formulation provides the basis for the following model for project cycle time:

$$\begin{aligned}\ln(CT_{ij}) = {} & \beta_0 + \beta_{ij} \cdot UNIT_{ij} + \beta_1 \cdot \ln(TIME_{ij}) + \beta_2 \cdot \ln(CPA_{ij}) \\ & + \beta_3 \cdot \ln(EXPTM_{ij}) + \beta_4 \cdot \ln(EXPSP_{ij}) + \beta_5 \cdot \ln(EXPREL_{ij}) + \beta_6 \cdot PU_{ij} \\ & + \beta_7 \cdot (PU_{ij} \times \ln(EXPSP_{ij})) + \beta_8 \cdot (PU_{ij} \times \ln(EXPREL_{ij})) + \varepsilon_{ij}\end{aligned}$$

The coefficients in this model can be interpreted as follows: β_{ij} is a vector of coefficients for the organizational unit dummy variables. Because the intercept is a linear combination of all seven unit dummies, a dummy variable for unit 1 is not included, and β_{ij} indicates the extent to which the average cycle time for unit *j* differs from the average cycle time of unit 1. In addition, β_1 captures the effect of time, β_2 captures the effect of concurrent project activity, and β_3 captures the effect of team experience on cycle time; β_4 and β_5 indicate the extent to which specialized and related organizational experience, respectively, bear on the cycle time of low uncertainty projects. For both β_4 and β_5, a negative, significant estimate implies that greater experience is associated with shorter cycle times for low uncertainty projects. The estimate for β_6 reflects the extent to which the average cycle time of high uncertainty projects differs from that of their low uncertainty counterparts. The interaction terms $PU_{ij} \cdot \ln(EXPSP_{ij})$ and $PU_{ij} \cdot \ln(EXPREL_{ij})$ support the comparison of the specialized and related organizational experience learning rates across the two types of projects. The coefficients β_7 and β_8 indicate the extent to which the impacts of specialized and related organizational experience, respectively, differ for high versus low uncertainty projects.

ANALYSIS AND RESULTS

Hierarchical regression analyses

An ordinary least square (OLS) regression served to estimate the model, with variables entered across columns in a stepwise manner (see Table 3.2). Model 1 included the control variables for organizational unit-specific differences, time, concurrent project activity, and team experience, producing an R-square value of 0.67 ($F = 35.17$, $p < 0.01$). The cycle times progressively shortened (-0.61, $p < 0.01$). Concurrent project activity was associated with an increase in cycle time, showing a positive, statistically significant estimate (0.31, $p < 0.01$). Team experience related significantly to project cycle time (-0.50, $p < 0.01$).

Model 2 introduced the main effects for specialized organizational experience, related organizational experience, and project uncertainty. This model was accompanied by a significant increase in the R^2 value of 0.15 ($F = 56.11$, $p < 0.01$). The main effects of specialized and related organizational experience were both negative and statistically significant. The negative effect (-0.19, $p < 0.01$) of specialized organizational experience suggested that, regardless of the level of project uncertainty, it

Table 3.2 Estimated coefficients for models predicting NPD project cycle time

Variable	**Model 1**	**Model 2**	**Model 3**
Constant	-0.34***	-0.22***	-0.23***
Step 1: Control variables			
Organizational unit 2	0.53***	0.42***	0.44**
Organizational unit 3	0.59***	0.23*	0.24*
Organizational unit 4	0.24*	0.28**	0.28**
Organizational unit 5	0.30*	0.13	0.18
Organizational unit 6	0.04*	-0.03	0.00
Organizational unit 7	0.51***	0.26*	0.29**
Time (β_1)	-0.61***	0.13	0.07
Concurrent project activity (β_2)	0.31***	0.26***	0.27***
Team experience (β_3)	-0.50***	-0.17***	-0.16**
Step 2: Main effects			
Specialized organizational experience (β_4)		-0.19***	-0.20***
Related organizational experience (β_5)		-0.28***	-0.23***
Project uncertainty (β_6)		0.01	0.01
Step 3: Two-way interaction effects			
Specialized organizational experience × Project uncertainty (β_7)			0.06
Related organizational experience × Project uncertainty (β_8)			-0.15**
R^2	0.67	0.81	0.82
F-statistic	35.17***	56.11***	49.90***
R^2 *change*		0.15	0.01
F-change statistic (df_1, df_2)		40.43***	3.18
		(3, 156)	(2, 154)

*$p \leq 0.10$; **$p \leq 0.05$; ***$p \leq 0.01$; $N = 169$

contributed to shorter cycle times, in support of H_1. Similarly, the effect of related organizational experience was negative and significant (-0.28, $p < 0.01$), in line with H_2. The effect of project uncertainty on cycle time was not significant (0.01, n.s.), in line with findings from previous studies (e.g., Chen et al. 2010).

In Model 2, the effect of time became non-significant (0.13, n.s.), indicating that the reduction in cycle times could not be attributable to the passage of time itself but instead reflected increased levels of specialized and related organizational experience. The effect of team experience remained significant in Model 2 but diminished (-0.17, $p < 0.01$). That is, team experience was relevant for cycle time reduction, but its effect was attenuated by the NPD experience available outside the team, in both the focal organizational unit and other organizational units.

The final stage also included interactions between project uncertainty and the specialized and related organizational experience variables (Model 3). The coefficient estimate for the specialized organizational experience–project uncertainty interaction (0.06, n.s.) provided directional but not significant support for H3, suggesting that specialized organizational experience had similar time-efficiency implications for incremental and new-to-the-firm projects. The coefficient for the related organizational experience– project uncertainty interaction was negative and statistically significant (-0.15, $p < 0.05$), in support of H4 regarding the proposed moderating effect of project uncertainty on the link between related organizational experience and cycle time. As indicated by the significant change in the R-square statistic ($\Delta F = 3.18$, $p < 0.05$), including these interactions improved the explained variance by a small, significant amount.

Robustness tests and additional analyses

Multicollinearity

All variables in Model 3 displayed variance inflation factors lower than the critical cut-off value of 10 and condition indices well below the cut-off value of 30 (Belsey, Kuh and Welsch 1980). Of the variables in the model, time and related organizational experience displayed the greatest correlation (see Table 1). To test whether correlation led to unstable coefficient estimates, a re-estimation of Model 3 excluded the time variable. Other repeated analyses excluded either related organizational experience and its interaction with project uncertainty or specialized organizational experience and its interaction with project uncertainty. As Appendix D shows, for all three additional analyses, the coefficients of the main variables remaining in the model led to similar conclusions, which reduced multicollinearity concerns.

Simultaneity bias

The chances of concurrent project activity might be higher for projects with longer cycle times, and there may be simultaneity between concurrent project activity and cycle time. The assessment of whether the model suffered from simultaneity biases relied on a Hausman specification test. Without any variables in the firm's database that could represent concurrent project activity, this study used a modified version of the same variable that included only the ongoing projects started before project *i* had begun, such that it could not be affected by how long the project took. With this modified concurrent project activity instrument, the model re-estimation with two-stage least squares indicated a non-significant Hausman test statistic of 1.00 (p = 0.17), suggesting no evidence of simultaneity. The analysis also yielded very similar coefficients to those yielded by OLS, affirming the robustness of the main results.

Comparing the effects of specialized and related organizational experience

Two Wald tests investigated whether the effects of specialized organizational experience were significantly different from the effects of related organizational experience for projects with a low versus high level of uncertainty. For low uncertainty projects, the comparison focused on the coefficient for specialized organizational experience β_4 (-0.20, $p < 0.01$) in Model 3 and the coefficient for related organizational experience β_5 (-0.23, $p < 0.01$). As expected due to the size of the two coefficients, the F-statistic of 0.12 ($df_1 = 1$, $df_2 = 154$) and its respective probability value of 0.73 indicated that the coefficients were not significantly different. For high uncertainty projects, the comparison featured the effects of specialized organizational experience $\beta_4 + \beta_7$ (-0.14) and of related organizational experience $\beta_5 + \beta_8$ (-0.38). The test produced an F-statistic of 3.89 ($df_1 = 1$, $df_2 = 154$) and was significant at $p < 0.05$. That is, high uncertainty projects benefited more from related organizational experience than from specialized organizational experience.

Progress ratios

To quantify the relative and absolute strength of the different experience effects in Table 2, the next test computed a progress ratio for each experience variable, indicating the percentage of change in cycle time when experience doubles, or $p = 2^{-b}$, where $-b$ is the learning rate and unstandardized regression coefficient (Lapré and Nembhard 2010). The four progress ratios computed for this study varied somewhat, but they all fell well within the 55% -108% range and close to the modal ratio of 80% indicated by previous studies (Boone, Ganeshan and Hicks 2008). For low uncertainty projects, specialized organizational experience indicated a progress ratio of 87%, such that each doubling of the level of specialized organizational experience led to a 13% (100% - 87%) reduction in cycle time (Wiersma 2007). The cycle time of low uncertainty projects fell by 15% with a doubling of related organizational experience. For high uncertainty projects, cycle time shortened by 9% when specialized organizational experience doubled and by 23% when related organizational experience doubled.

DISCUSSION

This study has shown that NPD experience available within an organization outside the project team is highly relevant for project cycle time reductions. Both low and high uncertainty projects benefit from specialized organizational experience gained in the same domains and from related organizational experience accumulated in other domains. These findings underscore the importance of research on NPD cycle time reduction, to take into account both the historical and the organizational context within which the projects are embedded. High uncertainty projects not only benefit more from related organizational experience than do their incremental counterparts, but they also benefit more from related organizational experience than from specialized organizational experience. These findings corroborate previous work and highlight the need for more varied information input, to address the fluid, uncertain character of high uncertainty projects (Brockman and Morgan 2003). Contrary to expectations, high uncertainty projects benefit from prior specialized organizational experience just as much as low uncertainty projects in terms of reduced cycle time. Thus the study results deepen understanding of the effect of experience on the cycle time of NPD projects; the following sections detail their theoretical and managerial implications, as well as some limitations and suggestions for further research.

Theoretical implications

This study has several important theoretical implications. First, it contributes to NPD cycle time literature by showing that multiple levels of analysis influence project cycle time reduction. Prior studies have mainly investigated cycle time at the project level (Chen et al. 2010); this study shows, with regard to the effects of organizational experience, that project performance is strongly affected by experience at other levels and that NPD projects slow down substantially with increasing concurrent project activity. Taken together, these findings offer evidence of two interdependencies between NPD projects: (1) *sequential* interdependencies associated with leveraging NPD knowledge generated from past development activity that contributes to shorter cycle times and (2) *inverse* dependencies that arise from the sharing of scarce resources across concurrent projects, at the cost of longer cycle times (Verma and Sinha 2002).

Second, this article explicates the influence of experience gained by organizational members outside the project team. At first glance, the results corroborate prior research by documenting a positive association between team experience and development speed (Chen et al. 2010). They also show that the effect of team experience is attenuated when accounting for specialized and related organizational experience. The value attached to team experience thus might be somewhat overestimated; the experience available outside the project team seems at least as important for cycle time reduction. This study is the first to disentangle the effects; similar to previous studies in other contexts (e.g., Easton and Rosenzweig 2012), it emphasizes that distinguishing different dimensions can enrich understanding of learning effects.

Third, this study adds to understanding of the project uncertainty–cycle time relationship. Although academic literature generally suggests that more innovative (and therefore more uncertain) products take longer to develop (Griffin 1997a), the meta-analysis by Chen et al. (2010) indicates ambiguous empirical support for this idea. The present study specifies that related organizational experience is more useful for uncertain projects than for those with lower levels of uncertainty, so the difference in cycle time between certain and uncertain projects (and therefore the project uncertainty–cycle time relationship) depends on the level of related organizational experience within a firm. Project uncertainty then might be more appropriate treated as a moderator of, rather than antecedent to, NPD speed.

Fourth and finally, this research extends learning curve literature by showing that a learning curve methodology is applicable to unstructured NPD tasks, just as much as it is to (relatively) structured tasks. The rate of learning (reflected in the progress ratios) in an NPD context is comparable to other studies in manufacturing settings, which tend to involve more structured, less knowledge-intensive tasks (e.g., Boh et al. 2007). However, the finding that related organizational experience is more important for high than for low uncertainty projects shows that the extent to which tasks can be programmed and structured helps explain learning rates. In this first study to provide empirical support for this idea, the results show that learning rates may vary with the characteristics of the contexts in which the tasks are executed (see Wiersma 2007), as well as with the characteristics of the focal task itself.

Managerial implications

Each new project offers a potential opportunity for a firm to expand its existing knowledge and capabilities, but learning is not an automatic outcome of NPD. Similar to the managers in this study, managers must take measures to prevent their loss and generalize lessons from each project, with special attention to their unique information requirements. To reap the full benefits of the organizational context, teams also must have an opportunity to access sources of experience outside the wider organization. When such conditions are in place, firms seeking to reduce project cycle time benefit from recognizing the importance and encouraging the use of knowledge accumulated not only within a given technological domain but also across related domains. Specialized organizational experience is important for all projects, regardless of their level of uncertainty. In addition, managers should attend carefully to the wider, related organizational knowledge base, beyond their focal domain, to manage highly uncertain projects.

Despite the importance of experience for cycle time reduction, the learning curve approach and the resulting progress ratios indicate that the effects of all experience dimensions decrease over time. In particular, NPD projects benefit from experience gained in early phases, after the implementation of new development processes or production technologies for example. However, as these organizational innovations mature, cycle time comes to be affected less by experience, and managers must start to draw on other available sources to reduce cycle time substantially.

Finally, managers need to limit the number of NPD projects running in parallel. The effect of concurrent project activity is substantial; concurrent projects can easily nullify the benefits of accumulated experience. Thus it is imperative for managers to ensure the allocation of sufficient resources to each project, through effective portfolio management, if they want their efforts to exploit organizational experience to produce benefits.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

This study did not differentiate between products that achieved success in the marketplace and those that did not. Learning-by-failing (Hora and Klassen 2012) is another way NPD learning can take place. Unsuccessful NPD efforts can provide valuable input for identifying necessary reconfigurations and improvements, as well as act as a potential leverage point for generating new product concepts and technological alternatives. It is also possible that projects characterized by different levels of uncertainty learn differentially from terminated and completed (successes and failures) projects.

An interesting avenue for research would be to explore whether the project phase has any bearing on the performance implications of NPD experience. Related organizational experience could have a greater impact in terms of reducing project cycle time in earlier phases of the development process; specialized organizational experience may have a greater impact later (Brockman and Morgan 2003). In addition, in the current research context, the organizational units were co-located groups, using different technology platforms and operating in different technological domains. Varying levels of abstraction used to define the “organizational unit” instead could produce different learning and knowledge transfer rates. For example, researchers might investigate learning that takes place within and across R&D facilities in different locations (Darr et al. 1995). Research that incorporates these possibilities can advance understanding of the ways in which past experience informs current NPD projects, as well as how organizations can exploit their stock of knowledge to its maximum potential.

Regarding the non-significant relationship between project uncertainty and cycle time, an innovation manager from the firm that provided the data explained, in line with the job characteristics model (Hackman and Oldham 1976), that in his experience, engineers displayed more enthusiasm, excitement, and effort (i.e., intrinsic motivation) in relation to more uncertain projects. Further research should investigate the possibility that differences in the motivation source (intrinsic vs. extrinsic) also influence the rates of learning from related and specialized knowledge. If such differences exist, then incentive structures should be designed to maximize team members’ motivation and rate of learning.

These findings stress the importance of examining experience as determinant of cycle time, through a lens that accommodates both the organizational and temporal settings of NPD projects. Focusing on multiple projects from a single organization, as opposed to a single project from multiple organizations, empirically reveals the influence of knowledge transfer between projects in a single firm. Such an integrative perspective should be fruitful for other investigations of NPD cycle time, particularly with the recognition that projects do not stand in isolation but relate to the stream of firms’ past NPD activity.

4

MANAGERIAL DECISION MAKING IN PROJECT ACCELERATION: THE ROLE OF PROJECT INNOVATIVENESS AND ACCELERATION GOALS IN ACCELERATION STRATEGY CHOICE [11]

[11] This chapter is currently being prepared for journal submission. An abriged version has been presented as Cankurtaran, P., Hultink, E.J., Langerak, F. 2014. The Role Of Project Innovativeness And Acceleration Goal On Acceleration Strategy Choice. *Proceedings of the 21st International Product Development Management Conference*, Limerick, Ireland.

INTRODUCTION

Chapter 2 showed that methodological differences across studies, such as differences in construct operationalization and measurement, can be responsible for the different findings concerning the link between development time and its antecedents and consequences (see also Chen et al. 2010). While data limitations prevented a thorough examination, Chapter 2 also hinted at some contextual study characteristics, such as type of innovation that can also lead to heterogeneity in empirical results. In addition to methodological and contextual differences across studies, the presence of contingencies (acknowledged or otherwise) is another compelling reason behind the divergent findings. Indeed, 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). Indeed, chapter 3 of this dissertation documented that project uncertainty influences the extent to which NPD projects gain time reduction benefits from related organizational experience (i.e., NPD experience accumulated within other organisational units).

This chapter 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 (*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. 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, much of the previous work focuses on external sources of uncertainty. 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. (2008a). 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 project innovativeness, which is a measure of the degree of newness from the developing firm's and/or customers' perspective (Garcia and Calantone 2002). Relevant in the context of acceleration strategy choice is the firm's perspective of innovativeness which relates to the new project's level of similarity with those already developed and marketed by the firm (Atuahene-Gima 1995). Higher 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 et al. 2012), leads to greater uncertainty experienced by the development team (Sethi 2000). Consequently, project 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 2000b). Surprisingly, whether it also influences acceleration strategy decisions has not yet been addressed.

Second, Chen et al. (2012) emphasise the importance of analysing the source and degree of uncertainty in the selection of acceleration strategies. The present 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, Turner, Fern and Burton 2011). Swink (2003) maintains that the intentional acceleration of an NPD project changes the effects of development speed antecedents on the project's schedule performance by exacerbating the uncertainty experienced by the development team. Extending this reasoning to practitioners' decisions to adopt different acceleration strategies, we propose the magnitude of the desired time reduction bears also on the extent to which the compression and experiential strategies are utilised. By considering this additional source of contingency, we are able to provide a more nuanced understanding of acceleration strategy choice in NPD and inform the mixed findings on the compression/experiential distinction.

Third, this is the first study, after the original work by Eisenhardt and Tabrizi (1995), that looks at both strategies in their entirety. Because acceleration tools are typically implemented as part of a broader acceleration strategy comprising of multiple initiatives to speed up development, this approach offers a more holistic and accurate reflection of practitioners' acceleration decisions.

Fourth, 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 (see Table 4.2 for examples). 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)).

The fifth feature of this study that sets it apart from previous work on compression and experiential acceleration strategies is its methodological approach. In contrast to earlier investigations that predominantly relied on survey data, we use a scenario-based experiment which allows us to precisely manipulate the contingency factors of interest. By using a scenario based decision experiment, we also heed the recent call by Guo (2008) for researchers to employ less common methodological approaches in NPD research. Also, an experimental approach is the best option when studying behavioural issues (Mantel, Tatikonda and Liao 2006).

This chapter 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 operationalization. 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). Table 4.1 lists the tools under each strategy and how they should contribute to shorter development times.

Table 4.1 Acceleration tools by strategy

Acceleration tool	**How it accelerates development**
Compression strategy	
Predevelopment planning	Reduces misunderstandings between development staff and provides blueprints for action.
Supplier involvement	Allows the development team to concentrate on where their skills and competencies lie, having delegated the tasks that are outside their expertise to the supplier.
Computer-aided design (CAD) use	Simplifies computations and allows designers to use past designs.
Concurrency	Overlaps activities and tasks instead of executing them sequentially.
Cross-functional team (CFT) use	Reduces the time between moving from one activity to the next.
Time-based rewards	Solidifies schedule goals in the mind of development staff and motivates them to achieve these goals.
Experiential strategy	
Frequent design iterations	Allows teams to build a better understanding of the product, helps them appreciate the presence of alternatives, and prevents them from getting stuck with unproductive options.
Frequent testing	Contributes to the team’s learning process, particularly via learning-by-failing.
Frequent milestones	Encourages team members to assess their performance throughout the project, giving them the chance to take corrective action and motivating them to stay on course.
Team leader authority and accountability	Enables the team to secure the necessary resources for the project and introduces a degree of discipline necessary to keep the project on course without stifling the development staff.

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. Accordingly, 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. As can be observed from Table 4.2 the literature is especially inconclusive regarding the influence of practices such as supplier involvement and CAD use. Even less is known about whether or not managers explicitly take uncertainty into account when deciding to implement these acceleration tools.

Table 4.2 Selected studies documenting the time performance implication of compression and experiential acceleration tools

Acceleration tool	Time performance implication	Source of uncertainty assessed	Effect of uncertainty
Predevelopment planning			
Callahan and Moretton (2001)	Not significant	Low vs. high project experience (split sample analysis)	Not significant for either sample
Cooper and Kleinschmidt (1994)	Positive	-	-
Filippini et al. (2004)	Positive	-	-
Supplier involvement			
Callahan and Moretton (2001)	Positive	Low vs. high project experience (split sample analysis)	Positive for low-experience projects; not significant for high-experience projects.
Dröge et al. (2000)	Not significant	-	-
Filippini et al. (2004)	Not significant	-	-
Ittner and Larcker (1997)	Negative	-	-
Langerak and Hultink (2005)	Positive	Pioneers vs. fast followers (split sample analysis)	Positive for pioneers, negative for fast followers
Primo and Amundson (2002)	Not significant	-	-
Sherman et al. (2000)	Not significant	-	-
Zirger and Hartley (1996)	Not significant	-	-

Table 4.2 (cont.) Selected studies documenting the time performance implication of compression and experiential acceleration tools

Acceleration tool	Time performance implication (main effect)	Source of uncertainty assessed	Effect of uncertainty
Computer-aided design (CAD) use			
Dröge et al. (2000)	Positive	-	-
Kessler and Chakrabarti (1999)	Negative	Incremental vs. radical projects (split sample analysis)	Not significant for incremental projects, negative for radical projects
Langerak and Hultink (2005)	Negative	Pioneers vs. fast followers (split sample analysis)	Negative for pioneers, not significant for fast followers
Swink (2003)	Not significant	Intended acceleration (moderator variable)	Not significant
Concurrency			
Bstieler (2005)	Positive	Market uncertainty Technological uncertainty	No moderating effect Less effective when technological uncertainty is high
Dröge et al. (2000)	Not significant	-	-
Duffy and Salvendy (1999)	Positive	-	-
Filippini et al. (2004)	Positive	-	-
Zirger and Hartley (1996)	Positive	-	-
Cross-functional team (CFT) use			
Carbonell and Rodriguez (2006a)	Positive (curvilinear)	-	-
Dröge et al. (2000)	Positive	-	-
Filippini et al. (2004)	Positive	-	-
Ittner and Larcker (1997)	Not significant	-	-
Parry, Song, De Weerd-Nederhof and Visscher (2009)	Positive	-	-
Sarin and McDermott (2003)	Not significant	-	-
Zirger and Hartley (1996)	Positive	-	-
Time-based rewards			
Callahan and Moretton (2001)	Not significant	Low vs. high project experience (split sample analysis)	Not significant for either sample
Carbonell and Rodriguez (2006a)	Not significant	-	-
Kessler and Chakrabarti (1999)	Not significant	Incremental vs. radical projects (split sample analysis)	Positive for incremental projects, not significant for radical projects
Swink (2003)	Not significant	Intended acceleration (moderator variable)	Not significant for normally-paced projects but negative for accelerated ones.

Table 4.2 (cont.) Selected studies documenting the time performance implication of compression and experiential acceleration tools

Acceleration tool	Time performance implication (main effect)	Source of uncertainty assessed	Effect of uncertainty
Frequent design iterations			
Callahan and Moretton (2001)	Not significant	Low vs. high project experience (split sample analysis)	Positive for low experience projects, not significant for high experience projects
Filippini et al. (2004)	Not significant	-	-
Terwiesch and Loch (1999)	Negative	Slow vs. fast uncertainty resolution projects (split sample analysis)	Negative for both samples.
Frequent testing			
Callahan and Moretton (2001)	Positive	Low vs. high project experience (split sample analysis)	Positive for low experience projects, not significant for high experience projects
Kessler and Chakrabarti (1999)	Negative	Incremental vs. radical projects (split sample analysis)	Negative for incremental projects, positive for radical projects
Terwiesch and Loch (1999)	Positive	Slow vs. fast uncertainty resolution projects (split sample analysis)	Positive for slow uncertainty resolution projects, not significant for fast uncertainty resolution projects
Frequent milestones			
Kessler and Chakrabarti (1999)	Not significant	Incremental vs. radical projects (split sample analysis)	Not significant for incremental projects, positive for radical projects
Terwiesch and Loch (1999)	Positive	Uncertainty resolution (Slow vs. fast uncertainty resolution projects (split sample analysis)	Positive for both samples
Team leader authority and accountability			
Callahan and Moretton (2001)	Positive	Low vs. high project experience (split sample analysis)	Positive for low experience projects, not significant for high experience projects
Kessler and Chakrabarti (1999)	Not significant	Incremental vs. radical projects (split sample analysis)	Negative for incremental projects, positive for radical projects
Parry et al. (2009)	Not significant	-	-
Rauniar et al. (2008a)	Positive (indirect)	-	-
Sarin and McDermott (2003)	Positive (indirect)	-	-

Project 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: project 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). As this study concerns practitioners' choice of acceleration strategies, a process that is internal to the organization and not visible to the customer, we adopt the firm's standpoint of project innovativeness, which concerns the extent to which the technological and marketing aspects of projects are familiar to the developing firm and display fit with its existing resources and capabilities (e.g., Song and Parry 1997). We 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 et al. 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, Gavin and Aiman-Smith 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, Sarangee and Montoya 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 et al. 2012).

Cycle time reduction objective

Performance goals have an important influence on the choice of project design (Cardinal et al. 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 behavioural science show that one of the ways in which individuals respond to time pressure is by changing their decision strategies (e.g., Payne, Bettman and Luce 1996; Svenson, Edland and Slovic 1990), typically in favour of simpler ones (Ben Zur and Breznitz 1981) and those aimed at routine maintenance (Betsch, Fiedler and Brinkmann 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

This study 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 project 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 1997a). Since project 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 strategy that would be implemented in the absence of other constraints such as an ambitious cycle time reduction objective) will be dictated by project innovativeness.

We posit cycle time reduction objective (i.e., the secondary source of uncertainty in this study) to have an indirect effect on acceleration strategy choice by *amplifying* the uncertainty arising from increased project content (i.e., project 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 project is highly innovative.

The effect of project 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 1997a; Loch and Terwiesch 1998). This is because overlapping introduces additional informational requirements to the development project (Ahmad, Mallick and Schroeder 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. However, new-to-the-firm projects do not enjoy high levels of synergy with the team's existing knowledge and skills, rendering it problematic to operate on the basis of mere assumptions and increasing the possibility of costly mistakes (Chen et al. 2005). Furthermore, the development process in new-to-the-firm projects as a whole differs substantially from past projects

(Gatignon, Tushman, Smith and Anderson 2002), making it difficult to implement overlapping as part of a viable acceleration strategy.

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, Morone and Paulson 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 et al. 2005). Because they are characterized by high levels of technology and marketing newness, new-to-firm products have little synergy with the firm's existing resources and capabilities (Danneels and Kleinschmidt 2001; McDermott and O'Connor 2002), increasing the need for probing and learning in their development. The need for iteration and testing is lower for incremental projects 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 require more extensive risk control. Milestones offer teams a methodological way of keeping track of a project by effectively breaking it into smaller, analysable goals and components (Lewis, Welsh, Dehler and Green 2002). Given that introducing review point throughout the development process is a practice which organizations use for managing and controlling risk (Schmidt et al. 2009), more uncertain projects should make more extensive use of them. In support of this reasoning, (Kessler and Chakrabarti 1999) documented empirically that having frequent development milestones accelerated the development of radical new products. Schmidt et al. (2009) also found that managers reported to using a significantly greater number of review points during radical projects than incremental ones.

The above lines of reasoning lead to the following hypotheses.

H_{1a} Incremental projects use the compression strategy to a greater extent to accelerate product development than new-to-the-firm projects.

H_{1b} New-to-the-firm projects use the experiential strategy to a greater extent to accelerate product development than incremental projects.

The effect 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 indirectly by amplifying task difficulty. Given the greater task difficulty inherent in highly innovative NPD projects (Olson, Walker Jr., Ruekerf and Bonnerd 2001), 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,

H_{2a} 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.

H_{2b} 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 et al. 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. 1999b), 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, Cavusgil and Calantone 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, Handfield and Ragatz 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:

H_{2c} 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.

H_{2d} 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 Turkey. 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.

Table 4.3 contains descriptive information on the participants.

Table 4.3 Sample description

	Mean	**SD**
Participants' NPD experience (in years)	7.87	4.69
	% of sample	
Participants' role in NPD team		
Project leader	61.36	
Team member	38.64	
Participants' functional area		
Engineering	44.32	
Marketing	28.41	
Finance	14.77	
Administration	12.50	
Company size		
Small	48.86	
Medium	37.50	
Large	13.64	

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 a group of graduate students in industrial design engineering. The group, consisting of 17 students were given the instructions and questions, and asked to assess their clarity and comprehensibility, and identify any interpretation difficulties. Modifications were made in the material based on their feedback. The actual scenario texts are shown in Appendix E.

Independent variables

Manipulation of project innovativeness (INN). In the low innovativeness condition the project involved the development of a new product 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 project 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 cycle time reduction objective 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 cycle time reduction objective condition was 40%. In both conditions participants were given the aimed development time in absolute terms also (9 months for the low cycle time reduction objective condition and 6 months for the high cycle time reduction objective condition).

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 4.4. Following Mantel et al. (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 chapters 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 4.5 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, Pertusa-Ortega and Molina-Azorin 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.

Table 4.4 Acceleration tool descriptions in data collection instrument

Compression strategy	
1. Predevelopment planning	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. Computer aided design (CAD) use	Increasing the extent to which design engineers working on the project utilise ***computer-aided design systems*** relative to similar past projects.
4. Concurrency	Increasing the extent of ***overlap between different project activities/stages*** (e.g., design and manufacturing, marketing and engineering) relative to similar past projects.
5. Cross-functional team (CFT) use	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.Frequent design iterations	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. Frequent testing	Increasing the ***percentage of total development time spent testing designs*** relative to similar past projects.
9. Frequent milestones	Decreasing the ***time (i.e., number of weeks) between official project review meetings*** relative to similar past projects.
10. Team leader authority and accountability	Assuming ***direct authority over and responsibility for all aspects of the project*** (e.g., project budget, team composition, project timetable, project management approach).

Table 4.5 Bivariate correlations between the implementation likelihood of individual acceleration tools

	1	2	3	4	5	6	7	8	9	10
1. Planning	1	0.16	0.06	-0.01	0.02	0.02	0.15	**0.27** *	**0.25** *	0.19
2. Supplier inv.	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 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

* $p < 0.05$; ** $p < 0.01$.

Covariates

We included product complexity as a covariate due to its well-documented association with innovativeness, development time and new product performance. While complexity and innovativeness are different constructs they are very closely linked, with highly innovative projects also being more complex (Clark and Fujimoto 1991; Griffin 2002; Langerak et al. 2008). Furthermore, like innovativeness, complexity can also be a source of uncertainty due to the increase in the number of product functions and task interdependencies (Swink 2003) and therefore have implications for development time (Griffin 1997a, 2002), NPD performance (Ahmad et al. 2013), and NPD organisation (Carbonell and Rodriguez 2006a; Clift and Vandenbosch 1999). Complexity has also been shown to moderate the effectiveness of acceleration methods, with Sarin and Mahajan (2001) documenting that outcome-based rewards to be useful for accelerating less complex projects only. 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.

Respondents’ characteristics will inevitably be reflected in their decisions. 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 and realism 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; $F(1, 88) = 72.81$, $p < 0.01$) and aim a significantly new target market ($M_{HighInn}$ = 3.84, M_{LowInn} = 2.84; $F(1, 88) = 9.53$, $p < 0.05$) than the product in the low innovativeness condition. The cycle time reduction objective had no effect on the extent to which products were viewed as incorporating a different technology (M_{LowCTO} = 3.91, $M_{HighCTO}$ = 4.02; $F(1, 88) = 0.14$, $p = 0.707$) or serving a different market (M_{LowCTO} = 3.48, $M_{HighCTO}$ = 3.21; $F(1, 88) = 0.71$, $p = 0.402$). The interaction between innovativeness and cycle time reduction objective did not influence respondents' ratings of either innovativeness manipulation check variable (p = 0.821 and 0.329, respectively). Based on these findings we conclude that the innovativeness manipulation has been successful and that respondents' product innovativeness ratings have been unaffected by the cycle time reduction objective manipulation (see Patzer 1996).

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 cycle time reduction objective condition viewed it to be significantly greater in magnitude (M_{LowCTO} = 3.66, $M_{HighCTO}$ = 5.50; $F(1, 88) = 61.05$, $p < 0.01$) and more ambitious (M_{LowCTO} = 3.57, $M_{HighCTO}$ = 5.48; $F(1, 88) = 60.98$, $p < 0.001$) than those in the low acceleration condition. Product innovativeness did not have a significant effect on the perceived magnitude (M_{LowInn} = 4.46, $M_{HighInn}$ = 4.70; $F(1, 88) = 1.13$, p=0.292) and ambition (M_{LowInn} = 4.32, $M_{HighInn}$ = 4.73; $F(1, 88) = 2.80$, p = 0.098) of the cycle time reduction objective. The interaction between cycle time reduction objective and product innovativeness did not have an effect on respondents' ratings of either cycle time reduction objective manipulation check variable (p = 0.388 and 0.268, respectively). Based on these findings we conclude that the cycle time reduction objective manipulation has been successful and that respondents' cycle time reduction objective ratings have been unaffected by the product innovativeness manipulation.

Finally, we used two realism check questions, which assessed whether the respondents (1) could imagine an actual company doing the things described in the scenario (1 = "very strongly disagree); 4 = "neither agree, nor disagree"; 7 = "very strongly agree) and (2) how realistic they thought the scenario was (1 = "not at all realistic"; 4 = "somewhat realistic"; 7 = "very realistic". The mean score for the realism check questions were 5.01 and 4.91, respectively. A two-way ANOVA revealed no significant difference between the product innovativeness (p = 0.213 for question 1 and p = 0.470 for question 2) and cycle time reduction objective (p=0.933 for question 1 and 0.857 for question 2) conditions with respect to the perceived realism of the scenarios. The interaction between innovativeness and cycle time reduction objective were also non-significant. Based on these results we conclude that respondents perceived the four scenarios as equally realistic. Therefore, we do not expect any confounding effect of perceived realism on the relationships studied.

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 4.6 shows the cell means and standard deviations for the dependent variables.

Table 4.6 Cell means, standard deviations for dependent variables

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

* Standard deviations are in parentheses.
Cell sizes are $N = 22$.

The effect of project innovativeness on the implementation likelihood of compression and experiential strategies

H_{1a}, 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 4.7 and Figure 3.1 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 (H_{1b}). The analysis revealed, in line with expectations, a significant main effect of product innovativeness, 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 ($F(1, 88) = 10.78$, $p < 0.01$; $M_{LowINN} = 5.75$, $M_{HighINN} = 53.33$). Both hypotheses regarding the role of product innovativeness on the implementation likelihood of different acceleration strategies were therefore supported.

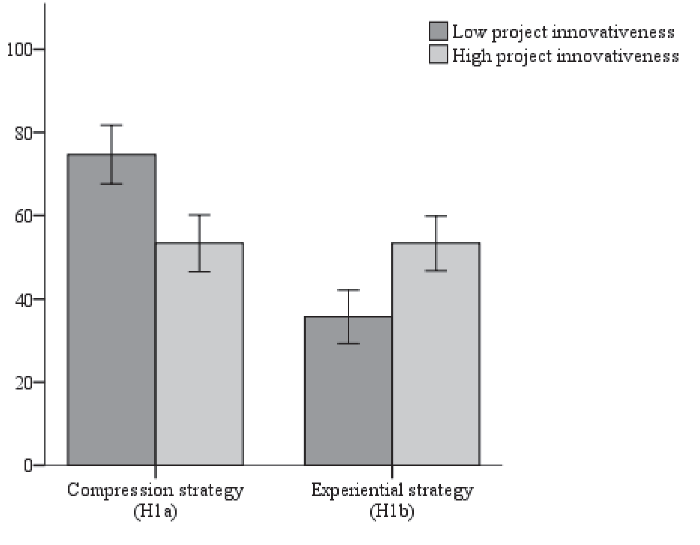
The effect of cycle time reduction objective on the implementation likelihood of compression and experiential strategies

Table 4.7 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 ($F(1, 88) = 8.29$, $p < 0.05$; $M_{LowCTO} = 57.11$, $M_{HighCTO} = 70.92$). 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 4.7 ANCOVA results for compression and experiential strategy models ($H_{1a\text{-}b}$)

Dependent variable:	**Compression strategy**			**Experiential strategy**		
Source of variation	*F*	*df*	Sig.	*F*	*df*	Sig.
Project innovativeness (*INN*)	250.1	1	0.00	100.7	1	0.00
Cycle time reduction objective (*CTO*)	80.29	1	0.01	0.26	1	0.61
Product complexity	10.56	1	0.22	0.83	1	0.36
Respondent NPD experience	0.92	1	0.34	0.16	1	0.69
Respondent background dummy: Marketing	0.63	1	0.43	0.37	1	0.55
Respondent background dummy: Engineering	0.14	1	0.71	0.97	1	0.33
Respondent background dummy: Administrative	0.00	1	0.96	0.08	1	0.78

Figure 4.1 Effect of project innovativeness on the use of compression and experiential acceleration strategies ($H_{1a\text{-}b}$)



H_{2a} and H_{2b} 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 display no change in how much they used the experiential strategy, respectively. H_{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). H_{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 4.8 for results).

Table 4.8 Planned contrast test results for compression and experiential strategy models ($H_{2a\text{-}d}$)

Hypothesis	Dependent variable	Studied groups*	Expected relationship	Contrast estimate (SE)	Sig.
H_{2a}	Compression	LI-LCTO vs. LI-HCTO	LI-LCTO <. LI-HCTO	-14.04 (6.97)	0.05
H_{2b}	Experiential	LI-LCTO vs. LI-HCTO	LI-LCTO = LI-HCTO	-0.75 (6.91)	0.91
H_{2c}	Compression	HI-LCTO vs. HI-HCTO	HI-LCTO < HI-HCTO	-14.02 (6.68)	0.04
H_{2d}	Experiential	HI-LCTO vs. HI-HCTO	HI-LCTO > HI-HCTO	-4.18 (6.63)	0.53

* 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.

Consistent with H_{2a}, 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 H_{2b}, 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 (H_{2c}). However, the analyses did not validate H_{2d}, 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).

DISCUSSION AND IMPLICATIONS

This study offered a descriptive account of the role of uncertainty on acceleration strategy choice. Specifically, 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. Although several past studies had addressed the uncertainty in the context of project acceleration, attention had predominantly been uncertainty associated with project environment rather than the characteristics of the project itself. With the exception of one study (Swink 2003), cycle time reduction objective as an additional source of uncertainty had been unscrutinised. By using an experimental approach, we were able to tease apart these sources and assess their relative importance in practitioners' choice of acceleration strategies.

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. Table 4.9 provides a summary of the results.

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).

Table 4.9 Summary of results

Hypothesis	Dependent variable	Studied groups*	Expected relationship	Result
H_{1a}	Compression	LI vs HI	LI > HI	Supported
H_{1b}	Experiential	LI vs HI	LI < HI	Supported
H_{2a}	Compression	LI-LCTO vs. LI-HCTO	LI-LCTO <. LI-HCTO	Supported
H_{2b}	Experiential	LI-LCTO vs. LI-HCTO	LI-LCTO = LI-HCTO	Supported
H_{2c}	Compression	HI-LCTO vs. HI-HCTO	HI-LCTO < HI-HCTO	Supported
H_{2d}	Experiential	HI-LCTO vs. HI-HCTO	HI-LCTO > HI-HCTO	Not supported

* 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.

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, Birkinshaw, Probst and Tushman 2009), ambidexterity is increasingly recognised as a learning capability critical for enhancing firms' ability to respond to uncertainty (Patel, Terjesen and Li 2012). Many studies indicate that high levels of uncertainty requires firms to engage in both exploitation and exploration activities (e.g., Lubatkin, Simsek, Ling and Veiga 2006; Voss, Sirdeshmukh and Voss 2008). By doing so, firms not only balance the maintenance of established routines with the incorporation of novel ideas and processes (Patel et al. 2012), but also avoid the risks and pitfalls associated with pure exploitation and exploitation (Cao, Gedajlovic and

Zhang 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 et al. 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, Menon and Bell 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 et al. 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 and

Chapter 2 of this dissertation 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, Garcia and Dröge 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. The existence of trade-offs is relevant to acceleration decisions because decisions taken in an effort to reduce development times may have implications for performance dimensions such as development costs and product quality. In a recent study, Cardinal et al. (2011) observe that certain project structures and processes produce positive results on one or two performance dimensions at the expense of the remaining ones. For instance, they find that while greater concurrency decreases project duration, the consequent increase in errors and rework leads to higher development costs and lower product quality. Future studies could accommodate for these trade-offs by looking into how the presence of cost and quality objectives (in addition to time objectives) affect acceleration strategy choice.

Second, the scenarios used in this study were framed such that the decisions to implement the acceleration practices of interest were taken at the beginning of the development project. This is because decisions concerning many of the acceleration practices discussed in this study are taken very early on in the development process (e.g., supplier integration decisions - Petersen et al. 2005). Griffin (1997a) finds that cross functional team use offers greater benefits at the initial stages of the project. Olson et al. (2001) arrive at a similar conclusion. In the light of these findings, incorporating *when* in the project acceleration practices are implemented is another way in which this research can be extended. Relatedly, one could also examine how practitioners' propensity to use certain acceleration approaches change over time. In their longitudinal study of project management styles, Lewis et al. (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 et al. (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.

5

CONCLUSION

SYNOPSIS

The past three decades have seen many companies adopting time-based strategies in an effort to bring their products to market quickly. While this trend in the industry has given rise to extensive scholarly interest in development speed, extant literature has yet to provide a coherent account of its consequences for new product development performance, its drivers, and the conditions under which these drivers are beneficial. Motivated by the clear need for more work the area, this dissertation sought to expand scholarly knowledge on NPD speed by answering the following questions:

- What is the effect of accelerated cycle time on performance (given the inconsistencies in the empirical findings)?
- How can cycle time effectively be reduced, taking into account uncertainty as a contingency factor?

This dissertation reported three studies undertaken with the aim of answering these questions. Each study approached development speed from a different angle and investigated it in different theoretical domains, each time using a different methodological approach. Study 1 focused on the consequences of development speed, and used meta-analytic methods to shed light into how development speed relates to new product success, taking into account its different dimensions. Studies 2 and 3 directed the attention to the antecedents of development speed, also taking into account the moderating role of uncertainty. While study 2 treated acceleration as a continuous process that is a by-product of the firm's prior NPD experience (which itself is a product of organizational learning), study 3 viewed acceleration as achievable primarily by active management intervention in the form of acceleration strategies. The next section briefly summarises the studies reported in this dissertation, with special attention on their main findings and conclusions.

SUMMARY OF STUDY FINDINGS AND CONCLUSIONS

Study 1 was a meta-analytic synthesis of the relationship between product development cycle time and other dimensions of new product performance documented in prior literature. Its primary point of departure from earlier meta-analyses involving the NPD speed construct were (1) its treatment of development speed as the focal variable and (2) its detailed consideration of its antecedent relationships to the different dimensions of new product performance. Acknowledging the multifaceted character of NPD success, it explored whether the speed-success link was influenced by the success dimension in question.

The main effect results were generally consistent with the notion that development speed is associated with increased new product success. We found that faster product development is linked to favourable outcomes in all but one dimension. Improved technical quality was the only performance dimension that is not significantly associated with how fast the NPD process is completed. Proficiency in market entry timing, on the other hand, displayed the largest positive correlation with development speed. Furthermore, the proficiency in market entry timing - development speed link was the only one that remained robust across research design and context characteristics.

Results of the heterogeneity analysis portrayed an even more nuanced picture of the speed - performance relationship. Market entry timing proficiency aside, all five performance dimensions (i.e., composite success, development costs, product competitive advantage, customer-based success and financial success) displayed considerable cross-situational heterogeneity in their association with development speed. Although their correlations with development speed remained positive, the magnitude and statistical significance of these correlations varied across research design and context characteristics. The three most important moderating variables were all methodological decisions, and pertained to sample randomness, number of items in the speed measurement scale, and the use of absolute or relative speed measures. The more methodologically rigorous practices of using random samples and absolute measures of speed being more likely to produce insignificant speed/success relationships was the most striking outcome of the heterogeneity analysis.

Study 2 used learning curve methodology to explore how NPD experience accumulated by organizational members that are not part of a given NPD project spills over to the focal project and affects its cycle time, and assess whether project uncertainty has any bearing on the extent to which the cycle time implications of organizational experience are realized. Organizational experience can be more specialized or varied depending on where in the organization it originates, and therefore can have different implications for project cycle time. Acknowledging this possibility, the study also examined if low- and high-uncertainty projects differ with respect to the extent to which they benefit from experience gained within their own organizational unit (specialized experience) and experience gained in other organizational units (related experience).

The analyses revealed that NPD experience available within an organization outside the project team is highly relevant for project cycle time reductions. Both low- and high-uncertainty projects benefit from specialized organizational experience gained in the same domain and from related organizational experience accumulated in other domains. High uncertainty projects not only benefit more from related organizational experience than do their low-uncertainty counterparts, but they also benefit more from related organizational experience than from specialized organizational experience. Contrary to expectations, high uncertainty projects benefit from specialized organizational experience just as much as low uncertainty projects in terms of reduced cycle times.

Study 3 adopted the view of project acceleration as an outcome of managers' purposeful implementation of acceleration strategies, and examined how project uncertainty influenced practitioners' choice of acceleration strategies. We proposed two sources of uncertainty to shape practitioners' decisions to implement the compression and acceleration strategies: product innovativeness (primary source) and cycle time reduction objective (secondary source). We hypothesised that, since product innovativeness is ascertained so early on in the project, the "default" acceleration strategy would be dictated by product innovativeness (compression for incremental projects and experiential for innovative projects). Cycle time reduction objective, on the other hand, was expected to have an indirect effect on acceleration strategy choice by *amplifying* the uncertainty arising from increased product innovativeness. We reasoned that, because incremental and new-to-the-firm projects are characterised by different levels of uncertainty, variations in the amount of time reduction sought should affect acceleration strategy choice differently across the two types of projects.

The analysis offered 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). We found that incremental and highly innovative projects responded differently to the hike in uncertainty due to an ambitious acceleration goal. 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 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.

That is, 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).

IMPLICATIONS

The studies reported in this dissertation represent standalone pieces of empirical work that touch upon different aspects of NPD speed. Collectively, they contribute to a more comprehensive understanding of NPD speed and its antecedents, thereby offering valuable insights into its management. In the remaining few paragraphs of this dissertation we highlight the main contributions of this dissertation to extant work on NPD speed.

Study 1 contributes to the consequences stream of literature on NPD speed by establishing that faster product development is indeed closely – and positively – related to new product performance. This finding is reassuring, as the value of faster product development as an organizational competency resides in its contribution to ultimate new product success. However, closer inspection of the main effect results reveal that the speed-success relationship is dependent on the dimension of success being considered, thereby reiterating that NPD success is a complex and multifaceted construct. The subsequent heterogeneity analyses indicate that methodological characteristics of the primary studies have a marked influence on the magnitude and significance of the speed-success link. Together, these findings highlight the importance of clear communication on part of scholars of construct choice and methodological decisions. This is crucial for the proper assessment of the accuracy, meaningfulness and cross-sectional generalizability of empirical findings.

Studies 2 and 3 advance our understanding of the drivers of NPD speed by focusing on two different ways in which faster development can be achieved: (1) organizational learning, a continuous process that draws on the historical and the organizational context within which projects are embedded, and (2) the implementation of acceleration strategies that are specific to the project at hand. This distinction is important, as previous work on the drivers on NPD speed typically does not distinguish between faster product development due to intentional acceleration and shorter cycle times attributable to broader organizational processes such as organizational learning and intra organizational knowledge transfer. Both studies also have implications for our understanding of uncertainty in the context of NPD speed. Study 2 shows that the uncertainty arising from higher levels of product innovativeness had a significant moderating effect on the time performance implications of organizational experience. Study 3 introduces time reduction objective as an additional source of uncertainty and documents both sources to be influential in practitioners' acceleration strategy decisions.

Specifically, study 2 extends the literature on NPD cycle time by examining the link between past project experience and cycle time through a lens which accommodates for the organizational and temporal setting in which NPD projects are located. This approach stands in contrast against the majority of cycle time studies, which either adopt a purely project level perspective with a focus on a single project from multiple organizations (e.g., Ali 2000; Swink et al. 2006) or a purely organizational level perspective that collapses firms' project portfolio into a single unit of analysis (e.g., Ittner and Larcker 1997). The former approach has its merits in the investigation of factors underlying variations in cycle time between organizations (e.g., Moorman 1995), while the latter has been fruitfully applied in the examination of the link between cycle time and other NPD performance indicators (e.g., (e.g., Ittner and Larcker 1997). However, both approaches fall short of recognizing the interrelationship between projects that together form the organization's project portfolio. Focusing on multiple projects from a single organization, as opposed to a single project from multiple organizations, allowed this study to empirically document the influence of knowledge transfer that takes place between projects on cycle time, which would have been impossible with a mere focus on the project or organizational level. Study 2 also has implications also for organizational learning literature thanks to its extension of the conventional learning curve approach to encompass a wider range of organizational settings and include a diversity of performance measures. Taken together, our results reveal that learning-by-doing is indeed manifest in the context of cycle time reduction in NPD, providing further evidence for its methodological value in the precise quantification of the effects of learning in highly knowledge intensive domains.

To the best of our knowledge, study 3 is the first study to offer a descriptive, rather than a prescriptive account of acceleration strategy choice. We acknowledge that establishing the effectiveness of acceleration strategies, which has been the focus of previous work, 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 is just as important as establishing the performance implications of these decisions in creating a more complete understanding of the phenomenon in question. Greater acknowledgement of these factors should also allow scholars to formulate their recommendations such that they are better aligned with the realities of NPD practice.

LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

A recent meta-analysis of NPD success factors showed that although the importance of most previously identified success factors, such as product advantage, marketing synergy and dedicated R&D resources have declined significantly over time, faster product development remains a salient success factor in new product development (Evanschitzky et al. 2012). This striking finding, combined with our documentation of the close association of NPD speed with NPD success, suggests that academic interest in the topic is unlikely to wane in the foreseeable future. We conclude this dissertation by acknowledging its limitations and suggesting several avenues for future research.

First, as noted several times throughout this dissertation, speed is just one intermediate outcome of the NPD process. Although our main effects meta-analytic results are aligned with synergistic accounts of the link between operational NPD outcomes rather than those emphasizing the trade-offs between them, they should not be interpreted as an outright refutation of the trade-off view. Indeed, the subsequent moderator analyses suggest that both the trade-off and synergy accounts may have merit, depending on the characteristics of the research and the setting in which it was conducted. Relatedly, factors that have a positive effect on NPD speed may influence other performance dimensions such as costs and quality differently. For instance, Cardinal et al. (2011) find that while greater concurrency decreases project duration, the consequent increase in errors and rework leads to higher development costs and lower product quality. In studies 2 and 3, we focused on development speed as the only indicator of NPD performance, and were therefore unable to explore the possibility of trade-offs. Given that development costs and product quality are also influential in the market and financial performance of new products (Tatikonda and Montoya-Weiss 2001), future investigations of the antecedents of development speed would benefit greatly from also considering how these antecedents bear on costs and quality as well. This would increase the usefulness of research findings for practitioners, since they are typically confronted with the challenge of meeting time, cost and quality objectives simultaneously.

Our second recommendation pertains to the interaction between drivers. The most recent PDMA best practices survey (Barczak et al. 2009) shows that the best firms owe their success to making effective use of several NPD practices simultaneously. In a recent study Ahmad et al. (2013) found that while process concurrency and cross functional team use did not have any direct effect on NPD performance, their interaction had a strong negative effect. Although many of the studies in the antecedents stream involve multiple drivers, not all consider their interactions. Relatedly, future research could look into how practitioners combine different acceleration approaches. Given these documentations of interaction effects one wonders whether managerial decisions to implement a particular practice depends on whether it is implemented in isolation or in conjunction with others. An empirical investigation of this issue, possibly using conjoint methods, is likely to yield very interesting insights into managerial decision making in NPD acceleration.

Third, future work on NPD speed would benefit greatly from utilising theoretical frameworks and/or methodological approaches from other research domains. Study 2 showed that the learning curve framework, which is recognised in organizational learning literature as a solid means of quantifying the performance implications of experience-based learning, is also well-suited in the context of unstructured NPD tasks, just as much as it is to (relatively) structured tasks. Study 3 hinted that the notion of ambidexterity, a key theme in organizational learning literature, is not limited to seemingly contradictory learning strategies (i.e., exploitation and exploration), but applies to acceleration strategies as well. Introducing new theories and methods would not only greatly enrich the literature but also offer the prospect of opening up new research areas.

BIBLIOGRAPHY

Adams-Bigelow, M., A. Griffin. 2005. Product development cycle time and success: New results from PDMA's comparative performance assessment study *Proceedings of the Product Development & Management Association International Conference*, San Diego, CA.

Adler, P.S., A. Mandelbaum, V. Nguyen, E. Schwerer. 1995. From project to process management: An empirically-based framework for analyzing product development time. *Management Science* **41**(3) 458-484.

Aguinis, H., C.A. Pierce. 1998. Testing moderator variable hypotheses meta-analytically. *Journal of Management* **24**(5) 577-592.

Ahmad, S., D.N. Mallick, R.G. Schroeder. 2013. New product development: Impact of project characteristics and development practices on performance. *Journal of Product Innovation Management* **30**(2) 331-348.

Akgün, A.E., G.S. Lynn. 2002. Antecedents and consequences of team stability on new product development performance. *Journal of Engineering and Technology Management* **19**(3-4) 263-286.

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

Ali, A., R. Krapfel, D. LaBahn. 1995. Product innovativeness and entry strategy: Impact on cycle time and break-even time. *Journal of Product Innovation Management* **12**(1) 54-69.

Ancona, D.G., D.F. Caldwell. 1992. Demography and design: Predictors of new product team performance. *Organization Science* **3**(3) 321-341.

Anzai, Y., H.A. Simon. 1979. Theory of learning by doing. *Psychological Review* **86**(2) 124-140.

Argote, L. 1999. *Organizational learning: Creating, retaining and transferring knowledge*. Kluwer Academic Publishers, Boston, MA.

Argote, L., S.L. Beckman, D. Epple. 1990. The persistence and transfer of learning in industrial settings. *Management Science* **36**(2) 140-154.

Argote, L., E. Miron-Spektor. 2011. Organizational learning: From experience to knowledge. *Organization Science* **22**(5) 1123-1137.

Aronson, Z.H., R.R. Reilly, G.S. Lynn. 2006. The impact of leader personality on new product development teamwork and performance: The moderating role of uncertainty. *Journal of Engineering and Technology Management* **23**(3) 221-247.

Atuahene-Gima, K. 2003. The effects of centrifugal and centripetal forces on product development speed and quality: How does problem solving matter? *Academy of Management Journal* **46**(3) 359-373.

Atuahene-Gima, K. 1995. An exploratory analysis of the impact of market orientation on new product performance. *Journal of Product Innovation Management* **12**(4) 275-293.

Balkundi, P., D.A. Harrison. 2006. Ties, leaders, and time in teams: Strong inference about network structure's effects on team viability and performance. *Academy of Management Journal* **49**(1) 49-68.

Barczak, G., A. Griffin, K.B. Kahn. 2009. Perspective: Trends and drivers of success in NPD practices: Results of the 2003 PDMA best practices study. *Journal of Product Innovation Management* **26**(1) 3-23.

Bayus, B.L. 1997. Speed-to-market and new product performance trade-offs. *Journal of Product Innovation Management* **14**(6) 485-497.

Bayus, B.L., S. Jain, A.G. Rao. 1997. Too little, too early: Introduction timing and new product performance in the personal digital assistant industry. *Journal of Marketing Research* 50-63.

Belsey, D.A., E. Kuh, R.E. Welsch. 1980. *Regression diagnostics: Identifying influential data and sources of collinearity*. John Wiley and Sons, New York.

Ben Zur, H., S.J. Breznitz. 1981. The effect of time pressure on risky choice behavior. *Acta Psychologica* **47**(2) 89-104.

Bergkvist, L., J.R. Rossiter. 2007. The predictive validity of multiple-item versus single-item measures of the same constructs. *Journal of Marketing Research* **44**(2) 175-184.

Betsch, T., K. Fiedler, J. Brinkmann. 1998. Behavioral routines in decision making: The effects of novelty in task presentation and time pressure on routine maintenance and deviation. *European Journal of Social Psychology* **28**(6) 861-878.

Boer, M., R. Logendran. 1999. A methodology for quantifying the effects of product development on cost and time. *IIE Transactions* **31**(4) 365-378.

Boh, W.F., S.A. Slaughter, J.A. Espinosa. 2007. Learning from experience in software development: A multilevel analysis. *Management Science* **53**(8) 1315-1331.

Boone, T., R. Ganeshan, R.L. Hicks. 2008. Learning and knowledge depreciation in professional services. *Management Science* **54**(7) 1231-1236.

Brettel, M., F. Heinemann, A. Engelen, S. Neubauer. 2011. Cross-Functional Integration of R&D, Marketing, and Manufacturing in Radical and Incremental Product Innovations and Its Effects on Project Effectiveness and Efficiency. *Journal of Product Innovation Management* **28**(2) 251-269.

Brockman, B.K., R.M. Morgan. 2003. The role of existing knowledge in new product innovativeness and performance. *Decision Sciences* **34**(2) 385-419.

Brown, S.L., K.M. Eisenhardt. 1995. Product development: Past research, present findings, and future directions. *Academy of Management Review* **20**(2) 343-378.

Brown, S.P., R.A. Peterson. 1993. Antecedents and consequences of salesperson job satisfaction: Meta-analysis and assessment of causal effects. *Journal of Marketing Research* **30**(1) 63-77.

Browning, T.R., S.D. Eppinger. 2002. Modeling impacts of process architecture on cost and schedule risk in product development. *IEEE Transactions on Engineering Management* **49**(4) 428-442.

Bstieler, L. 2005. The moderating effect of environmental uncertainty on new product development and time efficiency. *Journal of Product Innovation Management* **22**(3) 267-284.

Calantone, R., R. Garcia, C. Dröge. 2003. The effects of environmental turbulence on new product development strategy planning. *Journal of Product Innovation Management* **20**(2) 90-103.

Calantone, R.J., C.A. Di Benedetto. 2000. Performance and time to market: Accelerating cycle time with overlapping stages. *IEEE Transactions on Engineering Management* **47**(2) 232-244.

Calantone, R.J., S.K. Vickery, C. Dröge. 1995. Business performance and strategic new product development activities: An empirical investigation. *Journal of Product Innovation Management* **12**(3) 214-223.

Callahan, J., B. Moretton. 2001. Reducing software product development time. *International Journal of Project Management* **19**(1) 59-70.

Cao, Q., E. Gedajlovic, H. Zhang. 2009. Unpacking organizational ambidexterity: Dimensions, contingencies, and synergistic effects. *Organization Science* **20**(4) 781-796.

Carbonell, P., A.I. Rodriguez. 2006a. Designing teams for speedy product development: The moderating effect of technological complexity. *Journal of Business Research* **59**(2) 225-232.

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

Cardinal, L.B., S.F. Turner, M.J. Fern, R.M. Burton. 2011. Organizing for product development across technological environments: Performance trade-offs and priorities. *Organization Science* **22**(4) 1000-1025.

Chao, R.O., S. Kavadias. 2008. A theoretical framework for managing the new product development portfolio: When and how to use strategic buckets. *Management Science* **54**(5) 907-921.

Chen, J., F. Damanpour, R.R. Reilly. 2010. Understanding antecedents of new product development speed: A meta-analysis. *Journal of Operations Management* **28**(1) 17-33.

Chen, J., R.R. Reilly, G.S. Lynn. 2005. The impacts of speed-to-market on new product success: The moderating effects of uncertainty. *IEEE Transactions on Engineering Management* **52**(2) 199-212.

Chen, J., R.R. Reilly, G.S. Lynn. 2012. New product development speed: Too much of a good thing? *Journal of Product Innovation Management* **29**(2) 288-303.

Chin, W.W., P.R. Newsted. 1999. Structural equation modeling analysis with small samples using partial least squares. *Statistical Strategies for Small Sample Research* **1**(1) 307-341.

Clark, J.R., R.S. Huckman. 2012. Broadening focus: Spillovers, complementarities, and specialization in the hospital industry. *Management Science* **58**(4) 708-722.

Clark, K.B., T. Fujimoto. 1991. *Product development performance: Strategy, organization, and management in the world auto industry*. Harvard Business Press.

Claver-Cortes, E., E.M. Pertusa-Ortega, J.F. Molina-Azorin. 2012. Characteristics of organizational structure relating to hybrid competitive strategy: Implications for performance. *Journal of Business Research* **65**(7) 993-1002.

Clift, T.B., M.B. Vandenbosch. 1999. Project complexity and efforts to reduce product development cycle time. *Journal of Business Research* **45**(2) 187-198.

Cohen, J. 1992. A power primer. *Psychological Bulletin* **112**(1) 155-159.

Cohen, J., P. Cohen, S.G. West, L.S. Aiken. 1983. *Applied multiple regression/correlation analysis for the behavioral sciences*, 2nd. ed. Lawrence Erlenbaum Associates, Hillsdale, NJ.

Cohen, M.A., J. Eliashberg, T.-H. Ho. 1996. New product development: The performance and time-to-market tradeoff. *Management Science* **42**(2) 173-186.

Cooper, R.G., E.J. Kleinschmidt. 1987. Success factors in product innovation. *Industrial Marketing Management* **16**(3) 215-223.

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

Cordero, R. 1991. Managing for speed to avoid product obsolescence: A survey of techniques. *Journal of Product Innovation Management* **8**(4) 283-294.

Crawford, C.M. 1992. The hidden costs of accelerated product development. *Journal of Product Innovation Management* **9**(3) 188-199.

Crosno, J.L., R. Dahlstrom. 2008. A meta-analytic review of opportunism in exchange relationships. *Journal of the Academy of Marketing Science* **36**(2) 191-201.

Cyert, R.M., J.G. March. 1963. A behavioral theory of the firm. Prentice Hall, Englewood Cliffs, NJ.

Damanpour, F. 1991. Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal* **34**(3) 555-590.

Danneels, E. 2002. The dynamics of product innovation and firm competences. *Strategic Management Journal* **23**(12) 1095-1121.

Danneels, E., E.J. Kleinschmidt. 2001. Product innovativeness from the firm's perspective: Its dimensions and their relation with project selection and performance. *Journal of Product Innovation Management* **18**(6) 357-373.

Darr, E.D., L. Argote, D. Epple. 1995. The acquisition, transfer, and depreciation of knowledge in service organizations: Productivity in franchises. *Management Science* **41**(11) 1750-1762.

Datar, S., C. Jordan, S. Kekre, S. Rajiv, K. Srinivasan. 1997. New product development structures and time-to-market. *Management Science* **43**(4) 452-464.

Davis, P.S., C.C. Dibrell, B.D. Janz. 2002. The impact of time on the strategy–performance relationship: Implications for managers. *Industrial Marketing Management* **31**(4) 339-347.

Day, G.S. 1994. The capabilities of market-driven organizations. *Journal of Marketing* **58**(4) 37-52.

De Carolis, D.M. 2003. Competencies and imitability in the pharmaceutical industry: An analysis of their relationship with firm performance. *Journal of Management* **29**(1) 27-50.

Diamantopoulos, A., H.M. Winklhofer. 2001. Index construction with formative indicators: An alternative to scale development. *Journal of Marketing Research* **38**(2) 269-277.

Dröge, C., J. Jayaram, S.K. Vickery. 2000. The ability to minimize the timing of new product development and introduction: An examination of antecedent factors in the North American automobile supplier industry. *Journal of Product Innovation Management* **17**(1) 24-40.

Duffy, V.G., G. Salvendy. 1999. Relating company performance to staff perceptions: The impact of concurrent engineering on time to market. *International Journal of Production Research* **37**(4) 821-834.

Easton, G.S., E.D. Rosenzweig. 2012. The role of experience in six sigma project success: An empirical analysis of improvement projects. *Journal of Operations Management* **30**(7-8) 481–493.

Eisenhardt, K.M., B.N. Tabrizi. 1995. Accelerating adaptive processes: Product innovation in the global computer industry. *Administrative Science Quarterly* **40**(1) 84-110.

Emmanuelides, P.A. 1993. Towards an integrative framework of performance in product development projects. *Journal of Engineering and Technology Management* **10**(4) 363-392.

Ethiraj, S.K., D. Levinthal. 2009. Hoping for A to Z while rewarding only A: Complex organizations and multiple goals. *Organization Science* **20**(1) 4-21.

Evanschitzky, H., M. Eisend, R.J. Calantone, Y. Jiang. 2012. Success factors of product innovation: An updated meta-analysis. *Journal of Product Innovation Management* **29**(S1) 21-37.

Filippini, R., L. Salmaso, P. Tessarolo. 2004. Product development time performance: Investigating the effect of interactions between drivers. *Journal of Product Innovation Management* **21**(3) 199-214.

Flint, D.J. 2002. Compressing new product success-to-success cycle time: deep customer value understanding and idea generation. *Industrial Marketing Management* **31**(4) 305-315.

Franke, G.R., J.-E. Park. 2006. Salesperson adaptive selling behavior and customer orientation: A meta-analysis. *Journal of Marketing Research* **43**(4) 693-702.

Galbraith, J.R. 1973. *Designing complex organizations*. Addison-Wesley, Reading, MA.

García, N., M.J. Sanzo, J.A. Trespalacios. 2008. New product internal performance and market performance: Evidence from Spanish firms regarding the role of trust, interfunctional integration, and innovation type. *Technovation* **28**(11) 713-725.

Garcia, R., R.J. Calantone. 2002. A critical look at technological innovation typology and innovativeness terminology: A literature review. *Journal of Product Innovation Management* **19**(2) 110-132.

Gatignon, H., M.L. Tushman, W. Smith, P. Anderson. 2002. A structural approach to assessing innovation: Construct development of innovation locus, type, and characteristics. *Management Science* **48**(9) 1103-1122.

Gerwin, D., N.J. Barrowman. 2002. An evaluation of research on integrated product development. *Management Science* **48**(7) 938-953.

Geyskens, I., J.-B.E.M. Steenkamp, N. Kumar. 1998. Generalizations about trust in marketing channel relationships using meta-analysis. *International Journal of Research in Marketing* **15**(3) 223-248.

Geyskens, I., J.-B.E.M. Steenkamp, N. Kumar. 2006. Make, buy, or ally: A transaction cost theory meta-analysis. *Academy of Management Journal* **49**(3) 519-543.

Gleser, L.J., I. Olkin. 1994. Stochastically dependent effect sizes. H. Cooper, L.V. Hedges, eds. *The handbook of research synthesis and meta-analysis*. Russell Sage Foundation, New York, 339–355.

González, F.J.M., T.M.B. Palacios. 2002. The effect of new product development techniques on new product success in Spanish firms. *Industrial Marketing Management* **31**(3) 261-271.

Grant, R.M. 1996. Toward a knowledge-based theory of the firm. *Strategic Management Journal* **17**(Winter) 109-122.

Green, S.G., M.B. Gavin, L. Aiman-Smith. 1995. Assessing a multidimensional measure of radical technological innovation. *IEEE Transactions on Engineering Management* **42**(3) 203-214.

Griffin, A. 1993. Metrics for measuring product development cycle time. *Journal of Product Innovation Management* **10**(2) 112-125.

Griffin, A. 1997a. The effect of project and process characteristics on product development cycle time. *Journal of Marketing Research* **34**(1) 24-35.

Griffin, A. 1997b. PDMA research on new product development practices: Updating trends and benchmarking best practices. *Journal of Product Innovation Management* **14**(6) 429-458.

Griffin, A. 2002. Product development cycle time for business-to-business products. *Industrial Marketing Management* **31**(4) 291-304.

Griffin, A., A.L. Page. 1993. An interim report on measuring product development success and failure. *Journal of Product Innovation Management* **10**(4) 291-308.

Griffin, A., A.L. Page. 1996. PDMA success measurement project: Recommended measures for product development success and failure. *Journal of Product Innovation Management* **13**(6) 478-496.

Guo, L. 2008. PERSPECTIVE: An Analysis of 22 Years of Research in JPIM. *Journal of Product Innovation Management* **25**(3) 249-260.

Gupta, A.K., K. Brockhoff, U. Weisenfeld. 1992. Making trade-offs in the new product development process: A German/US comparison. *Journal of Product Innovation Management* **9**(1) 11-18.

Hackman, J.R., G.R. Oldham. 1976. Motivation through the design of work: Test of a theory. *Organizational Behavior and Human Performance* **16**(2) 250-279.

Hansen, M.T. 2002. Knowledge networks: Explaining effective knowledge sharing in multiunit companies. *Organization Science* **13**(3) 232-248.

Hart, S. 1993. Dimensions of success in new product development: An exploratory investigation. *Journal of Marketing Management* **9**(1) 23-41.

Harter, D.E., M.S. Krishnan, S.A. Slaughter. 2000. Effects of process maturity on quality, cycle time, and effort in software product development. *Management Science* **46**(4) 451-466.

Hedges, L.V., I. Olkin. 1985. *Statistical methods for meta-analysis*. Academic Press, New York.

Heim, G.R., M.E. Ketzenberg. 2011. Learning and relearning effects with innovative service designs: An empirical analysis of top golf courses. *Journal of Operations Management* **29**(5) 449-461.

Heim, G.R., D.X. Peng. 2010. The impact of information technology use on plant structure, practices, and performance: An exploratory study. *Journal of Operations Management* **28**(2) 144-162.

Henard, D.H., D.M. Szymanski. 2001. Why some new products are more successful than others. *Journal of Marketing Research* **38**(3) 362-375.

Hitt, M.A., R.E. Hoskisson, R.D. Nixon. 1993. A mid-range theory of interfunctional integration, its antecedents and outcomes. *Journal of Engineering and Technology Management* **10**(1) 161-185.

Hoegl, M., K. Weinkauf, H.G. Gemünden. 2004. Interteam coordination, project commitment, and teamwork in multiteam R&D projects: A longitudinal study. *Organization Science* **15**(1) 38-55.

Hong, P., A.Y. Nahm, W.J. Doll. 2004. The role of project target clarity in an uncertain project environment. *International Journal of Operations & Production Management* **24**(11-12) 1269-1291.

Hora, M., R.D. Klassen. 2012. Learning from others'misfortune: Factors influencing knowledge acquisition to reduce operational risk. *Journal of Operations Management* **31**(1-2) 52-61.

Huang, X., G.N. Soutar, A. Brown. 2004. Measuring new product success: An empirical investigation of Australian SMEs. *Industrial Marketing Management* **33**(2) 117-123.

Huber, G.P. 1991. Organizational learning: The contributing processes and the literatures. *Organization Science* **2**(1) 88-115.

Huckman, R.S., B.R. Staats, D.M. Upton. 2009. Team familiarity, role experience, and performance: Evidence from Indian software services. *Management Science* **55**(1) 85-100.

Hultink, E.J., H.S.J. Robben. 1995. Measuring new product success: The difference that time perspective makes. *Journal of Product Innovation Management* **12**(5) 392-405.

Hunter, J.E., F.L. Schmidt. 1990. *Methods of meta-analysis: Correcting error and bias in research findings*. Academic Press, New York.

Hunter, J.E., F.L. Schmidt. 2000. Fixed effects vs. random effects meta-analysis models: Implications for cumulative research knowledge. *International Journal of Selection and Assessment* **8**(4) 275-292.

Hwang, M.I. 1994. Decision making under time pressure: A model for information systems research. *Information & Management* **27**(4) 197-203.

Ingram, P., T. Simons. 2002. The transfer of experience in groups of organizations: Implications for performance and competition. *Management Science* **48**(12) 1517-1533.

Ittner, C.D., D.F. Larcker. 1997. Product development cycle time and organizational performance. *Journal of Marketing Research* **34**(1) 13-23.

Jayaram, J., R. Narasimhan. 2007. The influence of new product development competitive capabilities on project performance. *IEEE Transactions on Engineering Management* **54**(2) 241-256.

Johnson, M.D. 2009. A framework for incorporating time, cost, and fidelity trade-offs among design assessment methods in product development *International Conference on Industrial Engineering and Engineering Management*. IEEE, 578-582.

Johnson, W.H.A., Z. Piccolotto, R. Filippini. 2009. The impacts of time performance and market knowledge competence on new product success: an international study. *IEEE Transactions on Engineering Management* **56**(2) 219-228.

Joshi, A., H. Roh. 2009. The role of context in work team diversity research: A meta-analytic review. *Academy of Management Journal* **52**(3) 599-627.

Katila, R., G. Ahuja. 2002. Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal* **45**(6) 1183-1194.

Keinan, G. 1987. Decision making under stress: Scanning of alternatives under controllable and uncontrollable threats. *Journal of Personality and Social Psychology* **52**(3) 639-644.

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

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

Kessler, E.H., A.K. Chakrabarti. 1999. Speeding up the pace of new product development. *Journal of Product Innovation Management* **16**(3) 231-247.

Ketokivi, M.A., R.G. Schroeder. 2004. Strategic, structural contingency and institutional explanations in the adoption of innovative manufacturing practices. *Journal of Operations Management* **22**(1) 63-89.

Kim, D.-Y., V. Kumar, U. Kumar. 2012. Relationship between quality management practices and innovation. *Journal of Operations Management* **30**(4) 295-315.

Kirca, A.H., S. Jayachandran, W.O. Bearden. 2005. Market orientation: A meta-analytic review and assessment of its antecedents and impact on performance. *Journal of Marketing* **69**(2) 24-41.

Kusunoki, K., I. Nonaka, A. Nagata. 1998. Organizational capabilities in product development of Japanese firms: A conceptual framework and empirical findings. *Organization Science* **9**(6) 699-718.

Lambert, D., S.F. Slater. 1999. PERSPECTIVE: First, fast, and on time: The path to success. Or is it? *Journal of Product Innovation Management* **16**(5) 427-438.

Langerak, F., E.J. Hultink. 2005. The impact of new product development acceleration approaches on speed and profitability: Lessons for pioneers and fast followers. *IEEE Transactions on Engineering Management* **52**(1) 30-42.

Langerak, F., E.J. Hultink. 2006. The impact of product innovativeness on the link between development speed and new product profitability. *Journal of Product Innovation Management* **23**(3) 203-214.

Langerak, F., E.J. Hultink, A. Griffin. 2008. Exploring mediating and moderating influences on the links among cycle time, proficiency in entry timing, and new product profitability. *Journal of Product Innovation Management* **25**(4) 370-385.

Langerak, F., S. Rijsdijk, K. Dittrich. 2009. Development time and new product sales: A contingency analysis of product innovativeness and price. *Marketing Letters* **20**(4) 399-413.

Lapré, M.A., A.S. Mukherjee, L.N. van Wassenhove. 2000. Behind the learning curve: Linking learning activities to waste reduction. *Management Science* **46**(5) 597-611.

Lapré, M.A., I.M. Nembhard. 2010. Inside the organizational learning curve: Understanding the organizational learning process. *Foundations and Trends in Technology, Information and Operations Management* **4**(1) 1-103.

Larson, E.W., D.H. Gobeli. 1989. Significance of project management structure on development success. *IEEE Transactions on Engineering Management* **36**(2) 119-125.

Lee, H., K.G. Smith, C.M. Grimm, A. Schomburg. 2000. Timing, order and durability of new product advantages with imitation. *Strategic Management Journal* **21**(1) 23-30.

Leonard-Barton, D. 1995. *Wellsprings of knowledge: Building and sustaining the sources of innovation*. Harvard Business Press, Boston, MA.

Levitt, B., J.G. March. 1988. Organizational learning. *Annual Review of Sociology* **14** 319-340.

Lewis, M.W., M.A. Welsh, G.E. Dehler, S.G. Green. 2002. Product development tensions: Exploring contrasting styles of project management. *Academy of Management Journal* **45**(3) 546-564.

Li, T., R.J. Calantone. 1998. The impact of market knowledge competence on new product advantage: Conceptualization and empirical examination. *Journal of Marketing* **62**(4) 13-29.

Lieberman, M.B., D.B. Montgomery. 1988. First-mover advantages. *Strategic Management Journal* **9**(S1) 41-58.

Lilien, G.L., Y. Eunsang. 1989. Determinants of new industrial product performance: A strategic re-examination of the empirical literature. *IEEE Transactions on Engineering Management* **36**(1) 3-10.

Lipovetsky, S., A. Tishler, D. Dvir, A. Shenhar. 1997. The relative importance of project success dimensions. *R&D Management* **27**(2) 97-106.

Lipsey, M.W., D.B. Wilson. 2001. *Practical meta-analysis*. SAGE Publications, Thousand Oaks, CA.

Loch, C.H., C. Terwiesch. 1998. Communication and uncertainty in concurrent engineering. *Management Science* **44**(8) 1032-1048.

Lubatkin, M.H., Z. Simsek, Y. Ling, J.F. Veiga. 2006. Ambidexterity and performance in small-to medium-sized firms: The pivotal role of top management team behavioral integration. *Journal of Management* **32**(5) 646-672.

Lukas, B.A., A. Menon. 2004. New product quality: Intended and unintended consequences of new product development speed. *Journal of Business Research* **57**(11) 1258-1264.

Lukas, B.A., A. Menon, S.J. Bell. 2002. Organizing for new product development speed and the implications for organizational stress. *Industrial Marketing Management* **31**(4) 349-355.

Lynn, G.S., K.D. Abel, W.S. Valentine, R.C. Wright. 1999a. Key factors in increasing speed to market and improving new product success rates. *Industrial Marketing Management* **28**(4) 319-326.

Lynn, G.S., A.E. Akgün. 1998. Innovation strategies under uncertainty: A contingency approach for new product development. *Engineering Management Journal* **10**(3) 11-17.

Lynn, G.S., J. Morone, A. Paulson. 1996. Marketing and discontinuous innovation: The probe and learn process. *California Management Review* **38**(3) 8-37.

Lynn, G.S., R.B. Skov, K.D. Abel. 1999b. Practices that support team learning and their impact on speed to market and new product success. *Journal of Product Innovation Management* **16**(5) 439-454.

Madhavan, R., R. Grover. 1998. From embedded knowledge to embodied knowledge: New product development as knowledge management. *Journal of Marketing* **62**(4) 1-12.

Mallick, D.N., R.G. Schroeder. 2005. An integrated framework for measuring product development performance in high technology industries. *Production and Operations Management* **14**(2) 142-158.

Mansfield, E. 1988. The speed and cost of industrial innovation in Japan and the United States: External vs. internal technology. *Management Science* **34**(10) 1157-1168.

Mantel, S.P., M.V. Tatikonda, Y. Liao. 2006. A behavioral study of supply manager decision-making: Factors influencing make versus buy evaluation. *Journal of Operations Management* **24**(6) 822-838.

March, J.G. 1991. Exploration and exploitation in organizational learning. *Organization Science* **2**(1) 71-87.

McCreery, J.K., L.J. Krajewski, G.K. Leong, P.T. Ward. 2004. Performance implications of assembly work teams. *Journal of Operations Management* **22**(4) 387-412.

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

McDermott, C.M., G.N. Stock. 2011. Focus as emphasis: Conceptual and performance implications for hospitals. *Journal of Operations Management* **29**(6) 616-626.

McDonough III, E.F., G. Barczak. 1991. Speeding up new product development: The effects of leadership style and source of technology. *Journal of Product Innovation Management* **8**(3) 203-211.

McNally, R.C., E. Cavusgil, R.J. Calantone. 2010. Product innovativeness dimensions and their relationships with product advantage, product financial performance, and project protocol. *Journal of Product Innovation Management* **27**(7) 991-1006.

Meyer, C. 1993. *Fast cycle time: How to align purpose, strategy, and structure for speed*. Free Press, New York.

Meyer, M.H., J.M. Utterback. 1995. Product development cycle time and commercial success. *IEEE Transactions on Engineering Management* **42**(4) 297-304.

Milliken, F.J. 1987. Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. *Academy of Management Review* **12**(1) 133-143.

Millson, M.R., S.P. Raj, D. Wilemon. 1992. A survey of major approaches for accelerating new product development. *Journal of Product Innovation Management* **9**(1) 53-69.

Montoya-Weiss, M.M., R.J. Calantone. 1994. Determinants of new product performance: A review and meta-analysis. *Journal of Product Innovation Management* **11**(5) 397-417.

Moorman, C. 1995. Organizational market information processes: Cultural antecedents and new product outcomes. *Journal of Marketing Research* **32**(3) 318-335.

Moorman, C., A.S. Miner. 1998. The convergence of planning and execution: improvisation in new product development. *The Journal of Marketing* **62**(3) 1-20.

Morgan, L.O., R.M. Morgan, W.L. Moore. 2001. Quality and time-to-market trade-offs when there are multiple product generations. *Manufacturing & Service Operations Management* **3**(2) 89-104.

Murmann, P.A. 1994. Expected development time reductions in the German mechanical engineering industry. *Journal of Product Innovation Management* **11**(3) 236-252.

Naveh, E. 2005. The effect of integrated product development on efficiency and innovation. *International Journal of Production Research* **43**(13) 2789-2808.

Naveh, E. 2007. Formality and discretion in successful R&D projects. *Journal of Operations Management* **25**(1) 110-125.

Nelson, R.R., S.G. Winter. 1982. *An evolutionary theory of economic change*. Harvard University Press, Cambridge, MA.

Nonaka, I. 1994. A dynamic theory of organizational knowledge creation. *Organization Science* **5**(1) 14-37.

Olson, E.M., O.C. Walker Jr., R.W. Ruekerf, J.M. Bonnerd. 2001. Patterns of cooperation during new product development among marketing, operations and R&D: Implications for project performance. *Journal of Product Innovation Management* **18**(4) 258-271.

Orlitzky, M., F.L. Schmidt, S.L. Rynes. 2003. Corporate social and financial performance: A meta-analysis. *Organization Studies* **24**(3) 403-441.

Parry, M.E., X.M. Song, P.C. De Weerd-Nederhof, K. Visscher. 2009. The impact of NPD strategy, product strategy, and NPD processes on perceived cycle time. *Journal of Product Innovation Management* **26**(6) 627-639.

Patel, P.C., S. Terjesen, D. Li. 2012. Enhancing effects of manufacturing flexibility through operational absorptive capacity and operational ambidexterity. *Journal of Operations Management* **30**(3) 201-220.

Pattikawa, L.H., E. Verwaal, H.R. Commandeur. 2006. Understanding new product project performance. *European Journal of Marketing* **40**(11/12) 1178-1193.

Patzer, G.L. 1996. *Experiment-research methodology in marketing: Types and applications*. Greenwood Publishing Group, Westport, CT.

Payne, J.W., J.R. Bettman, M.F. Luce. 1996. When time is money: Decision behavior under opportunity-cost time pressure. *Organizational Behavior and Human Decision Processes* **66**(2) 131-152.

Perols, J., C. Zimmermann, S. Kortmann. 2012. On the relationship between supplier integration and time-to-market. *Journal of Operations Management* **31**(3) 153–167.

Petersen, K.J., R.B. Handfield, G.L. Ragatz. 2005. Supplier integration into new product development: Coordinating product, process and supply chain design. *Journal of Operations Management* **23**(3) 371-388.

Pisano, G.P. 1994. Knowledge, integration, and the locus of learning: An empirical analysis of process development. *Strategic Management Journal* **15**(S1) 85-100.

Primo, M.A.M., S.D. Amundson. 2002. An exploratory study of the effects of supplier relationships on new product development outcomes. *Journal of Operations Management* **20**(1) 33-52.

Rabino, S., A. Wright. 1993. Accelerated product introductions and emerging managerial accounting perspectives: implications for marketing managers in the technology sector. *Journal of Product Innovation Management* **10**(2) 126-135.

Raisch, S., J. Birkinshaw, G. Probst, M.L. Tushman. 2009. Organizational ambidexterity: Balancing exploitation and exploration for sustained performance. *Organization Science* **20**(4) 685-695.

Rauniar, R., W. Doll, G. Rawski, P. Hong. 2008a. The role of heavyweight product manager in new product development. *International Journal of Operations & Production Management* **28**(1-2) 130-154.

Rauniar, R., W. Doll, G. Rawski, P. Hong. 2008b. Shared knowledge and product design glitches in integrated product development. *International Journal of Production Economics* **114**(2) 723-736.

Reagans, R., L. Argote, D. Brooks. 2005. Individual experience and experience working together: Predicting learning rates from knowing who knows what and knowing how to work together. *Management Science* **51**(6) 869-881.

Rindfleisch, A., C. Moorman. 2001. The acquisition and utilization of information in new product alliances: A strength-of-ties perspective. *The Journal of Marketing* 1-18.

Rochford, L., W. Rudelius. 1992. How involving more functional areas within a firm affects the new product process. *Journal of Product Innovation Management* **9**(4) 287-299.

Rodriguez Cano, C., F.A. Carrillat, F. Jaramillo. 2004. A meta-analysis of the relationship between market orientation and business performance: evidence from five continents. *International Journal of Research in Marketing* **21**(2) 179-200.

Rosenthal, S.R. 1992. *Effective product design and development: How to cut lead time and increase customer satisfaction*. Business One Irwin, Homewood, IL.

Rosenthal, S.R., M.V. Tatikonda. 1993. Time management in new product development: Case study findings. *IEEE Engineering Management Review* **21**(3) 13–20.

Rusinko, C.A. 1999. Exploring the use of design-manufacturing integration (DMI) to facilitate product development: A test of some practices. *IEEE Transactions on Engineering Management* **46**(1) 56-71.

Salomo, S., J. Weise, H.G. Gemünden. 2007. NPD planning activities and innovation performance: The mediating role of process management and the moderating effect of product innovativeness. *Journal of Product Innovation Management* **24**(4) 285-302.

Sarin, S., V. Mahajan. 2001. The effect of reward structures on the performance of cross-functional product development teams. *Journal of Marketing* **65**(2) 35-53.

Sarin, S., C.M. McDermott. 2003. The effect of team leader characteristics on learning, knowledge application, and performance of cross-functional new product development teams. *Decision Sciences* **34**(4) 707-739.

Scarbrough, H., J. Swan, S. Laurent, M. Bresnen, L. Edelman, S. Newell. 2004. Project-based learning and the role of learning boundaries. *Organization Studies* **25**(9) 1579-1600.

Schilling, M.A., P. Vidal, R.E. Ployhart, A. Marangoni. 2003. Learning by doing something else: Variation, relatedness, and the learning curve. *Management Science* **49**(1) 39-56.

Schmidt, J.B., R.J. Calantone. 2002. Escalation of commitment during new product development. *Journal of the Academy of Marketing Science* **30**(2) 103-118.

Schmidt, J.B., K.R. Sarangee, M.M. Montoya. 2009. Exploring new product development project review practices. *Journal of Product Innovation Management* **26**(5) 520-535.

Schulze, A., M. Hoegl. 2006. Knowledge creation in new product development projects. *Journal of Management* **32**(2) 210-236.

Sethi, R. 2000. New product quality and product development teams. *Journal of Marketing* **64**(2) 1-14.

Setia, P., P.C. Patel. 2013. How information systems help create OM capabilities: Consequents and antecedents of operational absorptive capacity. *Journal of Operations Management* **31**(6) 409-431.

Shenhar, A.J. 2001. One size does not fit all projects: Exploring classical contingency domains. *Management Science* **47**(3) 394-414.

Sheremata, W.A. 2002. Finding and solving problems in software new product development. *Journal of Product Innovation Management* **19**(2) 144-158.

Sherman, J.D., W.E. Souder, S.A. Jenssen. 2000. Differential effects of the primary forms of cross functional integration on product development cycle time. *Journal of Product Innovation Management* **17**(4) 257-267.

Smith, P.G., D.G. Reinertsen. 1991. *Developing products in half the time*. Van Nostrand Reinhold, New York.

Song, X.M., M.M. Montoya-Weiss. 1998. Critical development activities for really new versus incremental products. *Journal of Product Innovation Management* **15**(2) 124-135.

Song, X.M., M.M. Montoya-Weiss, J.B. Schmidt. 1997. Antecedents and consequences of cross-functional cooperation: A comparison of R&D, manufacturing, and marketing perspectives. *Journal of Product Innovation Management* **14**(1) 35-47.

Song, X.M., M.E. Parry. 1999. Challenges of managing the development of breakthrough products in Japan. *Journal of Operations Management* **17**(6) 665-688.

Staats, B.R., F. Gino. 2012. Specialization and variety in repetitive tasks: Evidence from a Japanese bank. *Management Science* **58**(6) 1141-1159.

Stalk, G. 1988. Time - the next source of competitive advantage. *Harvard Business Review* **66**(4) 41-51.

Stalk Jr, G., T.M. Hout. 1990. *Competing against time: How time-based competition is reshaping global markets*. Free Press, New York.

Stock, G.N., M.V. Tatikonda. 2008. The joint influence of technology uncertainty and interorganizational interaction on external technology integration success. *Journal of Operations Management* **26**(1) 65-80.

Stock, W.A. 1994. Systematic coding for research synthesis. H. Cooper, L.V. Hedges, eds. *The handbook of research synthesis*. Russell Sage Foundation, New York, 231-244.

Svenson, O., A. Edland, P. Slovic. 1990. Choices and judgments of incompletely described decision alternatives under time pressure. *Acta Psychologica* **75**(2) 153-169.

Swink, M. 1999. Threats to new product manufacturability and the effects of development team integration processes. *Journal of Operations Management* **17**(6) 691-709.

Swink, M. 2003. Completing projects on-time: How project acceleration affects new product development. *Journal of Engineering and Technology Management* **20**(4) 319-344.

Swink, M., X.M. Song. 2007. Effects of marketing-manufacturing integration on new product development time and competitive advantage. *Journal of Operations Management* **25**(1) 203-217.

Swink, M., S. Talluri, T. Pandejpong. 2006. Faster, better, cheaper: A study of NPD project efficiency and performance tradeoffs. *Journal of Operations Management* **24**(5) 542-562.

Tatikonda, M.V., M.M. Montoya-Weiss. 2001. Integrating operations and marketing perspectives of product innovation: The influence of organizational process factors and capabilities on development performance. *Management Science* **47**(1) 151-172.

Tatikonda, M.V., S.R. Rosenthal. 2000a. Successful execution of product development projects: Balancing firmness and flexibility in the innovation process. *Journal of Operations Management* **18**(4) 401-425.

Tatikonda, M.V., S.R. Rosenthal. 2000b. Technology novelty, project complexity, and product development project execution success: A deeper look at task uncertainty in product innovation. *IEEE Transactions on Engineering Management* **47**(1) 74-87.

Terwiesch, C., C.H. Loch. 1999. Measuring the effectiveness of overlapping development activities. *Management Science* **45**(4) 455-465.

Thomke, S., T. Fujimoto. 2000. The effect of "front-loading" problem-solving on product development performance. *Journal of Product Innovation Management* **17**(2) 128-142.

Thomke, S.H. 2003. *Experimentation matters: Unlocking the potential of new technologies for innovation*. Harvard Business School Press, Boston, MA.

Thurstone, L.L. 1919. The learning curve equation. *Psychological Monographs* **26** 1-51.

Tortoriello, M., R. Reagans, B. McEvily. 2011. Bridging the knowledge gap: The influence of strong ties, network cohesion, and network range on the transfer of knowledge between organizational units. *Organization Science* **23**(4) 1024-1039.

Troy, L.C., T. Hirunyawipada, A.K. Paswan. 2008. Cross-functional integration and new product success: An empirical investigation of the findings. *Journal of Marketing* **72**(6) 132-146.

Ulrich, K., D. Sartorius, S. Pearson, M. Jakiela. 1993. Including the value of time in design-for-manufacturing decision making. *Management Science* **39**(4) 429-447.

Vandenbosch, M., T. Clift. 2002. Dramatically reducing cycle times through flash development. *Long Range Planning* **35**(6) 567-589.

Venkatraman, N., V. Ramanujam. 1986. Measurement of business performance in strategy research: A comparison of approaches. *Academy of Management Review* **11**(4) 801-814.

Verma, D., K.K. Sinha. 2002. Toward a theory of project interdependencies in high tech R&D environments. *Journal of Operations Management* **20**(5) 451-468.

Vesey, J.T. 1992. Time-to-market: put speed in product development. *Industrial Marketing Management* **21**(2) 151-158.

Viswesvaran, C., D.S. Ones. 1995. Theory testing: Combining psychometric meta-analysis and structural equations modeling. *Personnel Psychology* **48**(4) 865-885.

von Braun, C.F. 1990. The acceleration trap. *Sloan Management Review* **32**(1) 49-58.

Voss, G.B., D. Sirdeshmukh, Z.G. Voss. 2008. The effects of slack resources and environmental threat on product exploration and exploitation. *Academy of Management Journal* **51**(1) 147-164.

Wiersma, E. 2007. Conditions that shape the learning curve: Factors that increase the ability and opportunity to learn. *Management Science* **53**(12) 1903-1915.

Yan, T., K.J. Dooley. 2013. Communication intensity, goal congruence, and uncertainty in buyer–supplier new product development. *Journal of Operations Management* **31**(7) 523-542.

Yao, Y., R. Kohli, S.A. Sherer, J. Cederlund. 2013. Learning curves in collaborative planning, forecasting, and replenishment (CPFR) information systems: An empirical analysis from a mobile phone manufacturer. *Journal of Operations Management* **31**(6) 285-297.

Zirger, B.J., J.L. Hartley. 1996. The effect of acceleration techniques on product development time. *IEEE Transactions on Engineering Management* **43**(2) 143-152.

Zirger, B.J., M.A. Maidique. 1990. A model of new product development: An empirical test. *Management Science* **36**(7) 867-883.

Zirger, B.J., M.A. Maidique. 1994. A conceptual model of reducing product development time. *Journal of Engineering and Technology Management* **11**(3-4) 229-251.

APPENDIX

APPENDIX A Meta-analytic database (consequences)

Consequences: NPS=New product success; DC=Development costs; TQ=Technical product quality; PA=Product competitive advantage; MET=Market entry timing; MS=Marketplace success; FS= Financial success.

Research design characteristics: RD=Random selection of organizations; nRD=Non random selection of organizations; PRJ=Project level data; PRG=Program level data; SNG=Single informant; MLT=Multiple informants;

Speed measurement characteristics**:** SNG=Single item measure; MLT=Multi item measure; ABS=Absolute measure; REL=Relative measure; BJ=Objective measure; SBJ=Subjective measure;

Contextual characteristics: PRD=Sample manufacturing firms only; P&S= Sample manufacturing and service firms; SNG=Single industry sample; MLT=Multiple industry sample.

	Independent Sample	Speed Construct*	Consequence(s)	Research design			Speed measurement			Context	
1	Lynn, Reilly and Akgun (2000)	speed-to-market	NPS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
2	Akgün, Byrne, Keskin, Lynn and Imamoglu (2005)	speed-to-market	NPS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
3	Ali (2000)	development time (R)	PA, MS, FS	nRD	PRJ	SNG	MLT	ABS	SBJ	PRD	MLT
4	Aronson, Reilly and Lynn (2006)	development speed	NPS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
5	Atuahene-Gima (2003)	development speed	PA	RD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
6	Barczak, Hultink and Sultan (2008 - NL sample)	speed-to-market	MS	nRD	PRJ	SNG	MLT	REL	SBJ	P&S	MLT
7	Barczak et al. (2008 - US sample); Barczak, Sultan and Hultink (2007)	speed-to-market	MS	nRD	PRJ	SNG	MLT	REL	SBJ	P&S	MLT

	Independent Sample	Speed Construct*	Consequence(s)	Research design			Speed measurement			Context	
8	Calantone and Di Benedetto (2000)	speed-to-market	TQ	nRD	PRJ	SNG	SNG	REL	SBJ	PRD	MLT
9	Calantone, Vickery and Dröge (1995)	product development cycle time	MS, FS	nRD	PRG	SNG	SNG	ABS	SBJ	PRD	SGL
10	Callahan and Moretton (2001)	duration (R)	DC	nRD	PRJ	SNG	SNG	ABS	SBJ	PRD	SGL
11	Carbonell and Rodríguez-Escudero (2009); Carbonell and Rodriguez (2006b)	innovation speed	NPS, DC, PA	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
12	Carbonell, Rodríguez-Escudero and Pujari (2009)	innovation speed	TQ, MS	RD	PRJ	SNG	MLT	REL	SBJ	P&S	MLT
13	Chen, Reilly and Lynn (2005)	speed-to-market	NPS, DC	nRD	PRJ	SNG	MLT	REL	SBJ	P&S	MLT
14	Chryssochoidis and Wong (2000)	NPD timeliness	NPS, MET	nRD	PRJ	MLT	SNG	REL	SBJ	PRD	MLT
15	Dayan, Di Benedetto and Colak (2009)	speed to market	NPS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
16	de Brentani and Kleinschmidt (2004)	time efficiency	NPS	nRD	PRG	SNG	MLT	REL	SBJ	P&S	MLT
17	García, Sanzo and Trespalacios (2008)	meeting time goals	NPS, DC, PA	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
18	González and Palacios (2002)	development time (R)	NPS, PA	nRD	PRG	SNG	SNG	REL	SBJ	PRD	MLT
19	Griffin (1997b)	development time (R)	NPS	RD	PRJ	SNG	SNG	ABS	SBJ	P&S	MLT
20	Harmancioglu, Droge and Calantone (2009)	new product speed	PA, FS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
21	Harter, Krishnan and Slaughter (2000)	cycle time (R)	TQ	nRD	PRJ	SNG	SNG	ABS	OBJ	PRD	SGL
22	Hartley, Zirger and Kamath (1997)	project's overall delay (R)	TQ	nRD	PRJ	SNG	SNG	ABS	SBJ	PRD	MLT
23	Hauptman and Hirji (1996)	meeting project lead time	DC, TQ	nRD	PRJ	MLT	MLT	REL	SBJ	PRD	MLT

	Independent Sample	Speed Construct*	Consequence(s)	Research design			Speed measurement			Context	
24	Hoegl, Weinkauf and Gemünden (2004)	adherence to schedule	NPS, DC, TQ	nRD	PRJ	SNG	SNG	REL	SBJ	PRD	SGL
25	Hong, Nahm and Doll (2004)	time-to-market	PA	RD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
26	Ittner and Larcker (1997)	cycle time (R)	NPS, TQ, MS, FS	RD	PRG	MLT	SNG	ABS	OBJ	PRD	MLT
27	Jayaram and Narasimhan (2007)	time-to-market	DC, TQ, MS, FS	RD	PRJ	SNG	SNG	REL	SBJ	PRD	MLT
28	Johnson, Piccolotto and Filippini (2009)	time performance	NPS	RD	PRG	SNG	MLT	REL	SBJ	PRD	MLT
29	Karlsson and Åhlström (1999)	cycle time (R)	PA	nRD	PRJ	SNG	SNG	ABS	OBJ	PRD	SGL
30	(Keller 2001)	schedule performance	DC, TQ	nRD	PRJ	MLT	SNG	REL	SBJ	PRD	MLT
31	(Kessler and Bierly III 2002; Kessler, Bierly III and Gopalakrishnan 2000)	innovation speed	NPS, DC, TQ	nRD	PRJ	MLT	MLT	REL	SBJ	PRD	MLT
32	Kim and Kim (2009)	project duration (R)	TQ	nRD	PRJ	SNG	SNG	ABS	OBJ	PRD	SGL
33	(Langerak, Griffin and Hultink 2010)	development time	NPS, DC, MET, MS	RD	PRJ	SNG	SNG	REL	SBJ	PRD	MLT
34	(Langerak and Hultink 2005, 2006, 2008)	development speed	FS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
35	Langerak, Hultink and Griffin (2008)	development cycle time	NPS, DC, MET, PA, MS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
36	Langerak, Rijsdijk and Dittrich (2009)	development time	MS	nRD	PRJ	SNG	SNG	ABS	OBJ	PRD	SGL
37	Larson and Gobeli (1989)	meeting schedule	NPS, DC, TQ	RD	PRJ	SNG	SNG	REL	SBJ	PRD	MLT
38	Li and Atuahene-Gima (1999)	timeliness of development	NPS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
39	Lukas and Menon (2004)	innovation speed	PA	RD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT

	Independent Sample	Speed Construct*	Consequence(s)	Research design			Speed measurement			Context	
40	Lynn, Abel, Valentine and Wright (1999a); Lynn, Skov and Abel (1999b)	speed-to-market	NPS	nRD	PRJ	SNG	MLT	REL	SBJ	PRD	MLT
41	Lynn et al. (2000)	speed-to-market	NPS	nRD	PRJ	SNG	MLT	REL	SBJ	P&S	MLT
42	McDonough III (2000)	speed	DC, PA	RD	PRG	SNG	SNG	REL	SBJ	P&S	MLT
43	Meyer and Utterback (1995)	product development cycle time (R)	DC	nRD	PRJ	MLT	SNG	ABS	OBJ	PRD	SGL
44	Naveh (2005, 2007)	time to market deviation	DC, TQ	nRD	PRJ	MLT	SNG	REL	OBJ	PRD	SGL
45	Prašnikar and Škerlj (2006)	time-to-market (R)	MS	nRD	PRJ	MLT	SNG	ABS	SBJ	PRD	SGL
46	Primo and Amundson (2002)	time-to-market objective	DC, PA	nRD	PRJ	MLT	SNG	REL	SBJ	PRD	SGL
47	Rauniar, Doll, Rawski and Hong (2008a, b)	development time	DC, MS	RD	PRJ	SNG	MLT	REL	SBJ	PRD	SGL
47	Rusinko (1999)	time effectiveness	NPS, DC, TQ	nRD	PRJ	SNG	SNG	REL	SBJ	PRD	MLT
49	Sheremata (2002)	project length (R)	TQ	nRD	PRJ	SNG	SNG	ABS	SBJ	PRD	SGL
50	Swink (2003)	on-time schedule performance	TQ, FS	RD	PRJ	SNG	SNG	REL	SBJ	PRD	MLT
51	Swink and Song (2007)	development length (R)	PA, FS	nRD	PRJ	SNG	SNG	ABS	SBJ	PRD	MLT
52	Tatikonda and Montoya-Weiss (2001)	time-to-market	DC, TQ, PA, MS	nRD	PRJ	SNG	SNG	REL	SBJ	PRD	MLT

* R: reverse-coded in analysis.

APPENDIX B Meta-analytic database (antecedents)

Project characteristics: COMP=Complexity; F.INN=Firm perspective of innovativeness; MKT.INN=Market perspective of innovativeness; MX.INN=Composite/not specified perspective of innovativeness; NEW=Project newness; P.SIZE=Project size.

***Process characteristics*:** STD=Standardization; S.INV=Supplier involvement; C.INV=Customer involvement; EXT.INT=Use of other outside assistance/information; G.EFF=Goal effectiveness; FORM=Formal process use; CONC=Process concurrency; ITER=Iteration/build frequency; TEST=Testing.

NPD team characteristics: CFT=Cross-functional team use; F.DIV=Functional diversity; ORG.INT=Organizational integration; T.QUAL=Teamwork quality; T.SIZE=Team size; T.STBL=Team stability; T.COMM=Team dedication/commitment; MNG=Management style; LEAD=Team leader strength/influence; PROX=Team proximity/same site location.

***NPD competencies*:** P.PRF=Up-front planning proficiency; M.PRF=Marketing proficiency; T.PRF=Technical proficiency; PS.PRF=Problem solving proficiency; LEARN=Team learning.

***Firm characteristics*:** ALIGN= Prior experience & alignment with core competencies; RES=Availability of resources and facilities; SUPP=Organizational support; S.EMP=Speed emphasis; S.INC=Presence of time-based awards and incentives; PRIOR=Project priority; C.SIZE=Company size; INN.CL=Innovative organizational climate.

***Environmental characteristics*:** T.TURB=Technological turbulence; M.TURB=Market turbulence; COMP=Competitive intensity, M.ATTR=Market attractiveness and ease of entry.

	Independent Sample	Speed Construct*	Antecedent(s)
1	Akgün and Lynn (2002)	speed-to-market	G.EFF., T.STBL, SUPP, LEARN, T.TURB, M.TURB
2	Akgün et al. (2005)	speed-to-market	T.QUAL, T.SIZE, T.STBL, PROX
3	Ali (2000)	development time (R)	MX.INN, ALIGN, RES, COMP, M.ATTR

	Independent Sample	Speed Construct*	Antecedent(s)
4	Aronson et al. (2006)	development speed	T.QUAL
5	Atuahene-Gima (2003)	development speed	MX.INN, FORM, ORG.INT, T.QUAL, T.SIZE, T.COMM, MNG, LEAD, T.EMP, M.PRF, PS.PRF, C.SIZE
6	Barczak et al. (2008)- NL sample)	speed-to-market	EXT.INT, FORM, STD, MNG, PRIOR, INN.CL, PROX
7	Barczak et al. (2008) US sample); Barczak et al. (2007)	speed-to-market	EXT.INT, FORM, STD, PROX
8	Barnett and Clark (1996)	development time (R)	F.INN
9	Bstieler (2005 - CND sample)	time efficiency	F.INN, MKT.INN, CONC, CFT, M.PRF, T.PRF, C.SIZE, T.TURB, M.TURB
10	Bstieler (2005 - AUS sample)	time efficiency	F.INN, MKT.INN, CONC, CFT, M.PRF, T.PRF, C.SIZE, T.TURB, M.TURB
11	Calantone and Di Benedetto (2000)	speed-to-market	COMPL, CONC
12	Calantone et al. (1995)	product development cycle time	T.EMP
13	Callahan and Moretton (2001)	duration (R)	S.INV, TEST, ITER, ORG.INT, LEAD, T.INC, P.PRF
14	Carbonell and Rodríguez-Escudero (2009); Carbonell and Rodriguez (2006a, b)	innovation speed	COMPL, NEW, F.INN, G.EFF, F.DIV, T.SIZE, T.STBL, T.COMM, ALIGN, T.INC PROX, C.SIZE, RES, SUPP, COMP, M.ATTR, T.TURB, M.TURB
15	Carbonell et al. (2009)	innovation speed	F.INN, C.INV, T.TURB
16	Chandy, Hopstaken, Narasimhan and Prabhu (2006)	Speed	MX.INN, ALIGN
17	Chen et al. (2005)	speed-to-market	F.INN, T.SIZE, T.TURB, M.TURB
18	Chryssochoidis and Wong (2000)	NPD timeliness	COMPL, F.INN, M.ATTR
19	Cooper and Kleinschmidt (1994)	Timeliness	G.EFF, ALIGN, P.PRF, M.PRF, T.PRF, COMP, M.ATTR
20	Dayan and Di Benedetto (2008)	speed-to-market	T.QUAL, T.SIZE, MNG, LEARN, T.TURB, M.TURB

	Independent Sample	Speed Construct*	Antecedent(s)
21	Dayan et al. (2009)	speed-to-market	G.EFF, T.QUAL, T.SIZE, MNG, LEARN, T.TURB, M.TURB
22	de Brentani and Kleinschmidt (2004)	time efficiency	RES, SUPP, INN.CL
23	Dröge, Jayaram and Vickery (2000)	new product development time	STD, S.INV, CONC, CFT, MNG
24	Duffy and Salvendy (1999)	time to market reduction	CONC
25	Eisenhardt and Tabrizi (1995)	development time (R)	P.SIZE, STD, S.INV, CONC, ITER, TEST, F.DIV, LEAD, T.INC, P.PRF
26	Ettlie (1997)	development time (R)	EXT.INT, C.SIZE
27	Fang (2008)	speed-to-market	COMPL, MKT.INN, C.INV, EXT.INT, PRIOR, M.TURB
28	Filippini, Salmaso and Tessarolo (2004)	time performance	S.INV, C.INV, G.EFF, CONC, ITER, CFT, P.PRF, M.PRF, T.PRF
29	Ganesan, Malter and Rindfleisch (2005)	speed of new product development	MKT.INN, EXT.INT, C.SIZE
30	García et al. (2008)	meeting time goals	ORG.INT
31	Gomes, de Weerd-Nederhof, Pearson and Cunha (2003)	time for development (R)	ORG.INT, T.QUAL
32	González and Palacios (2002)	development time (R)	S.INV, C.INV, ORG.INT, SUPP
33	Griffin (1997b)	development time (R)	STD, CFT, M.PRF
34	Griffin (1997a, 2002)	development time (R)	COMPL, NEW, FORM, CFT
35	Harmancioglu et al. (2009)	new product speed	ALIGN, M.PRF, T.PRF
36	Harter et al. (2000)	cycle time (R)	COMPL, G.EFF
37	Hartley et al. (1997)	project's overall delay (R)	NEW, PRIOR

	Independent Sample	Speed Construct*	Antecedent(s)
38	Hauptman and Hirji (1996)	meeting project lead time	T.QUAL
39	Hoegl et al. (2004)	adherence to schedule	T.QUAL, T.COMM
40	Hong et al. (2004)	time-to-market	G.EFF, T.QUAL, T.TURB
41	Ittner and Larcker (1997)	cycle time (R)	STD, S.INV, C.INV, EXT.INT, CFT, INN.CL
42	Johnson et al. (2009)	time performance	M.PRF, C.SIZE
43	Keller (2001)	schedule performance	F.DIV, T.QUAL, T.SIZE, T.STBL
44	Kessler and Bierly III (2002); Kessler et al. (2000)	innovation speed	F.INN, EXT.INT, T.TURB, M.TURB
45	Kim and Kim (2009)	project duration (R)	F.INN, F.DIV, T.SIZE, PROX
46	Langerak and Hultink (2005, 2006, 2008)	development speed	COMPL, STD, S.INV, C.INV, T.QUAL, T.EMP, M.PRF, C.SIZE, M.TURB
47	Langerak et al. (2008)	development cycle time	MKT.INN
48	Langerak et al. (2009)	development cycle time	F.INN, C.INV
49	Larson and Gobeli (1989)	meeting schedule	COMPL, F.INN, G.EFF, RES, PRIOR
50	Li and Atuahene-Gima (1999)	timeliness of development	F.INN, FORM, ORG.INT
51	Lukas and Menon (2004)	innovation speed	MNG, C.SIZE
52	Lukas, Menon and Bell (2002)	NPD speed	MNG, C.SIZE
53	Lynn et al. (1999a); Lynn et al. (1999b)	speed-to-market	G.EFF, FORM, LEARN, SUPP, PS.PRF
54	Lynn et al. (2000)	speed-to-market	G.EFF, SUPP, PS.PRF

	Independent Sample	Speed Construct*	Antecedent(s)
55	McDonough III (1993); McDonough III and Barczak (1991)	speed of development	F.INN, EXT.INT, MNG
56	Meyer and Utterback (1995)	product development cycle time (R)	F.INN, MKT.INN, COMPL, EXT.INT, COMP
57	Naveh (2005, 2007)	time to market deviation	MKT.INN, F.INN, C.INV, FORM, T.SIZE, INN.CL, T.PRF, LEAD
58	Park, Lim and Birnbaum-More (2009)	NPD time efficiency	MKT.INN, T.QUAL, T.SIZE, ALIGN
59	Parry, Song, De Weerd-Nederhof and Visscher (2009)	perceived cycle time	MX.INN, G.EFF, CFT, LEAD, C.SIZE, INN.CL
60	Prašnikar and Škerlj (2006)	time-to-market (R)	F.INN, S.INV, EXT.INT, CONC, T.SIZE
61	Primo and Amundson (2002)	time-to-market objective	F.INT, S.INV
62	Rauniar et al. (2008a, b)	development time	G.EFF, ORG.INT, M.PRF, T.PRF, LEAD, ALIGN
63	Rusinko (1999)	time effectiveness	STD, ORG.INT, PROX
64	Sánchez and Pérez (2003)	new product development time minimization ability	STD, S.INV, CONC, CFT, MNG, T.PRF
65	Sarin and McDermott (2003)	speed-to-market	COMPL, MX.INN, G.EFF, F.DIV, T.SIZE, MNG, LEAD, PRIOR, LEARN
66	Shenhar, Dvir and Shulman (1995)	project duration (R)	COMPL, T.TURB
67	Sheremata (2002)	project length (R)	COMPL, NEW, FORM, LEAD, T.EMP, PS.PRF, C.SIZE, T.SIZE, MNG, T.QUAL
68	Sherman, Souder and Jenssen (2000)	cycle time (R)	S.INV, C.INV, EXT.INT, ORG.INT, LEARN
69	Souder, Sherman and Davies-Cooper (1998)	cycle time (R)	C.INV, ITER, ORG.INT, M.PRF, T.PRF, T.TURB, M.TURB
70	Swink (2000, 2003)	on-time schedule performance	COMPL, F.INN, STD, G.EFF, CONC, F.DIV, ORG.INT, T.EMP, T.INC, SUPP
71	Swink and Song (2007)	development length (R)	MKT.INN, P.SIZE, ORG.INT, T.SIZE, M.ATTR

	Independent Sample	Speed Construct*	Antecedent(s)
72	Tatikonda and Montoya-Weiss (2001)	time-to-market	F.INN, FORM, CONC, LEAD, C.SIZE, PRIOR, M.TURB
73	Terwiesch and Loch (1999)	standardized project duration	P.SIZE, CONC, ITER, TEST
74	Tessarolo (2007)	time performance	G.EFF
75	Zirger and Hartley (1996)	development time performance (R)	COMPL, NEW, S.INV, CONC, F.DIV, T.COMM, LEAD, SUPP, T.EMP, PROX

* R: reverse-coded in analysis.

APPENDIX C Meta-analytic database (bibliography)

Akgün, A.E., J. Byrne, H. Keskin, G.S. Lynn, S.Z. Imamoglu. 2005. Knowledge networks in new product development projects: a transactive memory perspective. *Information & Management* **42**(8) 1105-1120.

Akgün, A.E., G.S. Lynn. 2002. Antecedents and consequences of team stability on new product development performance. *Journal of Engineering and Technology Management* **19**(3-4) 263-286.

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

Aronson, Z.H., R.R. Reilly, G.S. Lynn. 2006. The impact of leader personality on new product development teamwork and performance: The moderating role of uncertainty. *Journal of Engineering and Technology Management* **23**(3) 221-247.

Atuahene-Gima, K. 2003. The effects of centrifugal and centripetal forces on product development speed and quality: How does problem solving matter? *Academy of Management Journal* **46**(3) 359-373.

Barczak, G., E.J. Hultink, F. Sultan. 2008. Antecedents and consequences of information technology usage in NPD: A comparison of Dutch and US companies. *Journal of Product Innovation Management* **25**(6) 620-631.

Barczak, G., F. Sultan, E.J. Hultink. 2007. Determinants of IT usage and new product performance. *Journal of Product Innovation Management* **24**(6) 600-613.

Barnett, B.D., K.B. Clark. 1996. Technological newness: An empirical study in the process industries. *Journal of Engineering and Technology Management* **13**(3) 263-282.

Bstieler, L. 2005. The moderating effect of environmental uncertainty on new product development and time efficiency. *Journal of Product Innovation Management* **22**(3) 267-284.

Calantone, R.J., C.A. Di Benedetto. 2000. Performance and time to market: Accelerating cycle time with overlapping stages. *IEEE Transactions on Engineering Management* **47**(2) 232-244.

Calantone, R.J., S.K. Vickery, C. Dröge. 1995. Business performance and strategic new product development activities: An empirical investigation. *Journal of Product Innovation Management* **12**(3) 214-223.

Callahan, J., B. Moretton. 2001. Reducing software product development time. *International Journal of Project Management* **19**(1) 59-70.

Carbonell, P., A.I. Rodríguez-Escudero. 2009. Relationships among team's organizational context, innovation speed, and technological uncertainty: An empirical analysis. *Journal of Engineering and Technology Management* **26**(1–2) 28-45.

Carbonell, P., A.I. Rodríguez-Escudero, D. Pujari. 2009. Customer Involvement in new service development: An examination of antecedents and outcomes. *Journal of Product Innovation Management* **26**(5) 536-550.

Carbonell, P., A.I. Rodriguez. 2006a. Designing teams for speedy product development: The moderating effect of technological complexity. *Journal of Business Research* **59**(2) 225-232.

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

Chandy, R., B. Hopstaken, O. Narasimhan, J. Prabhu. 2006. From invention to innovation: Conversion ability in product development. *Journal of Marketing Research* **43**(3) 494-508.

Chen, J., R.R. Reilly, G.S. Lynn. 2005. The impacts of speed-to-market on new product success: The moderating effects of uncertainty. *IEEE Transactions on Engineering Management* **52**(2) 199-212.

Chryssochoidis, G.M., V. Wong. 2000. Customization of product technology and international new product success: Mediating effects of new product development and rollout timeliness. *Journal of Product Innovation Management* **17**(4) 268-285.

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

Dayan, M., C.A. Di Benedetto. 2008. Procedural and interactional justice perceptions and teamwork quality. *Journal of Business & Industrial Marketing* **23**(8) 566-576.

Dayan, M., C.A. Di Benedetto, M. Colak. 2009. Managerial trust in new product development projects: Its antecedents and consequences. *R&D Management* **39**(1) 21-37.

de Brentani, U., E.J. Kleinschmidt. 2004. Corporate culture and commitment: Impact on performance of international new product development programs. *Journal of Product Innovation Management* **21**(5) 309-333.

Dröge, C., J. Jayaram, S.K. Vickery. 2000. The ability to minimize the timing of new product development and introduction: An examination of antecedent factors in the North American automobile supplier industry. *Journal of Product Innovation Management* **17**(1) 24-40.

Duffy, V.G., G. Salvendy. 1999. Relating company performance to staff perceptions: The impact of concurrent engineering on time to market. *International Journal of Production Research* **37**(4) 821-834.

Eisenhardt, K.M., B.N. Tabrizi. 1995. Accelerating adaptive processes: Product innovation in the global computer industry. *Administrative Science Quarterly* **40**(1) 84-110.

Ettlie, J.E. 1997. Integrated design and new product success. *Journal of Operations Management* **15**(1) 33-55.

Fang, E. 2008. Customer participation and the trade-off between new product innovativeness and speed to market. *Journal of Marketing* **72**(4) 90-104.

Filippini, R., L. Salmaso, P. Tessarolo. 2004. Product development time performance: Investigating the effect of interactions between drivers. *Journal of Product Innovation Management* **21**(3) 199-214.

Ganesan, S., A.J. Malter, A. Rindfleisch. 2005. Does distance still matter? Geographic proximity and new product development. *Journal of Marketing* **69**(4) 44-60.

García, N., M.J. Sanzo, J.A. Trespalacios. 2008. New product internal performance and market performance: Evidence from Spanish firms regarding the role of trust, interfunctional integration, and innovation type. *Technovation* **28**(11) 713-725.

Gomes, J.F.S., P.C. de Weerd-Nederhof, A.W. Pearson, M.P. Cunha. 2003. Is more always better? An exploration of the differential effects of functional integration on performance in new product development. *Technovation* **23**(3) 185-191.

González, F.J.M., T.M.B. Palacios. 2002. The effect of new product development techniques on new product success in Spanish firms. *Industrial Marketing Management* **31**(3) 261-271.

Griffin, A. 1997a. The effect of project and process characteristics on product development cycle time. *Journal of Marketing Research* **34**(1) 24-35.

Griffin, A. 1997b. PDMA research on new product development practices: Updating trends and benchmarking best practices. *Journal of Product Innovation Management* **14**(6) 429-458.

Griffin, A. 2002. Product development cycle time for business-to-business products. *Industrial Marketing Management* **31**(4) 291-304.

Harmancioglu, N., C. Droge, R.J. Calantone. 2009. Strategic fit to resources versus NPD execution proficiencies: What are their roles in determining success? *Journal of the Academy of Marketing Science* **37**(3) 266-282.

Harter, D.E., M.S. Krishnan, S.A. Slaughter. 2000. Effects of process maturity on quality, cycle time, and effort in software product development. *Management Science* **46**(4) 451-466.

Hartley, J.L., B.J. Zirger, R.R. Kamath. 1997. Managing the buyer-supplier interface for on-time performance in product development. *Journal of Operations Management* **15**(1) 57-70.

Hauptman, O., K.K. Hirji. 1996. The influence of process concurrency on project outcomes in product development: An empirical study of cross-functional teams. *IEEE Transactions on Engineering Management* **43**(2) 153-164.

Hoegl, M., K. Weinkauf, H.G. Gemünden. 2004. Interteam coordination, project commitment, and teamwork in multiteam R&D projects: A longitudinal study. *Organization Science* **15**(1) 38-55.

Hong, P., A.Y. Nahm, W.J. Doll. 2004. The role of project target clarity in an uncertain project environment. *International Journal of Operations & Production Management* **24**(11-12) 1269-1291.

Ittner, C.D., D.F. Larcker. 1997. Product development cycle time and organizational performance. *Journal of Marketing Research* **34**(1) 13-23.

Jayaram, J., R. Narasimhan. 2007. The influence of new product development competitive capabilities on project performance. *IEEE Transactions on Engineering Management* **54**(2) 241-256.

Johnson, W.H.A., Z. Piccolotto, R. Filippini. 2009. The impacts of time performance and market knowledge competence on new product success: an international study. *IEEE Transactions on Engineering Management* **56**(2) 219-228.

Karlsson, C., P. Åhlström. 1999. Technological level and product development cycle time. *Journal of Product Innovation Management* **16**(4) 352-362.

Keller, R.T. 2001. Cross-functional project groups in research and new product development: Diversity, communications, job stress, and outcomes. *Academy of Management Journal* **44**(3) 547-555.

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

Kessler, E.H., P.E. Bierly III, S. Gopalakrishnan. 2000. Internal vs. external learning in new product development: Effects on speed, costs and competitive advantage. *R&D Management* **30**(3) 213-224.

Kim, B., J. Kim. 2009. Structural factors of NPD (new product development) team for manufacturability. *International Journal of Project Management* **27**(7) 690-702.

Langerak, F., A. Griffin, E.J. Hultink. 2010. Balancing development costs and sales to optimize the development time of product line additions. *Journal of Product Innovation Management* **27**(3) 336-348.

Langerak, F., E.J. Hultink. 2005. The impact of new product development acceleration approaches on speed and profitability: Lessons for pioneers and fast followers. *IEEE Transactions on Engineering Management* **52**(1) 30-42.

Langerak, F., E.J. Hultink. 2006. The impact of product innovativeness on the link between development speed and new product profitability. *Journal of Product Innovation Management* **23**(3) 203-214.

Langerak, F., E.J. Hultink. 2008. The effect of new product development acceleration approaches on development speed: A case study. *Journal of Engineering and Technology Management* **25**(3) 157-167.

Langerak, F., E.J. Hultink, A. Griffin. 2008. Exploring mediating and moderating influences on the links among cycle time, proficiency in entry timing, and new product profitability. *Journal of Product Innovation Management* **25**(4) 370-385.

Langerak, F., S. Rijsdijk, K. Dittrich. 2009. Development time and new product sales: A contingency analysis of product innovativeness and price. *Marketing Letters* **20**(4) 399-413.

Larson, E.W., D.H. Gobeli. 1989. Significance of project management structure on development success. *IEEE Transactions on Engineering Management* **36**(2) 119-125.

Li, H., K. Atuahene-Gima. 1999. Marketing's influence and new product performance in Chinese firms. *Journal of International Marketing* **7**(1) 34-56.

Lukas, B.A., A. Menon. 2004. New product quality: Intended and unintended consequences of new product development speed. *Journal of Business Research* **57**(11) 1258-1264.

Lukas, B.A., A. Menon, S.J. Bell. 2002. Organizing for new product development speed and the implications for organizational stress. *Industrial Marketing Management* **31**(4) 349-355.

Lynn, G.S., K.D. Abel, W.S. Valentine, R.C. Wright. 1999a. Key factors in increasing speed to market and improving new product success rates. *Industrial Marketing Management* **28**(4) 319-326.

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

Lynn, G.S., R.B. Skov, K.D. Abel. 1999b. Practices that support team learning and their impact on speed to market and new product success. *Journal of Product Innovation Management* **16**(5) 439-454.

McDonough III, E.F. 1993. Faster new product development: Investigating the effects of technology and characteristics of the project leader and team. *Journal of Product Innovation Management* **10**(3) 241-250.

McDonough III, E.F. 2000. Investigation of factors contributing to the success of cross-functional teams. *Journal of Product Innovation Management* **17**(3) 221-235.

McDonough III, E.F., G. Barczak. 1991. Speeding up new product development: The effects of leadership style and source of technology. *Journal of Product Innovation Management* **8**(3) 203-211.

Meyer, M.H., J.M. Utterback. 1995. Product development cycle time and commercial success. *IEEE Transactions on Engineering Management* **42**(4) 297-304.

Naveh, E. 2005. The effect of integrated product development on efficiency and innovation. *International Journal of Production Research* **43**(13) 2789-2808.

Naveh, E. 2007. Formality and discretion in successful R&D projects. *Journal of Operations Management* **25**(1) 110-125.

Park, M.H.J., J.W. Lim, P.H. Birnbaum-More. 2009. The effect of multiknowledge individuals on performance in cross-functional new product development teams. *Journal of Product Innovation Management* **26**(1) 86-96.

Parry, M.E., X.M. Song, P.C. De Weerd-Nederhof, K. Visscher. 2009. The impact of NPD strategy, product strategy, and NPD processes on perceived cycle time. *Journal of Product Innovation Management* **26**(6) 627-639.

Prašnikar, J., T. Škerlj. 2006. New product development process and time-to-market in the generic pharmaceutical industry. *Industrial Marketing Management* **35**(6) 690-702.

Primo, M.A.M., S.D. Amundson. 2002. An exploratory study of the effects of supplier relationships on new product development outcomes. *Journal of Operations Management* **20**(1) 33-52.

Rauniar, R., W. Doll, G. Rawski, P. Hong. 2008a. The role of heavyweight product manager in new product development. *International Journal of Operations & Production Management* **28**(1-2) 130-154.

Rauniar, R., W. Doll, G. Rawski, P. Hong. 2008b. Shared knowledge and product design glitches in integrated product development. *International Journal of Production Economics* **114**(2) 723-736.

Rusinko, C.A. 1999. Exploring the use of design-manufacturing integration (DMI) to facilitate product development: A test of some practices. *IEEE Transactions on Engineering Management* **46**(1) 56-71.

Sánchez, A.M., M.P. Pérez. 2003. Flexibility in new product development: A survey of practices and its relationship with the product's technological complexity. *Technovation* **23**(2) 139-145.

Sarin, S., C.M. McDermott. 2003. The effect of team leader characteristics on learning, knowledge application, and performance of cross-functional new product development teams. *Decision Sciences* **34**(4) 707-739.

Shenhar, A.J., D. Dvir, Y. Shulman. 1995. A two-dimensional taxonomy of products and innovations. *Journal of Engineering and Technology Management* **12**(3) 175-200.

Sheremata, W.A. 2002. Finding and solving problems in software new product development. *Journal of Product Innovation Management* **19**(2) 144-158.

Sherman, J.D., W.E. Souder, S.A. Jenssen. 2000. Differential effects of the primary forms of cross functional integration on product development cycle time. *Journal of Product Innovation Management* **17**(4) 257-267.

Souder, W.E., J.D. Sherman, R. Davies-Cooper. 1998. Environmental uncertainty, organizational integration, and new product development effectiveness: A test of contingency theory. *Journal of Product Innovation Management* **15**(6) 520-533.

Swink, M. 2000. Technological innovativeness as a moderator of new product design integration and top management support. *Journal of Product Innovation Management* **17**(3) 208-220.

Swink, M. 2003. Completing projects on-time: How project acceleration affects new product development. *Journal of Engineering and Technology Management* **20**(4) 319-344.

Swink, M., X.M. Song. 2007. Effects of marketing-manufacturing integration on new product development time and competitive advantage. *Journal of Operations Management* **25**(1) 203-217.

Tatikonda, M.V., M.M. Montoya-Weiss. 2001. Integrating operations and marketing perspectives of product innovation: The influence of organizational process factors and capabilities on development performance. *Management Science* **47**(1) 151-172.

Terwiesch, C., C.H. Loch. 1999. Measuring the effectiveness of overlapping development activities. *Management Science* **45**(4) 455-465.

Tessarolo, P. 2007. Is integration enough for fast product development? An empirical investigation of the contextual effects of product vision. *Journal of Product Innovation Management* **24**(1) 69-82.

Zirger, B.J., J.L. Hartley. 1996. The effect of acceleration techniques on product development time. *IEEE Transactions on Engineering Management* **43**(2) 143-152.

APPENDIX D Robustness tests of multicollinearity

Variable	Model 1	Model 2	Model 3
Constant	-0.23***	-0.34***	-0.15***
Step 1: Control variables			
Organizational unit 2	0.44**	0.82***	0.17
Organizational unit 3	0.24*	0.31**	0.24*
Organizational unit 4	0.28**	0.45***	0.12
Organizational unit 5	0.18	0.17	0.16
Organizational unit 6	0.01	0.01	-0.01
Organizational unit 7	0.29**	0.20	0.33**
Time *(β_1)*	---	0.17*	0.03
Concurrent project activity (β_2)	0.27***	0.27***	0.28***
Team experience (β_3)	-0.16***	-0.18***	-0.25**
Step 2: Main effects			
Specialized organizational experience (β_4)	-0.19***	-0.30***	---
Related organizational experience (β_5)	-0.20***	---	-0.35***
Project uncertainty (β_6)	0.01	0.00	0.04
Step 3: Two-way interaction effects			
Specialized organizational experience × Project uncertainty (β_7)	0.06	-0.07	---
Related organizational experience × Project uncertainty (β_8)	-0.16**	---	-0.13**
R^2	0.82	0.78	0.80
F-statistic	53.83***	45.59***	51.58***

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$, $N = 169$.

APPENDIX E Scenario descriptions

General instructions

You are a Product Development Manager at MedAssist, a company specializing in home health equipment. Your latest project has been given the go-ahead and will commence in less than a month. The project entails the development of a new medicine dispenser for home use.

Condition 1: Low Innovativeness, low cycle time reduction objective

Like MedAssist's existing medicine dispenser, the new product will ensure dose accuracy by delivering a fixed amount of medication to the patient at the specified time. While it will be ***similar in form*** to the existing dispenser, it will have a ***larger container unit***. This will allow the new dispenser to be used with a greater range of pill shapes and sizes, thereby offering a ***minor improvement*** over the existing one. With the larger container unit the company hopes to provide greater convenience and flexibility to its existing customers. The new medicine dispenser can easily be produced using the manufacturing process used in the production of the existing medicine dispenser, with some ***small modifications***.

In last week's meeting top management has been reprimanded by the Board of Directors because for the last three years MedAssist's new product development projects have been taking ***slightly longer*** (i.e., 10% longer) than the similar projects of major competitors. The company has therefore initiated a companywide acceleration programme that dictates development times be ***reduced by at least 10%.***

Last year, a project similar in character and magnitude to your new project was completed in ***10 months***. In line with the new acceleration programme, your new project should take ***no more than 9 months***. As product development manager you are responsible for ***taking the necessary actions*** to ensure the ***successful and timely completion*** of your project.

Condition 2: Low Innovativeness, high cycle time reduction objective

Like MedAssist's existing medicine dispenser, the new product will ensure dose accuracy by delivering a fixed amount of medication to the patient at the specified time. While it will be ***similar in form*** to the existing dispenser, it will have a ***larger container unit***. This will allow the new dispenser to be used with a greater range of pill shapes and sizes, thereby offering a ***minor improvement*** over the existing one. With the larger container unit the company hopes to provide greater convenience and flexibility to its existing customers. The new medicine dispenser can easily be produced using the manufacturing process used in the production of the existing medicine dispenser, with some ***small modifications***.

In last week's meeting top management has been reprimanded by the Board of Directors because for the last three years MedAssist's new product development projects have been taking ***significantly longer*** (i.e., 40% longer) than the similar projects of major competitors. The company has therefore initiated a companywide acceleration programme that dictates development times be ***reduced by at least 40%***.

Last year, a project similar in character and magnitude to your new project was completed in ***10 months***. In line with the new acceleration programme, your new project should take ***no more than 6 months***. As product development manager you are responsible for taking the ***necessary actions*** to ensure the ***successful and timely completion*** of your project.

Condition 3: High innovativeness, low cycle time reduction objective

Like MedAssist's existing medicine dispenser, the new product will ensure dose accuracy by delivering a fixed amount of medication to the patient at the specified time. However, it will also incorporate ***a unique, patent-pending lock-out feature***, which requires ***extensive changes*** to be made in product form. This feature disables the unit until the next dose, enabling the new product to offer a ***significant improvement*** over existing medicine dispensers in the market. With the new lock-out feature, the company hopes to also cater for the needs of patients with memory problems or patients with the risk of overdose. In order to produce the new medicine dispenser, ***major modifications*** to the manufacturing process used in the production of the existing medicine dispenser need to be made.

In last week's meeting top management has been reprimanded by the Board of Directors because for the last three years MedAssist's new product development projects have been taking ***slightly longer*** (i.e., 10% longer) than the similar projects of major competitors. The company has therefore initiated a companywide acceleration programme that dictates development times be ***reduced by at least 10%***.

Last year, a project similar in character and magnitude to your new project was completed in ***10 months***. In line with the new acceleration programme, your new project should take ***no more than 9 months***. As product development manager you are responsible for taking the ***necessary actions*** to ensure the ***successful and timely completion*** of your project.

Condition 4: High innovativeness, high cycle time reduction objective

Like MedAssist's existing medicine dispenser, the new product will ensure dose accuracy by delivering a fixed amount of medication to the patient at the specified time. However, it will also incorporate a ***unique, patent-pending lock-out feature***, which requires ***extensive changes*** to be made in ***product form***. This feature disables the unit until the next dose, enabling the new product to offer a ***significant improvement*** over existing medicine dispensers in the market. With the new lock-out feature, the company hopes to also cater for the needs of patients with memory problems or patients with the risk of overdose. In order to produce the new medicine dispenser, ***major modifications*** to the manufacturing process used in the production of the existing medicine dispenser need to be made.

In last week's meeting top management has been reprimanded by the Board of Directors because for the last three years MedAssist's new product development projects have been taking ***significantly longer*** (i.e., 40% longer) than the similar projects of major competitors. The company has therefore initiated a companywide acceleration programme that dictates development times be ***reduced by at least 40%***.

Last year, a project similar in character and magnitude to your new project was completed in ***10 months***. In line with the new acceleration programme, your new project should take ***no more than 6 months***. As product development manager you are responsible for taking the ***necessary actions*** to ensure the ***successful and timely completion*** of your project.

SUMMARY

The past three decades have seen many companies adopting time-based strategies in an effort to bring their products to market quickly. While this trend in the industry has given rise to extensive scholarly interest in product development speed, extant literature has yet to provide a coherent account of its consequences for new product development performance, its drivers, and the conditions under which these drivers are beneficial. Motivated by the clear need for more work the area, this dissertation seeks to expand scholarly knowledge on NPD speed by examining (1) the effect of speed on performance given the inconsistencies in the empirical findings; and (2) how product development can effectively be accelerated, taking into account uncertainty as a contingency factor. It consists of three studies, each of which approaches the subject matter from a different angle and investigates it in different theoretical domains. Collectively, these studies offer a comprehensive account of product development speed and its successful management.

Study 1 focuses on the consequences of development speed, and uses meta-analytic methods to shed light into how development speed relates to new product success, taking into account its different dimensions. The results indicate that, in general, new product development speed is associated with improved NPD performance outcomes. However, those relationships diminish or even disappear depending upon a number of methodological design decisions and research contexts.

Studies 2 and 3 direct the attention to the antecedents of development speed. Study 2 treats acceleration as a continuous process that is a by-product of the firm's prior NPD experience, and investigates how NPD experience accumulated by organizational members that are not part of a given NPD project might spill over to the focal project and affect its cycle time. Using learning curve methodology, it quantifies the time performance implications of NPD experience, and assesses whether uncertainty plays a role in the realisation of time performance improvements. The analyses, which are based on objective data on 169 NPD projects taking place over a seven-year span in multiple units of a single organization, reveal that both specialized and related organizational experience help decrease project cycle times, but related experience is more influential for highly uncertain projects than less uncertain ones. In contrast, study 3 views acceleration as achievable primarily by active management intervention in the form of acceleration strategies. Using a decision experiment, it 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. The results indicate 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.

SAMENVATTING

In de afgelopen drie decennia hebben veel bedrijven op tijd gebaseerde strategieën geadopteerd om hun producten sneller naar de markt te brengen. Ondanks dat deze trend heeft geleid tot uitgebreide academische interesse voor snelheid in productontwikkeling, geeft de bestaande literatuur nog geen coherent beeld van de gevolgen van ontwikkelingssnelheid voor het succes van nieuwe producten, de drijvers van snelheid in productontwikkeling en de condities waaronder deze drijvers effectief zijn. Gemotiveerd door de duidelijke noodzaak om hier meer onderzoek naar uit te voeren, richt dit proefschrift zich op het vergroten van de academische kennis over snelheid in productontwikkeling. Dit wordt bereikt door het volgende te onderzoeken: (1) het effect van snelheid in productontwikkeling op het succes van nieuwe producten, gegeven de inconsistenties in de empirische bevindingen, en (2) hoe productontwikkeling effectief versneld kan worden in het licht van onzekerheid als contingentiefactor. Het onderzoek bestaat uit drie studies die elk het onderwerp van een andere kant en vanuit een verschillend theoretische domein onderzoeken. Gezamenlijk bieden de studies een veelomvattend beeld van productontwikkelingssnelheid en het succesvol managen hiervan.

Studie 1 richt zich op de gevolgen van productontwikkelingssnelheid en gebruikt meta-analytische methoden om te onderzoeken hoe snelheid in ontwikkeling zich verhoudt tot de verschillende dimensies waarop het succes van nieuwe producten kan worden gemeten. De resultaten tonen weliswaar aan dat snelheid van productontwikkeling in het algemeen positief is geassocieerd met verschillende dimensies van succes, maar dat deze relaties verminderen of zelfs verdwijnen, afhankelijk van bepaalde methodologische ontwerpbeslissingen en onderzoekcontexten.

Studies 2 en 3 richten zich op de drijvers van ontwikkelingssnelheid. Studie 2 beschouwt versnelling van productontwikkeling als een continu leerproces waarbij snelheid het bijproduct is van ervaring die door het bedrijf in eerdere productontwikkelingsprojecten is opgedaan. Het onderzoekt hoe de ervaring van medewerkers die wel (gespecialiseerd) of geen (gerelateerd) deel uitmaken zijn het gegeven ontwikkelingsproject, kan overvloeien op het onderzochte project en diens ontwikkelingstijd kan beïnvloeden. Gebruikmakend van de leercurvemethodologie kwantificeert het onderzoek de gevolgen van deze ervaring uit voorgaande projecten voor de ontwikkelingstijd van huidige projecten en stelt het vast welke onzekerheden een rol spelen in de realisatie van verbeteringen in ontwikkelingssnelheid. De analyses, gebaseerd op objectieve data van 169 productontwikkelingsprojecten die plaats vonden in een periode van zeven jaar bij verschillende onderdelen van één bedrijf, onthullen dat zowel gespecialiseerde als gerelateerde ervaring van medewerkers de ontwikkelingstijd helpt verminderen, maar dat gerelateerde ervaring meer invloed heeft op projecten met hoge onzekerheid dan op die met minder onzekerheid.

In tegenstelling tot studie 2 beschouwt studie 3 ontwikkelingssnelheid als maakbaar door actieve managementinterventie in de vorm van het toepassen van versnellingsstrategieën. Gebruikmakend van een beslissingsexperiment onderzoekt deze studie hoe de innovativiteit van het productontwikkelingsproject, als bron van onzekerheid, van invloed is op de strategiekeuze, hierbij rekening houdend met de mate van versnelling die besluitvormers willen bereiken. De resultaten tonen aan dat besluitvormers wel degelijk rekening houden met de innovativiteit van het productontwikkelingsproject waarvoor zij versnellingsstrategieën selecteren. Deze bevindingen komen overeen met bestaand werk dat aantoont dat projectmanagementstijlen gevormd worden, hoewel gedeeltelijk, door het onzekerheidsniveau van het project in kwestie.

ACKNOWLEDGEMENTS

I'm *really* not very good with this kind of stuff but here we go anyway. A big thank you to…

… my promoters Fred Langerak and Gerrit van Bruggen for having me as their PhD candidate and guiding me along the way. Gents, I can only hope that the experience wasn't too insufferable. Especially my colour-coded excel sheets. Those things are evil, as I'm sure Fred will agree.

… my co-authors Abbie Griffin, Serge Rijswijk and Erik Jan Hultink.

… everyone who was at the RSM Marketing Management department when I was there.

… and everyone at PIM (my new home!). I couldn't wish for more delightful colleagues.

Super special thanks to Maria Sääksjärvi for being a total inspiration and a wonderful friend.

And extra super special thanks to mum and dad for, well, being mum and dad.

Y'all rock! ☺

Cheers

p.

ABOUT THE AUTHOR

Pinar Cankurtaran was born in 1982, in Ankara, Turkey. She received the B.Sc. degree in Business Administration from Bilkent University in Turkey, and the M.Sc. degrees in International Development and Management Research from the University of Bath and the University of Oxford, respectively, in the United Kingdom. She received the M.Phil. in Business Research from the Rotterdam School of Management at Erasmus University, and is currently an assistant professor of new product marketing at the Faculty of Industrial Design Engineering, Delft University of Technology. Her primary research interests so far have been new product development speed, organizational learning, and strategic new product development, but she has recently started to venture into other topics such as new product adoption. Her work has been published in the Journal of Product Innovation Management, and presented at PDMA 2008, Marketing Science 2010, IPDMC 2011 and IPDMC 2014.

ERASMUS RESEARCH INSTITUTE OF MANAGEMENT (ERIM)

ERIM Ph.D. SERIES RESEARCH IN MANAGEMENT

The ERIM PhD Series contains PhD dissertations in the field of Research in Management defended at Erasmus University Rotterdam and supervised by senior researchers affiliated to the Erasmus Research Institute of Management (ERIM). All dissertations in the ERIM PhD Series are available in full text through the ERIM Electronic Series Portal: http://hdl.handle.net/1765/1

ERIM is the joint research institute of the Rotterdam School of Management (RSM) and the Erasmus School of Economics at the Erasmus University Rotterdam (EUR).

DISSERTATIONS LAST FIVE YEARS

Acciaro, M., *Bundling Strategies in Global Supply Chains*, Promotor(s): Prof.dr. H.E. Haralambides, EPS-2010-197-LIS, http://hdl.handle.net/1765/19742

Akpinar, E., *Consumer Information Sharing; Understanding Psychological Drivers of Social Transmission*, Promotor(s): Prof.dr.ir. A. Smidts, EPS-2013-297-MKT, http://hdl.handle.net/1765/50140

Alexiev, A., Exploratory Innovation: The Role of Organizational and Top Management Team Social Capital, Promotor(s): Prof.dr. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2010-208-STR, http://hdl.handle.net/1765/20632

Akin Ates, M., *Purchasing and Supply Management at the Purchase Category Level: Strategy, Structure, and Performance*, Promotor: Prof.dr. J.Y.F. Wynstra, EPS-2014-300-LIS, http://hdl.handle.net/1765/1

Almeida, R.J.de, *Conditional Density Models Integrating Fuzzy and Probabilistic Representations of Uncertainty*, Promotor Prof.dr.ir. Uzay Kaymak, EPS-2014-310-LIS, http://hdl.net/1765/1

Bannouh, K., *Measuring and Forecasting Financial Market Volatility using High-Frequency Data*, Promotor: Prof.dr.D.J.C. van Dijk, EPS-2013-273-F&A, http://hdl.handle.net/1765/38240

Benning, T.M., *A Consumer Perspective on Flexibility in Health Care: Priority Access Pricing and Customized Care*, Promotor: Prof.dr.ir. B.G.C. Dellaert, EPS-2011-241-MKT, http://hdl.handle.net/1765/23670

Ben-Menahem, S.M., S*trategic Timing and Proactiveness of Organizations*, Promotor(s): Prof.dr. H.W. Volberda & Prof.dr.ing. F.A.J. van den Bosch, EPS-2013-278-S&E, http://hdl.handle.net/1765/39128

Berg, W.E. van den, *Understanding Salesforce Behavior Using Genetic Association Studies*, Promotor: Prof.dr. W.J.M.I. Verbeke, EPS-2014-311-MKT, http://hdl.handle.net/1765/51440

Betancourt, N.E., *Typical Atypicality: Formal and Informal Institutional Conformity, Deviance, and Dynamics*, Promotor: Prof.dr. B. Krug, EPS-2012-262-ORG, http://hdl.handle.net/1765/32345

Binken, J.L.G., *System Markets: Indirect Network Effects in Action, or Inaction*, Promotor: Prof.dr. S. Stremersch, EPS-2010-213-MKT, http://hdl.handle.net/1765/21186

Blitz, D.C., *Benchmarking Benchmarks*, Promotor(s): Prof.dr. A.G.Z. Kemna & Prof.dr. W.F.C. Verschoor, EPS-2011-225-F&A, http://hdl.handle.net/1765/226244

Boons, M., *Working Together Alone in the Online Crowd: The Effects of Social Motivations and Individual Knowledge Backgrounds on the Participation and Performance of Members of Online Crowdsourcing Platforms*, Promotor: Prof.dr. H.G. Barkema, EPS-2014-306-S&E, http://hdl.net/1765/50711

Borst, W.A.M., *Understanding Crowdsourcing: Effects of Motivation and Rewards on Participation and Performance in Voluntary Online Activities*, Promotor(s): Prof.dr.ir. J.C.M. van den Ende & Prof.dr.ir. H.W.G.M. van Heck, EPS-2010-221-LIS, http://hdl.handle.net/1765/21914

Budiono, D.P., *The Analysis of Mutual Fund Performance: Evidence from U.S. Equity Mutual Funds*, Promotor: Prof.dr. M.J.C.M. Verbeek, EPS-2010-185-F&A, http://hdl.handle.net/1765/18126

Burger, M.J., *Structure and Cooptition in Urban Networks*, Promotor(s): Prof.dr. G.A. van der Knaap & Prof.dr. H.R. Commandeur, EPS-2011-243-ORG, http://hdl.handle.net/1765/26178

Byington, E., *Exploring Coworker Relationships: Antecedents and Dimensions of Interpersonal Fit, Coworker Satisfaction, and Relational Models*, Promotor: Prof.dr. D.L. van Knippenberg, EPS-2013-292-ORG, http://hdl.handle.net/1765/41508

Camacho, N.M., H*ealth and Marketing; Essays on Physician and Patient Decision-making*, Promotor: Prof.dr. S. Stremersch, EPS-2011-237-MKT, http://hdl.handle.net/1765/23604

Cankurtaran, P. *Essays On Accelerated Product Development*, Promotor: Prof.dr.ir. G.H. van Bruggen, EPS-2014-317-MKT, http://hdl.handle.net/1765/1

Caron, E.A.M., *Explanation of Exceptional Values in Multi-dimensional Business Databases*, Promotor(s): Prof.dr.ir. H.A.M. Daniels & Prof.dr. G.W.J. Hendrikse, EPS-2013-296-LIS, http://hdl.handle.net/1765/50005

Carvalho, L., *Knowledge Locations in Cities; Emergence and Development Dynamics*, Promotor: Prof.dr. L. van den Berg, EPS-2013-274-S&E, http://hdl.handle.net/1765/38449

Carvalho de Mesquita Ferreira, L., *Attention Mosaics: Studies of Organizational Attention*, Promotor(s): Prof.dr. P.M.A.R. Heugens & Prof.dr. J. van Oosterhout, EPS-2010-205-ORG, http://hdl.handle.net/1765/19882

Cox, R.H.G.M., *To Own, To Finance, and to Insure; Residential Real Estate Revealed*, Promotor: Prof.dr. D. Brounen, EPS-2013-290-F&A, http://hdl.handle.net/1765/40964

Defilippi Angeldonis, E.F., *Access Regulation for Naturally Monopolistic Port Terminals: Lessons from Regulated Network Industries*, Promotor: Prof.dr. H.E. Haralambides, EPS-2010-204-LIS, http://hdl.handle.net/1765/19881

Deichmann, D., *Idea Management: Perspectives from Leadership, Learning, and Network Theory*, Promotor: Prof.dr.ir. J.C.M. van den Ende, EPS-2012-255-ORG, http://hdl.handle.net/1765/31174

Desmet, P.T.M., *In Money we Trust? Trust Repair and the Psychology of Financial Compensations*, Promotor: Prof.dr. D. De Cremer & Prof.dr. E. van Dijk, EPS-2011-232-ORG, http://hdl.handle.net/1765/23268

Dietvorst, R.C., *Neural Mechanisms Underlying Social Intelligence and Their Relationship with the Performance of Sales Managers*, Promotor: Prof.dr. W.J.M.I. Verbeke, EPS-2010-215-MKT, http://hdl.handle.net/1765/21188

Dollevoet, T.A.B., *Delay Management and Dispatching in Railways*, Promotor: Prof.dr. A.P.M. Wagelmans, EPS-2013-272-LIS, http://hdl.handle.net/1765/38241

Doorn, S. van, *Managing Entrepreneurial Orientation*, Promotor(s): Prof.dr. J.J.P. Jansen, Prof.dr.ing. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2012-258-STR, http://hdl.handle.net/1765/32166

Douwens-Zonneveld, M.G., *Animal Spirits and Extreme Confidence: No Guts, No Glory*, Promotor: Prof.dr. W.F.C. Verschoor, EPS-2012-257-F&A, http://hdl.handle.net/1765/31914

Duca, E., *The Impact of Investor Demand on Security Offerings*, Promotor: Prof.dr. A. de Jong, EPS-2011-240-F&A, http://hdl.handle.net/1765/26041

Duursema, H., *Strategic Leadership; Moving Beyond the Leader-follower Dyad*, Promotor: Prof.dr. R.J.M. van Tulder, EPS-2013-279-ORG, http://hdl.handle.net/1765/39129

Eck, N.J. van, *Methodological Advances in Bibliometric Mapping of Science*, Promotor: Prof.dr.ir. R. Dekker, EPS-2011-247-LIS, http://hdl.handle.net/1765/26509

Essen, M. van, *An Institution-Based View of Ownership*, Promotor(s): Prof.dr. J. van Oosterhout & Prof.dr. G.M.H. Mertens, EPS-2011-226-ORG, http://hdl.handle.net/1765/22643

Feng, L., *Motivation, Coordination and Cognition in Cooperatives*, Promotor: Prof.dr. G.W.J. Hendrikse, EPS-2010-220-ORG, http://hdl.handle.net/1765/21680

Fourne, S. *The Role of Middle Managers in Harnessing Complexity Reconciling and Mastering Role Conflicts: Individual Level Absorptive Capacity and the Moderating Effects of Social Capital and The Organizational Context*, Promotor(s): Prof.dr. J.J.P. Jansen, Prof.dr. S.J. Magala & dr. T.J.M.Mom, EPS-2014-318-S&E, http://hdl.handle.net/1765/21680

Gharehgozli, A.H., *Developing New Methods for Efficient Container Stacking Operations*, Promotor: Prof.dr.ir. M.B.M. de Koster, EPS-2012-269-LIS, http://hdl.handle.net/1765/37779

Gils, S. van, *Morality in Interactions: On the Display of Moral Behavior by Leaders and Employees*, Promotor: Prof.dr. D.L. van Knippenberg, EPS-2012-270-ORG, http://hdl.handle.net/1765/38028

Ginkel-Bieshaar, M.N.G. van, *The Impact of Abstract versus Concrete Product Communications on Consumer Decision-making Processes*, Promotor: Prof.dr.ir. B.G.C. Dellaert, EPS-2012-256-MKT, http://hdl.handle.net/1765/31913

Gkougkousi, X., *Empirical Studies in Financial Accounting*, Promotor(s): Prof.dr. G.M.H. Mertens & Prof.dr. E. Peek, EPS-2012-264-F&A, http://hdl.handle.net/1765/37170

Hakimi, N.A, *Leader Empowering Behaviour: The Leader's Perspective: Understanding the Motivation behind Leader Empowering Behaviour*, Promotor: Prof.dr. D.L. van Knippenberg, EPS-2010-184-ORG, http://hdl.handle.net/1765/17701

Hensmans, M., *A Republican Settlement Theory of the Firm: Applied to Retail Banks in England and the Netherlands (1830-2007)*, Promotor(s): Prof.dr. A. Jolink & Prof.dr. S.J. Magala, EPS-2010-193-ORG, http://hdl.handle.net/1765/19494

Hernandez Mireles, C., *Marketing Modeling for New Products,* Promotor: Prof.dr. P.H. Franses, EPS-2010-202-MKT, http://hdl.handle.net/1765/19878

Heyde Fernandes, D. von der, T*he Functions and Dysfunctions of Reminders*, Promotor: Prof.dr. S.M.J. van Osselaer, EPS-2013-295-MKT, http://hdl.handle.net/1765/41514

Heyden, M.L.M., *Essays on Upper Echelons & Strategic Renewal: A Multilevel Contingency Approach*, Promotor(s): Prof.dr. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2012-259-STR, http://hdl.handle.net/1765/32167

Hoever, I.J., *Diversity and Creativity: In Search of Synergy*, Promotor(s): Prof.dr. D.L. van Knippenberg, EPS-2012-267-ORG, http://hdl.handle.net/1765/37392

Hoogendoorn, B., S*ocial Entrepreneurship in the Modern Economy: Warm Glow, Cold Feet*, Promotor(s): Prof.dr. H.P.G. Pennings & Prof.dr. A.R. Thurik, EPS-2011-246-STR, http://hdl.handle.net/1765/26447

Hoogervorst, N., *On The Psychology of Displaying Ethical Leadership: A Behavioral Ethics Approach*, Promotor(s): Prof.dr. D. De Cremer & Dr. M. van Dijke, EPS-2011-244-ORG, http://hdl.handle.net/1765/26228

Huang, X., *An Analysis of Occupational Pension Provision: From Evaluation to Redesign*, Promotor(s): Prof.dr. M.J.C.M. Verbeek & Prof.dr. R.J. Mahieu, EPS-2010-196-F&A, http://hdl.handle.net/1765/19674

Hytönen, K.A. *Context Effects in Valuation, Judgment and Choice*, Promotor(s): Prof.dr.ir. A. Smidts, EPS-2011-252-MKT, http://hdl.handle.net/1765/30668

Jaarsveld, W.L. van, *Maintenance Centered Service Parts Inventory Contro*l, Promotor(s): Prof.dr.ir. R. Dekker, EPS-2013-288-LIS, http://hdl.handle.net/1765/39933

Jalil, M.N., *Customer Information Driven After Sales Service Management: Lessons from Spare Parts Logistics*, Promotor(s): Prof.dr. L.G. Kroon, EPS-2011-222-LIS, http://hdl.handle.net/1765/22156

Kagie, M., *Advances in Online Shopping Interfaces: Product Catalog Maps and Recommender Systems*, Promotor(s): Prof.dr. P.J.F. Groenen, EPS-2010-195-MKT, http://hdl.handle.net/1765/19532

Kappe, E.R., *The Effectiveness of Pharmaceutical Marketing*, Promotor(s): Prof.dr. S. Stremersch, EPS-2011-239-MKT, http://hdl.handle.net/1765/23610

Karreman, B., *Financial Services and Emerging Markets*, Promotor(s): Prof.dr. G.A. van der Knaap & Prof.dr. H.P.G. Pennings, EPS-2011-223-ORG, http://hdl.handle.net/1765/22280

Kil, J.C.M., *Acquisitions Through a Behavioral and Real Options Lens*, Promotor(s): Prof.dr. H.T.J. Smit, EPS-2013-298-F&A, http://hdl.handle.net/1765/50142

Klooster, E. van't, *Travel to Learn: The Influence of Cultural Distance on Competence Development in Educational Travel*, Promotors: Prof.dr. F.M. Go & Prof.dr. P.J. van Baalen, EPS-2014-312-MKT, http://hdl.handle.net/1765/151460

Koendjbiharie, S.R., *The Information-Based View on Business Network Performance Revealing the Performance of Interorganizational Networks*, Promotors: Prof.dr.ir. H.W.G.M. van Heck & Prof.mr.dr. P.H.M. Vervest, EPS-2014-315-LIS, http://hdl.handle.net/1765/1

Konter, D.J., *Crossing borders with HRM: An inquiry of the influence of contextual differences in the adaption and effectiveness of HRM*, Promotor: Prof.dr. J. Paauwe, EPS-2014-305-ORG, http://hdl.handle.net/1765/1

Korkmaz, E. *Understanding Heterogeneity in Hidden Drivers of Customer Purchase Behavior*, Promotors: Prof.dr. S.L. van de Velde & dr. R.Kuik, EPS-2014-316-LIS, http://hdl.handle.net/1765/1

Lam, K.Y., *Reliability and Rankings*, Promotor(s): Prof.dr. P.H.B.F. Franses, EPS-2011-230-MKT, http://hdl.handle.net/1765/22977

Lander, M.W., *Profits or Professionalism? On Designing Professional Service Firms*, Promotor(s): Prof.dr. J. van Oosterhout & Prof.dr. P.P.M.A.R. Heugens, EPS-2012-253-ORG, http://hdl.handle.net/1765/30682

Langhe, B. de, *Contingencies: Learning Numerical and Emotional Associations in an Uncertain World*, Promotor(s): Prof.dr.ir. B. Wierenga & Prof.dr. S.M.J. van Osselaer, EPS-2011-236-MKT, http://hdl.handle.net/1765/23504

Larco Martinelli, J.A., *Incorporating Worker-Specific Factors in Operations Management Models*, Promotor(s): Prof.dr.ir. J. Dul & Prof.dr. M.B.M. de Koster, EPS-2010-217-LIS, http://hdl.handle.net/1765/21527

Leunissen, J.M., *All Apologies: On the Willingness of Perpetrators to Apologize*, Promotor: Prof.dr. D. De Cremer, EPS-2014-301-ORG, http://hdl.handle.net/1765/1

Liang, Q., *Governance, CEO Indentity, and Quality Provision of Farmer Cooperatives*, Promotor: Prof.dr. G.W.J. Hendrikse, EPS-2013-281-ORG, http://hdl.handle.net/1765/1

Liket, K.C., *Why 'Doing Good' is not Good Enough: Essays on Social Impact Measurement*, Promotor: Prof.dr. H.R. Commandeur, EPS-2014-307-S&E, http://hdl.handle.net/1765/51130

Loos, M.J.H.M. van der, *Molecular Genetics and Hormones; New Frontiers in Entrepreneurship Research*, Promotor(s): Prof.dr. A.R. Thurik, Prof.dr. P.J.F. Groenen & Prof.dr. A. Hofman, EPS-2013-287-S&E, http://hdl.handle.net/1765/40081

Lovric, M., *Behavioral Finance and Agent-Based Artificial Markets*, Promotor(s): Prof.dr. J. Spronk & Prof.dr.ir. U. Kaymak, EPS-2011-229-F&A, http://hdl.handle.net/1765/22814

Lu, Y., *Data-Driven Decision Making in Auction Markets*, Promotors: Prof.dr.ir.H.W.G.M. van Heck & Prof.dr.W.Ketter, EPS-2014-314-LIS, http://hdl.handle.net/1765/1

Markwat, T.D., *Extreme Dependence in Asset Markets Around the Globe*, Promotor: Prof.dr. D.J.C. van Dijk, EPS-2011-227-F&A, http://hdl.handle.net/1765/22744

Mees, H., *Changing Fortunes: How China's Boom Caused the Financial Crisis*, Promotor: Prof.dr. Ph.H.B.F. Franses, EPS-2012-266-MKT, http://hdl.handle.net/1765/34930

Meuer, J., *Configurations of Inter-Firm Relations in Management Innovation: A Study in China's Biopharmaceutical Industry*, Promotor: Prof.dr. B. Krug, EPS-2011-228-ORG, http://hdl.handle.net/1765/22745

Mihalache, O.R., *Stimulating Firm Innovativeness: Probing the Interrelations between Managerial and Organizational Determinants*, Promotor(s): Prof.dr. J.J.P. Jansen, Prof.dr.ing. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2012-260-S&E, http://hdl.handle.net/1765/32343

Milea, V., *New Analytics for Financial Decision Support*, Promotor: Prof.dr.ir. U. Kaymak, EPS-2013-275-LIS, http://hdl.handle.net/1765/38673

Naumovska, I. *Socially Situated Financial Markets:a Neo-Behavioral Perspective on Firms, Investors and Practices*, Promoter(s) Prof.dr. P.P.M.A.R. Heugens & Prof.dr. A.de Jong, EPS-2014-319-S&E, http://hdl.handle.net/1765/1

Nielsen, L.K., *Rolling Stock Rescheduling in Passenger Railways: Applications in Short-term Planning and in Disruption Management*, Promotor: Prof.dr. L.G. Kroon, EPS-2011-224-LIS, http://hdl.handle.net/1765/22444

Nijdam, M.H., *Leader Firms: The Value of Companies for the Competitiveness of the Rotterdam Seaport Cluster,* Promotor(s): Prof.dr. R.J.M. van Tulder, EPS-2010-216-ORG, http://hdl.handle.net/1765/21405

Noordegraaf-Eelens, L.H.J., *Contested Communication: A Critical Analysis of Central Bank Speech*, Promotor: Prof.dr. Ph.H.B.F. Franses, EPS-2010-209-MKT, http://hdl.handle.net/1765/21061

Nuijten, A.L.P., *Deaf Effect for Risk Warnings: A Causal Examination Applied to Information Systems Projects*, Promotor: Prof.dr. G. van der Pijl & Prof.dr. H. Commandeur & Prof.dr. M. Keil, EPS-2012-263-S&E, http://hdl.handle.net/1765/34928

Oosterhout, M., van, *Business Agility and Information Technology in Service Organizations*, Promotor: Prof,dr.ir. H.W.G.M. van Heck, EPS-2010-198-LIS, http://hdl.handle.net/1765/19805

Osadchiy, S.E., *The Dynamics of Formal Organization: Essays on Bureaucracy and Formal Rules*, Promotor: Prof.dr. P.P.M.A.R. Heugens, EPS-2011-231-ORG, http://hdl.handle.net/1765/23250

Otgaar, A.H.J., *Industrial Tourism: Where the Public Meets the Private*, Promotor: Prof.dr. L. van den Berg, EPS-2010-219-ORG, http://hdl.handle.net/1765/21585

Ozdemir, M.N., *Project-level Governance, Monetary Incentives and Performance in Strategic R&D Alliances*, Promotor: Prof.dr.ir. J.C.M. van den Ende, EPS-2011-235-LIS, http://hdl.handle.net/1765/23550

Peers, Y., *Econometric Advances in Diffusion Models*, Promotor: Prof.dr. Ph.H.B.F. Franses, EPS-2011-251-MKT, http://hdl.handle.net/1765/30586

Pince, C., *Advances in Inventory Management: Dynamic Models*, Promotor: Prof.dr.ir. R. Dekker, EPS-2010-199-LIS, http://hdl.handle.net/1765/19867

Porck, J.P., *No Team is an Island*, Promotor: Prof.dr. P.J.F. Groenen & Prof.dr. D.L. van Knippenberg, EPS-2013-299-ORG, http://hdl.handle.net/1765/50141

Porras Prado, M., *The Long and Short Side of Real Estate, Real Estate Stocks, and Equity*, Promotor: Prof.dr. M.J.C.M. Verbeek, EPS-2012-254-F&A, http://hdl.handle.net/1765/30848

Potthoff, D., R*ailway Crew Rescheduling: Novel Approaches and Extensions*, Promotor(s): Prof.dr. A.P.M. Wagelmans & Prof.dr. L.G. Kroon, EPS-2010-210-LIS, http://hdl.handle.net/1765/21084

Poruthiyil, P.V., *Steering Through: How Organizations Negotiate Permanent Uncertainty and Unresolvable Choices*, Promotor(s): Prof.dr. P.P.M.A.R. Heugens & Prof.dr. S. Magala, EPS-2011-245-ORG, http://hdl.handle.net/1765/26392

Pourakbar, M. *End-of-Life Inventory Decisions of Service Parts*, Promotor: Prof.dr.ir. R. Dekker, EPS-2011-249-LIS, http://hdl.handle.net/1765/30584

Pronker, E.S., *Innovation Paradox in Vaccine Target Selection*, Promotor(s): Prof.dr. H.R. Commandeur & Prof.dr. H.J.H.M. Claassen, EPS-2013-282-S&E, http://hdl.handle.net/1765/39654

Retel Helmrich, M.J., *Green Lot-Sizing*, Promotor: Prof.dr. A.P.M. Wagelmans, EPS-2013-291-LIS, http://hdl.handle.net/1765/41330

Rietveld, C.A., *Essays on the Intersection of Economics and Biology*, Promotor(s): Prof.dr. P.J.F. Groenen, Prof.dr. A. Hofman & Prof.dr. A.R. Thurik, EPS-2014-320-S&E, http://hdl.handle.net/1765/1

Rijsenbilt, J.A., *CEO Narcissism; Measurement and Impact*, Promotor: Prof.dr. A.G.Z. Kemna & Prof.dr. H.R. Commandeur, EPS-2011-238-STR, http://hdl.handle.net/1765/23554

Roelofsen, E.M., *The Role of Analyst Conference Calls in Capital Markets*, Promotor(s): Prof.dr. G.M.H. Mertens & Prof.dr. L.G. van der Tas RA, EPS-2010-190-F&A, http://hdl.handle.net/1765/18013

Roza, M.W., *The Relationship between Offshoring Strategies and Firm Performance: Impact of Innovation, Absorptive Capacity and Firm Size*, Promotor(s): Prof.dr. H.W. Volberda & Prof.dr.ing. F.A.J. van den Bosch, EPS-2011-214-STR, http://hdl.handle.net/1765/22155

Rubbaniy, G., *Investment Behavior of Institutional Investors*, Promotor: Prof.dr. W.F.C. Verschoor, EPS-2013-284-F&A, http://hdl.handle.net/1765/40068

Schellekens, G.A.C., *Language Abstraction in Word of Mouth*, Promotor: Prof.dr.ir. A. Smidts, EPS-2010-218-MKT, http://hdl.handle.net/1765/21580

Shahzad, K., *Credit Rating Agencies, Financial Regulations and the Capital Markets*, Promotor: Prof.dr. G.M.H. Mertens, EPS-2013-283-F&A, http://hdl.handle.net/1765/39655

Sotgiu, F., *Not All Promotions are Made Equal: From the Effects of a Price War to Cross-chain Cannibalization*, Promotor(s): Prof.dr. M.G. Dekimpe & Prof.dr.ir. B. Wierenga, EPS-2010-203-MKT, http://hdl.handle.net/1765/19714

Sousa, M., *Servant Leadership to the Test: New Perspectives and Insight*, Promotors: Prof.dr. D. van Knippenberg & Dr. D. van Dierendonck, EPS-2014-313-ORG, http://hdl.net/1765/1

Spliet, R., *Vehicle Routing with Uncertain Demand*, Promotor: Prof.dr.ir. R. Dekker, EPS-2013-293-LIS, http://hdl.handle.net/1765/41513

Srour, F.J., *Dissecting Drayage: An Examination of Structure, Information, and Control in Drayage Operations*, Promotor: Prof.dr. S.L. van de Velde, EPS-2010-186-LIS, http://hdl.handle.net/1765/18231

Staadt, J.L., *Leading Public Housing Organisation in a Problematic Situation: A Critical Soft Systems Methodology Approach*, Promotor: Prof.dr. S.J. Magala, EPS-2014-308-ORG, http://hdl.handle.net/1765/50712

Stallen, M., *Social Context Effects on Decision-Making; A Neurobiological Approach*, Promotor: Prof.dr.ir. A. Smidts, EPS-2013-285-MKT, http://hdl.handle.net/1765/39931

Tarakci, M., *Behavioral Strategy; Strategic Consensus, Power and Networks*, Promotor(s): Prof.dr. P.J.F. Groenen & Prof.dr. D.L. van Knippenberg, EPS-2013-280-ORG, http://hdl.handle.net/1765/39130

Teixeira de Vasconcelos, M., *Agency Costs, Firm Value, and Corporate Investment*, Promotor: Prof.dr. P.G.J. Roosenboom, EPS-2012-265-F&A, http://hdl.handle.net/1765/37265

Tempelaar, M.P., *Organizing for Ambidexterity: Studies on the Pursuit of Exploration and Exploitation through Differentiation, Integration, Contextual and Individual Attributes*, Promotor(s): Prof.dr.ing. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2010-191-STR, http://hdl.handle.net/1765/18457

Tiwari, V., *Transition Process and Performance in IT Outsourcing: Evidence from a Field Study and Laboratory Experiments*, Promotor(s): Prof.dr.ir. H.W.G.M. van Heck & Prof.dr. P.H.M. Vervest, EPS-2010-201-LIS, http://hdl.handle.net/1765/19868

Tröster, C., *Nationality Heterogeneity and Interpersonal Relationships at Work*, Promotor: Prof.dr. D.L. van Knippenberg, EPS-2011-233-ORG, http://hdl.handle.net/1765/23298

Tsekouras, D., *No Pain No Gain: The Beneficial Role of Consumer Effort in Decision Making*, Promotor: Prof.dr.ir. B.G.C. Dellaert, EPS-2012-268-MKT, http://hdl.handle.net/1765/37542

Tzioti, S., *Let Me Give You a Piece of Advice: Empirical Papers about Advice Taking in Marketing*, Promotor(s): Prof.dr. S.M.J. van Osselaer & Prof.dr.ir. B. Wierenga, EPS-2010-211-MKT, hdl.handle.net/1765/21149

Vaccaro, I.G., *Management Innovation: Studies on the Role of Internal Change Agents,* Promotor(s): Prof.dr. F.A.J. van den Bosch & Prof.dr. H.W. Volberda, EPS-2010-212-STR, hdl.handle.net/1765/21150

Vagias, D., *Liquidity, Investors and International Capital Markets*, Promotor: Prof.dr. M.A. van Dijk, EPS-2013-294-F&A, http://hdl.handle.net/1765/41511

Verheijen, H.J.J., *Vendor-Buyer Coordination in Supply Chains*, Promotor: Prof.dr.ir. J.A.E.E. van Nunen, EPS-2010-194-LIS, http://hdl.handle.net/1765/19594

Venus, M., *Demystifying Visionary Leadership; In Search of the Essence of Effective Vision Communication*, Promotor: Prof.dr. D.L. van Knippenberg, EPS-2013-289-ORG, http://hdl.handle.net/1765/ 40079

Visser, V., *Leader Affect and Leader Effectiveness; How Leader Affective Displays Influence Follower Outcomes*, Promotor: Prof.dr. D. van Knippenberg, EPS-2013-286-ORG, http://hdl.handle.net/1765/40076

Vlam, A.J., Customer First? *The Relationship between Advisors and Consumers of Financial Products*, Promotor: Prof.dr. Ph.H.B.F. Franses, EPS-2011-250-MKT, http://hdl.handle.net/1765/30585

Waard, E.J. de, *Engaging Environmental Turbulence: Organizational Determinants for Repetitive Quick and Adequate Responses*, Promotor(s): Prof.dr. H.W. Volberda & Prof.dr. J. Soeters, EPS-2010-189-STR, http://hdl.handle.net/1765/18012

Waltman, L., *Computational and Game-Theoretic Approaches for Modeling Bounded Rationality*, Promotor(s): Prof.dr.ir. R. Dekker & Prof.dr.ir. U. Kaymak, EPS-2011-248-LIS, http://hdl.handle.net/1765/26564

Wang, Y., *Information Content of Mutual Fund Portfolio Disclosure*, Promotor: Prof.dr. M.J.C.M. Verbeek, EPS-2011-242-F&A, http://hdl.handle.net/1765/26066

Wang, Y., *Corporate Reputation Management; Reaching Out to Find Stakeholders*, Promotor: Prof.dr. C.B.M. van Riel, EPS-2013-271-ORG, http://hdl.handle.net/1765/38675

Weenen, T.C., *On the Origin and Development of the Medical Nutrition Industry*, Promotors: Prof.dr. H.R. Commandeur & Prof.dr. H.J.H.M. Claassen, EPS-2014-309-S&E, http://hdl.handle.net/1765/51134

Wolfswinkel, M., *Corporate Governance, Firm Risk and Shareholder Value of Dutch Firms*, Promotor: Prof.dr. A. de Jong, EPS-2013-277-F&A, http://hdl.handle.net/1765/39127

Xu, Y., *Empirical Essays on the Stock Returns, Risk Management, and Liquidity Creation of Banks*, Promotor: Prof.dr. M.J.C.M. Verbeek, EPS-2010-188-F&A, http://hdl.handle.net/1765/18125

Zaerpour, N., *Efficient Management of Compact Storage Systems*, Promotor: Prof.dr. M.B.M. de Koster, EPS-2013-276-LIS, http://hdl.handle.net/1765/38766

Zhang, D., *Essays in Executive Compensation*, Promotor: Prof.dr. I. Dittmann, EPS-2012-261-F&A, http://hdl.handle.net/1765/32344

Zhang, X., *Scheduling with Time Lags*, Promotor: Prof.dr. S.L. van de Velde, EPS-2010-206-LIS, http://hdl.handle.net/1765/19928

Zhou, H., *Knowledge, Entrepreneurship and Performance: Evidence from Country-level and Firm-level Studies*, Promotor(s): Prof.dr. A.R. Thurik & Prof.dr. L.M. Uhlaner, EPS-2010-207-ORG, http://hdl.handle.net/1765/20634

Zwan, P.W. van der, *The Entrepreneurial Process: An International Analysis of Entry and Exit*, Promotor(s): Prof.dr. A.R. Thurik & Prof.dr. P.J.F. Groenen, EPS-2011-234-ORG, http://hdl.handle.net/1765/23422

Erasmus Research Institute of Management - ERiM

ESSAYS ON ACCELERATED PRODUCT DEVELOPMENT

The past three decades have seen many companies adopting time-based strategies in an effort to bring their products to market quickly. While this trend in the industry has given rise to extensive scholarly interest in product development speed, extant literature has yet to provide a coherent account of its consequences for new product development performance, its drivers, and the conditions under which these drivers are beneficial. Motivated by the clear need for more work the area, this dissertation seeks to expand scholarly knowledge on NPD speed by examining (1) the effect of speed on performance given the inconsistencies in the empirical findings; and (2) how product development can effectively be accelerated, taking into account uncertainty as a contingency factor. This dissertation consists of three studies, each of which approaches the subject matter from a different angle and investigates it in different theoretical domains. Study 1 focuses on the consequences of development speed, and uses meta analytic methods to shed light into how development speed relates to new product success, taking into account its different dimensions. Studies 2 and 3 direct the attention to the antecedents of development speed, also taking into account the moderating role of uncertainty. While study 2 treats acceleration as a continuous process that is a by-product of the firm's prior NPD experience, study 3 views acceleration as achievable primarily by active management intervention in the form of acceleration strategies. Collectively, the three studies offer a comprehensive account of product development speed and its successful management.

ERIM PhD Series
Research in Management

Erasmus Research Institute of Management - ERiM
Rotterdam School of Management (RSM)
Erasmus School of Economics (ESE)
Erasmus University Rotterdam (EUR)
P.O. Box 1738, 3000 DR Rotterdam,
The Netherlands

Tel. +31 10 408 11 82
Fax +31 10 408 96 40
E-mail info@erim.eur.nl
Internet www.erim.eur.nl

Design & layout: B&T Ontwerp en advies (www.b-en-t.nl) Print: Haveka (www.haveka.nl)